S. HRG. 110–1251

ENVIRONMENTAL PROTECTION AGENCY OVERSIGHT: IMPLEMENTING THE RENEWABLE FUEL STANDARD

JOINT HEARING

BEFORE THE

SUBCOMMITTEE ON CLEAN AIR AND NUCLEAR SAFETY

AND THE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS UNITED STATES SENATE

ONE HUNDRED TENTH CONGRESS

SECOND SESSION

JULY 10, 2008

Printed for the use of the Senate Committee on Environment and Public Works

ENVIRONMENTAL PROTECTION AGENCY OVERSIGHT: IMPLEMENTING THE RENEWABLE FUEL STANDARD

S. Hrg. 110–1251

ENVIRONMENTAL PROTECTION AGENCY OVERSIGHT: IMPLEMENTING THE RENEWABLE FUEL STANDARD

HEARING

BEFORE THE

SUBCOMMITTEE ON CLEAN AIR AND NUCLEAR SAFETY

OF THE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

UNITED STATES SENATE

ONE HUNDRED TENTH CONGRESS

SECOND SESSION

JULY 10, 2008

Printed for the use of the Committee on Environment and Public Works

Available via the World Wide Web: http://www.access.gpo.gov/congress.senate

U.S. GOVERNMENT PUBLISHING OFFICE

85–536 PDF WASHINGTON : 2015

For sale by the Superintendent of Documents, U.S. Government Publishing Office
Internet: bookstore.gpo.gov Phone: toll free (866) 512–1800; DC area (202) 512–1800
Fax: (202) 512–2104 Mail: Stop IDCC, Washington, DC 20402–0001

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

ONE HUNDRED TENTH CONGRESS
SECOND SESSION

BARBARA BOXER, California, *Chairman*

MAX BAUCUS, Montana
JOSEPH I. LIEBERMAN, Connecticut
THOMAS R. CARPER, Delaware
HILLARY RODHAM CLINTON, New York
FRANK R. LAUTENBERG, New Jersey
BENJAMIN L. CARDIN, Maryland
BERNARD SANDERS, Vermont
AMY KLOBUCHAR, Minnesota
SHELDON WHITEHOUSE, Rhode Island

JAMES M. INHOFE, Oklahoma
JOHN W. WARNER, Virginia
GEORGE V. VOINOVICH, Ohio
JOHNNY ISAKSON, Georgia
DAVID VITTER, Louisiana
JOHN BARRASSO, Wyoming
LARRY E. CRAIG, Idaho
LAMAR ALEXANDER, Tennessee
CHRISTOPHER S. BOND, Missouri

BETTINA POIRIER, *Majority Staff Director and Chief Counsel*
ANDREW WHEELER, *Minority Staff Director*

SUBCOMMITTEE ON CLEAN AIR AND NUCLEAR SAFETY

THOMAS R. CARPER, Delaware, *Chairman*

JOSEPH I. LIEBERMAN, Connecticut
HILLARY RODHAM CLINTON, New York
BERNARD SANDERS, Vermont
BARBARA BOXER, California *(ex officio)*

GEORGE V. VOINOVICH, Ohio
JOHNNY ISAKSON, Georgia
LAMAR ALEXANDER, Tennessee
JAMES M. INHOFE, Oklahoma *(ex officio)*

C O N T E N T S

Page

JULY 10, 2008

OPENING STATEMENTS

WITNESSES

ADDITIONAL MATERIAL

ENVIRONMENTAL PROTECTION AGENCY OVERSIGHT: IMPLEMENTING THE RENEWABLE FUEL STANDARD

Wednesday, July 10, 2008

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
SUBCOMMITTEE ON CLEAN AIR AND NUCLEAR SAFETY
Washington, DC.

The subcommittee met, pursuant to notice, at 10 a.m. in room 406, Dirksen Senate Office Building, Hon. Thomas R. Carper (chairman of the subcommittee) presiding.

Present: Senators Carper, Inhofe, Bond, Boxer, Craig.

OPENING STATEMENT OF HON. THOMAS R. CARPER, U.S. SENATOR FROM THE STATE OF DELAWARE

Senator CARPER. The hearing will come to order. Good morning, everyone.

I am delighted that we are joined by the first panel of witnesses. Mr. Meyers and Mr. Chalk, welcome, and also my friend and colleague, former Governor, Kit Bond. We will be joined by some of our other colleagues as we get into the hearing.

We have two panels of witnesses today. I have just learned that our first vote in the Senate is going to occur roughly at 10:50 a.m., but that may change, so we will work with that, but we may have the opportunity to complete this first panel and the questions for the first panel, and maybe take a break, go vote, and then come back and bring the second panel before us and proceed along those lines.

As you may all know, today's hearing is focused on the implementation of the renewable fuel standard. The renewable fuel standard was first enacted in legislation called EPACT 2005. It was later expanded in the Energy Independence and Security Act of 2007 that we passed less than a year ago.

The EPA implements the provisions of the renewable fuel standard under the authority of the Clean Air Act. Our witnesses today will discuss issues related to the greenhouse gas life cycle analysis currently being conducted by the EPA, as well as developments in advanced biofuels. Senators will have roughly 5 minutes for opening statements. I will then recognize EPA Assistant Administrator Robert J. Meyers to offer his statement to the Committee.

Following his statement, Steve Chalk, Deputy Assistant Secretary for Renewable Energy from the Department of Energy will offer his statement. And then we will have at least one, maybe two

rounds of questions, which may be determined as much by the votes as our interest in asking those questions. Then our second panel of witnesses will come forward and their testimony will be followed by a round or two of questions as well.

At a time when Americans are facing high food and fuel prices, I believe that today's hearing on the renewable fuel standard is an especially timely topic. As many of you know, the renewable fuel standard is within the Clean Air Act and therefore under the jurisdiction of this Subcommittee, which Senator Voinovich and I are privileged to lead. Although this is the first hearing in the Subcommittee on this issue, I assure you that it will not be the last.

First implemented, as I said, in the 2005 Energy Policy Act and enhanced in the 2007 Energy Independence and Security Act we adopted last December, the renewable fuel standard is intended to promote energy independence and to protect the environment at the same time. The EPA must implement the renewable fuel standard to meet both of these objectives.

Of course, there are several other critical issues that must be carefully weighed when considering the effectiveness of the standard. Increasing energy prices are already placing a strain on families across our Nation. In light of growing gas prices, there are a number of things I believe can be done that will reduce financial burdens, as well as provide energy security.

One, I believe that oil and gas companies should drill for oil on the 68 million acres of land that the Federal Government has provided. In addition, Congress has provided opening a 500,000 acre section in the Gulf of Mexico to new drilling.

And the second point I would hope we would keep in mind in this Country is that the lion's share of oil produced in the United States should stay in the United States. Most of our oil should be sold to Americans and consumed here, and not shipped overseas.

A third point I would want to start off here with is that our Nation needs to make a stronger commitment to reducing our energy demands through conservation and investments in renewable energy alternatives. I also believe we must develop advanced biofuels that reduce greenhouse gas emissions and do not divert crops from the food stream.

Increasing food prices have been blamed on biofuel mandates. From leaked reports to published studies, the impact of biofuels mandates and subsidies and rising commodity prices ranges from as low as 3 percent to as high as 75 percent. In truth, we don't know the exact impact on food costs, but we do know the technology is coming online that will enable us to produce the biofuels needed to support energy independence and reduce greenhouse gas emissions without impacting food prices.

We must evaluate any unintended consequences of the renewable fuels provision. As academia, government and industry continue to research these effects, this Subcommittee will maintain strong oversight.

Today, we will begin to review the methods EPA will use to evaluate the greenhouse gas emissions of biofuels compared to traditional fuels. In addition, we will hear testimony about advancement in the next generation of biofuels. It is important we take a

close look at the State of new biofuels which will be based on feedstocks of waste materials that are not competing with food sources.

Personally, I am excited about the investments and the advancements that DuPont is making in renewable fuels, and look forward to hearing about the result of the company's current pilot programs. We need to ensure that facilities to manufacture new biofuels and the infrastructure needed to deliver the product to the public will be in place to meet the established target of $20 billion gallons of advanced biofuels by the year 2022.

The renewable fuel standard makes these new biofuel technologies a viable choice for business. Ultimately, the renewable fuel standard must be implemented in a way that positively impacts the environment and our economy. I believe this Subcommittee must work together to make sure that happens.

[The prepared statement of Senator Carper follows:]

STATEMENT OF HON. THOMAS R. CARPER, U.S. SENATOR FROM THE STATE OF DELAWARE

At a time when Americans are facing high food and fuel prices, I believe today's hearing on the Renewable Fuel Standard is an especially timely topic. As many of you know, the Renewable Fuel Standard is within the Clean Air Act—and therefore under the jurisdiction of this Subcommittee. Although this is the first hearing in the Subcommittee on this issue—I assure you, it will not be the last.

First implemented in the 2005 Energy Policy Act and enhanced in the 2007 Energy Independence and Security Act, the Renewable Fuel Standard is intended to promote energy independence and protect the environment. The EPA must implement the Renewable Fuel Standard to meet both these objectives.

Of course, there are several other critical issues that must be carefully weighed when considering the effectiveness of the Renewable Fuel Standard. Increasing energy prices are already placing a strain on families across this Nation. In light of growing gas prices, there are a number of things I believe can be done that will reduce financial burdens as well as provide energy security:

1. I believe that oil and gas companies should drill for oil on the 68 million acres of land that Federal Government has provided. In addition, Congress has approved opening a 1.5 million acre section off the Gulf of Mexico to new drilling.

2. The lion's share of oil produced in the United States should stay in the United States. Most of our oil should be sold to Americans and consumed here, not shipped overseas.

3. Our nation must make a stronger commitment to reducing our energy demands through conservation and investments in renewable energy alternatives. I also believe we must develop advanced biofuels that reduce greenhouse gas emissions and do not divert crops from the food stream.

Increasing food prices have been blamed on biofuel mandates. From leaked reports to published studies, the impact of biofuel mandates and subsidies on rising commodity prices ranges from 3 percent to 75 percent. In truth, we don't know the exact impact on food costs. But we do know that technology is coming online that will enable us to produce the biofuels needed to support energy independence and reduce greenhouse gas emissions without impacting food prices.

We must evaluate any unintended consequences of the renewable fuel provisions. As academia, government and industry continue to research these effects, this subcommittee will maintain strong oversight.

Today, however, we will begin to review the methods the EPA will use to evaluate the greenhouse gas emissions of biofuels compared to traditional fuels. In addition, we will hear testimony about advancements in next generation biofuels. It is important that we take a close look at the State of new biofuels, which will be based on feedstocks of waste materials that are not competing with food sources.

I am excited about the investments and advancements DuPont is making in renewable fuels. And look forward to hearing about the results of the company's current pilot programs. We need to ensure that facilities to manufacture new biofuels and the infrastructure needed to deliver the products to the public will be in place to meet the established target of 20 billion gallons of advanced biofuels by 2022. The Renewable Fuel Standard makes these new biofuels technologies a viable choice for business.

Ultimately, the Renewable Fuel Standard must be implemented in a way that positively impacts the environment and economy. I believe this subcommittee must work together to make sure this happens.

I am grateful to all the witnesses here to today, and look forward to hearing your testimony.

Senator CARPER. Again, we are grateful to all our witnesses for being here today. We look forward to hearing your testimony. With that having been said, I am not sure who I should yield to first. Should I yield to the Ranking Member of the Committee?

All right. Senator Bond, why don't you lead off, and then we will go to Senator Inhofe and then Senator Craig.

Thank you. We are delighted to see you. Thank you.

Senator Bond.

OPENING STATEMENT OF HON. CHRISTOPHER BOND, U.S. SENATOR FROM THE STATE OF MISSOURI

Senator BOND. Thank you, Mr. Chairman.

As an officious intermeddler, I am happy to participate in this Subcommittee hearing today. I thank you and Chairman Boxer and Senator Inhofe for holding the hearing. And I thank and welcome our witnesses today.

I think we all should agree that we need a massive re-start of United States energy production and conservation across the board. The high cost of energy is burdening families, threatening the viability of many businesses, potentially crippling our economy which is already suffering from the impact of $4-plus a gallon gasoline.

As the Chairman noted, several years ago Congress passed a mandate to begin using clean-burning American farm-grown ethanol and biodiesel as an alternative fuel. Gentlemen, I am here to say it has worked. Last year, 6.7 billion gallons of ethanol were used in America. That is 6.7 billion gallons that we did not have to import from Venezuela, the Middle East or Russia. This clean-burning fuel reduced greenhouse gas emissions by 10 million tons, the equivalent of taking 1.5 million cars off the road.

Ethanol has turned out to be a much less expensive form of energy. Vendors are now paying around $2.55 per gallon at the ethanol plants in Missouri, and a State mandate we have to use 10 percent ethanol has reduced the average price of gasoline to $3.79 per gallon, which I paid last weekend in my home of Mexico, Missouri, when the national average is $4, and I was in Alaska where the average is about $5.

Thousands of farmers in Missouri and across the Nation have invested large sums pursuant to the congressional ethanol mandate to develop the infrastructure to produce this energy. To repeal the mandate now, as some have advocated, would be a major break of faith with all of these small investors, the farmers who grow corn primarily. It would cause our imports to rise and increase the amount of pollution coming from other petroleum sources.

Contrary to popular myths being fostered by the petroleum industry, ethanol is more efficient to produce than gasoline. According to the U.S. Department of Energy and U.S. Department of Agriculture, consumers get 30 percent more energy from ethanol for every unit of energy used for production. Whereas, consumers get 19 percent less energy from gasoline for each unit of energy used for production.

Another myth is that ethanol and biodiesel are having a vast impact on food prices. In actuality, it is negligible because there is less than a dime's worth of corn even at the higher prices in a $3.69 box of corn flakes on sale in Central Missouri now. Corn farmers have increased their productivity through genetically enhanced seeds and better production. In the 2007 crop year, producers brought in 2.6 billion more bushels of corn than the previous year, when only 900 million bushels were needed to meet the increased ethanol demand for that same period of time.

The real cost of food comes from off-farm costs, which are approximately 81 percent. Much of this cost is due to higher oil prices in the form of transportation costs, since the average food item travels 1,300 miles to the grocery store. Thus, rather than driving up the price of food, the far less expensive ethanol and biodiesel actually could help hold food costs down.

As I said earlier, energy is one of the biggest burdens on our economy. We absolutely must start now with a whole new commitment to use all possible means to reduce the supply demand imbalance. A wide range of conservation measures are needed, as well as more renewable, clean fuels, more nuclear power, more oil and gas production in North America, more clean coal technology. This means continuing to develop renewable fuels beyond the technologies we use today.

I am very excited about cellulosic ethanol made from wood. We did a study, and the University of Missouri carried it out. We have 1.4 million acres of forest land that is clogged with low-grade timber that has no market value. It is holding down the good tree production. On one square mile, the university identified 4,200 tons of green timber that should be harvested to keep our forests are healthy, to avoid the spread of disease, and to prevent ruinous fires.

Yet when I talk to the scientists, they tell me we are not there yet, at an efficient economical means of converting wood into cellulosic ethanol. Congress in its "wisdom" has said we must produce 16 billion gallons by 2022, and we aren't there yet.

I am going to have to leave for an Intelligence Committee meeting, so I won't be able to ask questions, but I might ask our grocery manufacturer friends if only 5 percent of the increased costs of corn flakes, five cents in the $3.69, comes from corn, where does the other 90 cents come from? Is it possible those off-farm costs such as transportation are running it up? I would be interested to hear your views on supporting additional sources of energy to bring these crushing high prices of fuel down.

I thank the Chair and I appreciate your courtesies.

Senator CARPER. We are delighted you are here. Before you slip out, as many of our colleagues know, Senator Bond, along with Senator Rockefeller who chairs the Intelligence Committee, and Congressman Steny Hoyer who is the Democratic Leader in the House, worked for many months, and will try to bring us to consensus on a difficult issue. The difficult issue deals with how do we make sure that our intelligence agencies are able to intercept communications from people who wish us harm from outside of our Country, to sources within this Country. How do we do that in a way to protect our safety and our security in this Country, but at

the same time to protect the civil liberties of the folks who live here, the Americans who live here? They worked very hard to find a way to do both—protect civil liberties and to try to make sure that we protect our safety and security.

The issue before us I think here today is not dissimilar. How do we find a way to use biofuels to make us more energy independent, to protect us on that security side of the equation, and at the same time to make sure that we have food to eat at prices we can afford and the rest of the world can afford. That is a challenge for us, but I think today we were brought into session in the U.S. Senate, and the guest chaplain was from Delaware, Reverend Patricia Bryant Harris. She prayed for, among other things, for wisdom for us, and we need wisdom to work through this one. We needed wisdom to work through FISA. We did it, got it, and my hope is we can do as well here today.

So thanks very much for your work and effort.

Senator Inhofe.

OPENING STATEMENT OF HON. JAMES M. INHOFE, U.S. SENATOR FROM THE STATE OF OKLAHOMA

Senator INHOFE. Thank you, Mr. Chairman.

I am glad that we are finally holding today's hearing. The EPW Committee oversight hearing on the renewable fuel standard is long overdue. We have talked about this for a long time, and we have been trying to get one. This is the first one that we have had in this Committee. At the same time, the Senate Energy and Natural Resources Committee has held four hearings. House Energy and Commerce has held three hearings. The Senate Agriculture Committee has held two hearings. Even the Homeland Security Committee has had a hearing. And yet that is all in the 110th Congress, and this is where the jurisdiction should be.

It is important to note that today is also nearly 7 months after Congress has passed a massive fivefold increase in biofuels mandates.

When I was Chairman of this Committee, the Committee and the Subcommittee held 14 hearings on the RFS program, examining some of the issues from the future of transportation fuels to the most recent and unfortunately last oversight hearing in September 2006, which highlighted the implementation of the program.

In the face of mounting questions surrounding ethanol's effect on livestock feed prices, which is what I hear in my State of Oklahoma, its effect on food prices, its economic feasibility, its transportation and infrastructure needs, its water usage, and its numerous environmental impacts, the majority has chosen to avoid examining these real issues. Instead, the focus of today's oversight hearing is on the status of life cycle analysis and advancements in next-generation biofuels. No doubt, that is an important issue, but hardly as pressing as the raging food and fuel debate that is occurring across the Country today.

Right now, there is only one issue in America, and that is the price of fuel at the pumps. Now, if you question that, talk to my wife and I am sure there are others who would stand behind that. Now, as far as what we are trying to do with biofuels, you mentioned the University of Missouri. Oklahoma State University and

the Noble Foundation are very, very active right now. In fact, a former Senator from Oklahoma is now heading up that program on his own.

Well, a lot of things have been printed recently that I would like to share with the record and with the Committee. The New York Times has stated: "Soaring food prices, driven in part by demand for ethanol made from corn have helped slash the amount of food aid the government buys to its lowest level in a decade, possibly resulting in more hungry people around the world this year." The U.N. Secretary General Ban Ki-Moon recently warned that high food prices could wipe out progress in reducing poverty and hurt global economic growth.

In April, a Time magazine article titled The Clean Energy Scam, by reporter Michael Grunwald, stated that our current policies on corn ethanol are "environmentally disastrous. The biofuels boom, in short, is one that could haunt the planet for generations, and it is only getting started."

Even Miles O'Brien, who is one that I have had several confrontations with, and the one thing we have in common is we both love aviation, so we have that, but even Miles O'Brien of CNN, a man who I have been harshly critical of for some of the climate change reporting, understands our current problems. Miles O'Brien reported on CNN in February that, and I am quoting now, if every last "ear of corn grown in America were used for ethanol, it would reduce our oil consumption by only 7 percent." He said, "Corn ethanol is not as clean, efficient, or practical as the politicians claim."

On Earth Day, Lester Brown, who has been dubbed the guru of the environmental movement, called on Congress to "revisit recently enacted Federal mandates requiring the diversion of foodstuffs for production of biofuels."

Now, when you have—and I say this to the Chairman who has joined us now, Senator Boxer—when you have Lester Brown, Miles O'Brien, Time magazine, the New York Times, the United Nations and me all in agreement on the need to reexamine our current renewable fuels policy, you can rest assured this current policy is horribly misguided. It is this Committee's delegated responsibility to exercise oversight, to reassess, and to legislate on the renewable fuel standard. I hope that we will be able to do that.

I do agree with the previous speak that we do have a serious problem. It is one that we are going to have to deal with in supply and demand. I believe that we are going to have to really look at the supply side in terms of what is available now. How do we run this machine called America? What is out there that can be used? I certainly am going to be joining the Senator from Missouri in trying to resolve that problem.

Thank you, Mr. Chairman.

[The prepared statement of Senator Inhofe follows:]

STATEMENT OF HON. JAMES M. INHOFE, U.S. SENATOR FROM THE STATE OF OKLAHOMA

ENVIRONMENTAL PROTECTION AGENCY OVERSIGHT: IMPLEMENTING THE RENEWABLE FUEL STANDARD

I'd first like to thank the Chairman for finally holding today's hearing. An EPW committee oversight hearing on the Renewable Fuel Standard is long overdue. De-

spite the enormous amount of attention and the eventual legislative enactment of the now greatly expanded RFS program, the EPW committee has failed to hold even one hearing on RFS in the 110th Congress—until today. Not one hearing despite the fact that the EPW committee is the primary committee of jurisdiction.

The Senate Energy and Natural Resources Committee has held 4 hearings. The House Energy and Commerce Committee has held 3 hearings. The Senate Agriculture Committee has held 2 hearings. Even the Senate Homeland Security Committee has held a hearing. In the 110th Congress we've seen at least 5 House and Senate committees hold at least 12 hearings reviewing biofuels policy, but EPW has not held one—until today. It's important to note that today is also nearly 7 months after—after Congress passed a massive fivefold increase in the biofuels mandates. Where was the RFS oversight and legislative input before enactment of this act? Not anywhere before this committee.

Under my leadership, the committee and subcommittee held 14 hearings on the RFS program, examining issues from the future of transportation fuels to the most recent and unfortunately last oversight hearing in September 2006 which highlighted the implementation of the RFS program.

I'm further disappointed that today's hearing appears to merely be a "check the box" exercise for the majority. In the face of mounting questions surrounding ethanol's effect on livestock feed prices, its effect on food prices, its economic feasibility, its transportation and infrastructure needs, its water usage, and its numerous environmental impacts, the majority has purposely chosen to avoid examining these real issues. Instead, the focus of today's oversight hearing is on "the status of life-cycle analysis and advancements in next generation biofuels." No doubt that's an important issue, but hardly as pressing as the raging food vs. fuel debate that's occurring across the country and around the globe—a debate occurring everywhere but before the EPW committee.

Additionally, limiting this hearing to just three outside witnesses does not even begin to address the numerous issues arising from the RFS mandates. In my home State of Oklahoma, many cattlemen, pork producers, and poultry producers are struggling with the record high corn prices. We need to hear from the livestock producers, the corn growers, the ethanol producers, the States, the oil refiners, the economists and others to fully understand and appreciate the consequences of this program. I hope the majority will schedule the hearing which I requested in my May 5th letter to Chairman Boxer to fully examine these issues.

The New York Times has stated, "Soaring food prices, driven in part by demand for ethanol made from corn, have helped slash the amount of food aid the government buys to its lowest level in a decade, possibly resulting in more hungry people around the world this year."

U.N. Secretary-General Ban Ki-Moon recently warned that high food prices could wipe out progress in reducing poverty and hurt global economic growth.

In April, a Time Magazine article titled "The Clean Energy Scam," by reporter Michael Grunwald stated that our current policies on corn ethanol are "environmentally disastrous... The bio-fuels boom, in short, is one that could haunt the planet for generations—and it's only getting started."

Even Miles O'Brien of CNN, a man whom I have been harshly critical of for his climate change reporting, understands our current problems. O'Brien reported on CNN in February, that "if every last ear of corn grown in America were used for ethanol, it would reduce our oil consumption by only 7 percent." O'Brien also reported, "Corn ethanol is not as clean, efficient, or practical as the politicians claim."

On Earth Day, Lester Brown, who has been dubbed "the guru of the environmental movement," called on Congress to "revisit recently enacted Federal mandates requiring the diversion of foodstuffs for production of bio-fuels."

When you have Lester Brown, Miles O'Brien, Time Magazine, the New York Times, the United Nations, and James Inhofe all in agreement on the need to reexamine our current renewable fuels policy, you can rest assured this current policy is horribly misguided. It's this Committee's delegated responsibility to exercise oversight, to reassess, and to legislate on the Renewable Fuels Standard. I sincerely hope that process will finally start today.

Senator CARPER. Thank you, Senator Inhofe.

We have been joined by full Committee Chairman Boxer. We are delighted you are here. You are recognized.

OPENING STATEMENT OF HON. BARBARA BOXER, U.S. SENATOR FROM THE STATE OF CALIFORNIA

Senator BOXER. Thank you very much.

I want to thank you very much, Senator Carper, for your leadership on this, and for calling this hearing, and for all the work that you put into it. We really appreciate it.

We spend billions of dollars overseas each year to buy foreign oil, often to unstable regions of the world. We all know that burning fuel for transportation is responsible for about one-third of our global warming pollution. There are solutions to our fuel crisis that will cut prices, cut our imports of foreign oil, and cut global warming emissions. I believe that renewable fuels certainly start us down that path.

But we need to have stronger incentives to move us away from oil and conventional biofuels, and incentives toward cellulosic and other advanced biofuels that have a smaller carbon and environmental footprint, are good for our economy, and will make us more secure. Cellulosic ethanol and other advanced biofuels can be made from agricultural waste, grass and many non-food sources.

I want to place in the record a letter from the California Poultry Federation. They are experiencing hugely larger costs. I am sure you are hearing this in your State as well. I think that what is really disturbing to me about this—and you can all read it in the record, I won't take the time of the Subcommittee to do it now—is that it is so expensive now for them to produce the turkeys and such that people are switching from turkey breast meat to hot dogs to feed their family. The visit I had from the poultry federation in California, they just said they can't keep the hot dogs on the shelves, and yet they are stuck with the more healthful products. So they are very, very concerned about this.

So we do need strong incentives to move us away from the conventional biofuels. That is why I support the development of cellulosic ethanol and why the Boxer-Lieberman-Warner global warming legislation included many strong incentives, including a low carbon fuel standard to move us toward those advanced biofuels.

I believe we must do everything possible, again, to move in that direction. I think we have to understand the implications for the economy, including food prices and current policies that promote the increased use of corn-based ethanol. The role that the ethanol mandate is playing in the recent spike in food prices is controversial. I read your statement. We don't know exactly what the impact is. The Administration has estimated it is about 3 percent of the increase in global food prices.

The Agriculture Department estimates the recent upswing in biofuels production is only a small contributor to increased domestic food prices, an increase of .025 percent or less. But other estimates of the cost impacts of biofuels production are higher, and it is clear that corn prices are affected by ethanol production. Higher corn prices are having impacts on some food producers, again I reference the California Poultry Federation.

I believe we must create stronger incentives for moving more quickly toward cellulosic and advanced biofuels. We must move away from reliance on corn-based ethanol. I am concerned about increasing corn and soybean prices. I look forward to hearing more about this issue. I believe we need to review our policies regarding grain ethanol incentives, including domestic ethanol subsidies.

And here is an important point. The tariffs on foreign ethanol, I think that is one that is really counterproductive to the well being of the people of this Nation. With the energy bill that we passed in December 2007, we have taken the first step through the expanded renewable fuel standard to replacing oil in our cars with home-grown fuels. We have set targets for advanced biofuels in the bill. We must consider lifestyle greenhouse gas emissions and environmental impacts when evaluating biofuels. Getting off oil is the crucial benefit, but we must also maximize the reduction in global warming pollution.

We are very close to significant breakthroughs in biofuels. I have met with people in my home State. It is the most exciting time in many ways for us to be here in the United States because we will witness the way we will transform how we power our cars and trucks, how we cleanup our air, improve our energy security, keep our dollars at home, and protect our climate. We really do owe it to our grandchildren to push aggressively for these new solutions that will transform our economy and save our planet.

Again, I want to say to Senator Carper thank you very much for convening this important oversight hearing. I look forward to hearing from our witnesses.

Senator CARPER. Thank you, Madam Chair, and thanks very much for your terrific work and leadership on renewable fuel standards to get us to this point today.

Senator Craig from Idaho, welcome. Please proceed.

OPENING STATEMENT OF HON. LARRY CRAIG, U.S. SENATOR FROM THE STATE OF IDAHO

Senator CRAIG. Mr. Chairman, thank you. Like my colleagues, without question, this is an important hearing.

I find it fascinating that almost all of us aren't really in disagreement. We are all very excited about what is going on in the marketplace of energy today, at least I am. One of the things I say at home is that the bad news is that it is $4 a gallon. The good news is that it is $4 a gallon. America is awakening like never before. We thought we could conserve our way out of this business, and now we know we can't.

So the question is, how do we do it and do it in a reasonable way that takes the markets where they want to go, and build the type of energy supplies that are clean, renewable, and sustainable? That is really our challenge. It is a fundamental challenge.

And how do we get from here to there in that 10-or 20-year period? How do we transition from traditional energy sources that are now less reliable because foreign nations have them and foreign governments have them, and are at best risky at times? The marketplace is reacting and the American consumer is experiencing something that took them from anger to fear. Now they fear, because they can't understand why everything is going up at a phenomenal rate at this moment—their food bill, their energy bill.

I am also fascinated that almost every week we have a new study blaming somebody for something. We have new modeling and new formats that say, well, there is no question corn ethanol has shot food prices out the window. You know, if it hadn't been for increased commodity prices with 20 percent and 25 percent increases

in input cost to the farm for fertilizers and fuels, our farmers would be in bankruptcy today and we would be bailing them out. But they aren't in bankruptcy. They are experiencing substantial profits today, but against phenomenal high new costs of operations.

So the marketplace works really quite well, and instead of the American taxpayer picking up the subsidy to keep agriculture alive, the American consumer is paying for it today. Maybe that is a marketplace that has more viability in it and more sustainability in the long term.

Mr. Chairman, I visited with a young man the other day that I found quite fascinating. I had never met him before. He is back here. He is working in Washington. He is the son of an Iowa farmer. He has two brothers. One is a lawyer and one is a doctor. They all left the farm. When he left the farm, dad said don't come back, because we can't make a living for ourselves and for you and your family. Go out and find something else to do.

Now, his dad is saying come home. The farm is profitable again, and I am ready to retire and you can take it over. So he is having this debate with his wife about going home. What happens when he goes home? The average age of the farmer on that farm drops from 70 years of age to 42 years of age and America's agricultural portfolio gets renewed.

Now, there is nothing wrong with that. So let the marketplace work. We dropped the subsidy on corn-based ethanol from 51 cents to 45 cents in the farm bill. We are beginning to ratchet that down. I don't disagree with Senator Boxer at all on cellulosic, but it is out there a little ways. I was in Ottawa several months ago with Iogen. They probably lead in the area with the enzymes that deal with straws and cornstover and the waste we see in agriculture. Their enzymes aren't as good as some enzymes as it relates to wood, and that is another form of cellulosic, and we will get there, but we are not there.

So this morning, I am on a radio show, and the fellow who was asking the questions at the other end out in Idaho is on the board for the senior center in Twin Falls. I used to chair the Aging Committee. He said, Senator, the problem today is we can't find people to deliver the meals on wheels to our shut-in aging. Now, it wasn't the cost of the food that was in the car. It was the cost of fuel that was in the tank. They couldn't afford to drive down the street and stop at the houses to deliver the food to the shut-in.

We will get this right, but the best news today is America has awakened to the reality that we have to be producers because we are aggressive consumers. We quit producing, but we kept consuming for the last two decades, and we ran ourselves up against a brick wall. American consumers have grown very angry today at their public officials who denied them the right of production.

How do we do it? I hope we do it well. I hope it is clean. I hope it is responsible. I hope we go after our oil reserves that are sitting out there in environmentally sensitive areas where we know we can get it in environmentally sensitive ways and use them as transitional fuels while we wait for the cellulosics to come online, while we wait for other technologies and biomass to come online, and we reduce our carbon footprint—a phenomenal challenge.

So the bad news is gas is $4 a gallon. The good news is it is $4 a gallon.

Thank you.

Senator CARPER. Thank you for those comments.

My colleagues have heard me quote from time to time Thomas Edison, who used to say that sometimes we miss out on opportunity because it comes along wearing overalls and is disguised and looks a lot like work. We certainly have a challenge here, but there is also a terrific opportunity, and those opportunities can be translated into technological breakthroughs and economic opportunity and job creation.

With that having been said, again to our witnesses, Assistant Administrator Robert Meyers, to Deputy Assistant Secretary Steven Chalk, we welcome you. You are recognized. Your full statement will be made part of the record. We will ask you to summarize, and stay as close as you can to 5 minutes. If you go a little bit long, that is OK, but not too long. Thank you.

Mr. Meyers, why don't you proceed. Thank you.

STATEMENT OF ROBERT J. MEYERS, PRINCIPAL DEPUTY ASSISTANT ADMINISTRATOR, OFFICE OF AIR AND RADIATION, U.S. ENVIRONMENTAL PROTECTION AGENCY

Mr. MEYERS. Yes, thank you, Mr. Chairman. I appreciate the opportunity to come before you today to testify on the implementation of the renewable fuel provisions of the Energy Independence and Security Act, EISA, and advancements in biofuels.

The Environmental Protection Agency is responsible for implementing the RFS program, which was originally established, as noted earlier, in the Energy Policy Act of 2005, as section 211(O) of the Clean Air Act. Since EISA was enacted in December 2007, the Agency has been working to develop an effective program under the new and amended RFS provisions Congress approved, commonly referred to as RFS2.

In this regard, Agency staff have met with more than 30 different stakeholders, including renewable fuel producers, technology companies, petroleum refiners and importers, agricultural associations, environmental groups, gasoline and petroleum marketers, pipeline owners, and fuel terminal operators. Of course, we also continue to meet our statutory obligations to collaborate regularly with the Departments of Agriculture and Energy.

While EPA can and will draw from its experience in developing the original RFS regulations, it is important to understand that EISA made a number of significant changes to the RFS program. First, as noted, EISA increased the total renewable fuel volume mandate fivefold over the 2005 energy bill, and extended the statutory schedule for the RFS by 10 years.

In addition, the very character of renewable fuels used for transportation will likely change over this period by force of law and expected technology developments. New emerging fuel production technologies hold the potential to make gasoline-and diesel-like fuels from renewable sources, as opposed to simply blending such fuel into traditional petroleum-based fuel.

Second, EISA extended the RFS program to include both on-road and non-road gasoline and diesel fuel volumes. Extending the pro-

gram to producers and importers of on-road and non-road gasoline and diesel fuel is a significant change and may affect many new parties, possibly including a number of small businesses.

Third, EISA increased the number of renewable fuel categories and standards to a total of four, including total renewable fuels and three new subcategories, each with its own required minimum volumes: advanced biofuels, biomass-based diesel and cellulosic biofuels. EISA also specified that by 2022, cellulosic volume should exceed the volumes required for what might be termed conventional corn-based ethanol.

Fourth, new provisions included in EISA that require EPA to apply life-cycle greenhouse gas performance threshold standards to each category of renewable fuel. Life-cycle greenhouse gas emissions is a defined term within the RFS2 program and generally refers to the aggregate quantity of greenhouse gas emissions related to the full fuel life-cycle, including all stages of fuel and feedstock production and distribution.

There are many separate elements of this definition, and certainly there are significant complexities, but EPA is presently working with our interagency partners to develop approaches for utilizing such analysis within the RFS2. In general, work is necessary with respect to the modeling framework for life-cycle analysis, better understanding of GHG emissions sources, the development of key components for the agricultural sector, biofuel production, and baseline petroleum fuel. While EPA has done considerable work in this area, additional new and improved analysis will be necessary.

Fifth, EISA adds a number of other new provisions, including changing the definition of renewable fuel feedstocks in a fundamental manner. Developing appropriate and enforceable regulations addressing this provision will require extensive dialog with USDA, USTR, DOE, the agricultural community, and renewable fuels producers and others.

Finally, as required by Congress, we will also be assessing the impacts of EISA on vehicle emissions, air quality, greenhouse gases, water quality, land use and energy security. These analyses will provide important information to the public and Congress on the effectiveness of the new legislation.

We expect other implementation issues. As you may be aware, Texas Governor Rick Perry sent a letter to EPA Administrator Johnson on April 25 requesting a partial waiver of the 2008 RFS volume obligations. EPA then issued a Federal Register notice on May 22 requesting public comment on the request, and the comment period just closed back on June 23.

All together, we have received about 15,000 comments, with about 150 substantive comments, from a wide range of stakeholders, including individual companies, associations representing renewable fuel producers, farmers, the cattle, beef and poultry industries, the food and grain industries and many others.

We are currently evaluating these comments and other pertinent information, and conducting the analysis that is necessary under the law to support the decision by the Administrator. Also as part of this effort, we are continuing to work with the assistance of the Department of Agriculture and the Department of Energy, and we

also additionally have been closely monitoring the aftermath of the Midwest floods to determine to what extent the natural disaster may impact the Renewable Fuel Program.

Again, I will just end right here. I would say overall we are faced with many challenges. The law that Congress passed creates many new definitions, many new challenges for the Agency, and we are attempting to work through all the issues in the legislation and utilize the successful approach we did with the RFS1 Program. We look forward to working closely with the Committee and Members of Congress and other stakeholders.

Thank you very much.

[The prepared statement of Mr. Meyers follows:]

ROBERT J. MEYERS
PRINCIPAL DEPUTY ASSISTANT ADMINISTRATOR
OFFICE OF AIR AND RADIATION
U.S. ENVIRONMENTAL PROTECTION AGENCY

BEFORE THE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
SUBCOMMITTEE ON CLEAN AIR AND NUCLEAR SAFETY
UNITED STATES SENATE
JULY 10, 2008

Mr. Chairman and members of the Subcommittee, I appreciate the opportunity to come before you today to testify on implementation of the renewable fuel provisions of the Energy Independence and Security Act of 2007 (EISA). The Act's aggressive new renewable fuel standards (RFS) will further our nation's goals of achieving energy security and reducing greenhouse gases by building on the successful RFS program established by the Energy Policy Act of 2005 (EPACT 2005).

Renewable fuels are a key element of a national strategy for addressing our energy security and the challenge of global climate change. The national renewable fuel standards, in combination with the vehicle fuel economy standards in EISA, will reduce emissions of greenhouse gases in the transportation sector and improve our energy security. The changes brought about by EISA are expected to prevent the release of billions of metric tons of greenhouse gases emissions into the atmosphere over the next several decades.

The Environmental Protection Agency is responsible for implementing the RFS program, and we are proud of our success to date in working with stakeholders in industry, states and the environmental community to build an effective program for

increasing the volumes of renewable fuel used by the transportation sector. In April 2007 we announced final regulations for implementing the RFS Program under EPACT 2005. The Agency worked very closely with both our federal partners and stakeholders to develop broad support for the program. This program was officially launched in September 2007. We believe our success is grounded on our close collaboration with stakeholders on the design and implementation of the program.

Since EISA was signed into law on December 19, 2007, the Agency has been working diligently to develop regulations to implement the new RFS program established by that legislation, commonly called RFS2. Our first and most pressing task was to issue a new renewable volume standard for 2008. The RFS program established by EPACT 2005 required 5.4 billion gallons of renewable fuel in 2008. The EISA legislation increased the standard to 9 billion gallons in 2008, with annual increases in mandated volumes resulting in 36 billion gallons being required in 2022. We published a notice implementing the 2008 volume requirement in the Federal Register on February 14 of this year.

While the RFS program established under EPACT 2005 provides a solid foundation for the new regulations, RFS2 includes new elements which add complexity to the program. As a result, the new EISA provisions require careful evaluation and considerable new analysis.

In this new undertaking, the Agency is following much of the same approach we used in developing the first RFS program. This includes obtaining critical input from our stakeholders throughout the rulemaking process. Since EISA was enacted less than seven months ago, the Agency has met with more than thirty different stakeholders, including renewable fuel producers, technology companies, petroleum refiners and importers, agricultural associations, environmental groups, gasoline and petroleum marketers, pipeline owners and fuel terminal operators. Agency technical staff have participated in numerous conferences and workshops, which have allowed us to reach a broad range of technical, programmatic and policy issue experts. We also continue to meet and collaborate regularly with the Departments of Energy and Agriculture. Through these meetings, EPA has sought input on the key RFS2 program design elements as highlighted in this testimony.

While EPA will draw from its experience in developing the original RFS regulations, it is important to understand that EISA made a significant number of changes to the RFS program. First, as mentioned previously, RFS2 increases the total renewable fuel volumes mandated to 36 billion gallons a year by 2022. This is nearly a five fold increase over the 7.5 billion gallons a year mandated under EPACT 2005 for 2012, and constitutes a 10-year extension of the schedule provided for in that legislation. EPA believes that the implications of this substantial increase are not trivial. Development of infrastructure capable of delivering, storing and blending these volumes in new markets and expanding existing market capabilities will be needed. In addition, the market's absorption of increased volumes of ethanol will ultimately require new "outlets" beyond

E10 blends (i.e., gasoline containing 10% ethanol by volume). A rule of thumb estimate is that E10 blends, if used nationwide, would utilize approximately 15 billion gallons of ethanol. Accommodating approximately an additional 20 billion gallons of ethanol-blended fuel is expected to require an expansion of the number of flexible-fuel E85 vehicles and their utilization of E85 and/or other actions. New emerging renewable fuel production technologies may hold potential to make gasoline and diesel-like fuels from renewable sources. The Agency will continue to monitor and evaluate the development of such technologies as we implement the RFS program over the coming years.

Second, beyond the significant increase in the volume mandate, EISA extended the RFS program to include both non-road gasoline and diesel fuel volumes. Under the regulations implementing EPACT 2005, RFS volume requirements were applied only to producers and importers of on-road gasoline. The extension of this program to both non-road gasoline and diesel fuel volumes, along with the potential for opt-in by participants of the home hearing oil and jet fuel markets is a significant change that may affect new parties, including a number of small businesses that have not been regulated under this program in the past.

Third, EISA has established new categories of renewable fuel. EPACT 2005 established standards for two categories of renewable fuels: one standard for the total volume of renewable fuel; and a second standard for cellulosic ethanol requiring 250 million gallons beginning in 2013. RFS2 increased the number of renewable fuel categories and standards to a total of four, including total renewable fuel and three new

categories within that with unique volume requirements: advanced biofuels, biomass-based diesel and cellulosic biofuels. Industry will be required to demonstrate compliance with the four separate fuel standards. This will likely require the obligated parties, producers and importers, to forge new business relationships and contracts that are necessary to guarantee their compliance with the new standards. Establishing the necessary systems to track and verify the production and distribution of these fuels and demonstrate compliance with four separate standards will also require sufficient lead time to design and implement these new tracking systems. As in the current program under EPACT 2005, in the near term, some parties may not be able to comply by blending the renewable fuels, and thus may need to purchase or trade credits for the appropriate number and category of fuels to satisfy their volume obligations. It will be very important to conduct effective outreach with these parties to support a smooth implementation. In addition, certain requirements in RFS2 pertain only to renewable fuel production facilities that commence construction after the legislation was enacted. EPA will need to carefully consider how this new provision should be interpreted.

As part of its restructuring of the renewable fuel mandate, EISA increased the cellulosic biofuel mandate from 250 million to 1.0 billion gallons by 2013, with additional yearly increases to 16 billion gallons in 2022. EISA also provided a new definition of this fuel: cellulosic biofuel must be derived from renewable biomass, which includes requirements that place various limitations on the types of land from which the feedstocks are taken, and cellulosic biofuel must also have lifecycle greenhouse gas

emissions that are at least 60 percent less than the baseline lifecycle greenhouse gas emissions for petroleum based fuel (RFS2 established the baseline year as 2005)..

Implementing these requirements will entail additional work by EPA as it develops its upcoming regulation. For example, the Act authorizes EPA in certain circumstances to adjust the cellulosic biofuel standard to a level lower than that specified in the law. However it requires in this circumstance that the Agency also make credits available for compliance purposes and provides instructions on how to establish a specific price for these credits. The Agency will therefore need to address several critical issues, such as the quantity of credits to be generated, to whom they will be available, the extent to which they can be traded, and the life of the credit.

RFS2 also established for the first time minimum volume standards for biomass based diesel fuel. These standards begin in 2009 at a half billion gallons and ramp up to one billion gallons per year in 2012 and thereafter. To qualify as biomass based diesel, the renewable fuel portion of the biomass based diesel blend must result in greenhouse gas emissions that are at least 50 percent lower than the baseline GHG emissions for petroleum based diesel fuel (RFS2 established the baseline year as 2005) and cannot be co-processed with a petroleum feedstock.

Fourth, EISA requires the Agency to apply lifecycle greenhouse gas (GHG) performance threshold standards to each category of renewable fuel. Congress provided a specific definition of lifecycle analysis that requires EPA to consider all stages of fuel

and feedstock production and distribution, from feedstock generation or extraction through the distribution and use of the finished fuel to the ultimate consumer. The Act also specifies that EPA take into account both direct emissions and significant indirect emissions such as emissions from land use changes.

EPA is currently developing a methodology that meets the EISA requirements. This effort builds on a substantial amount of work the Agency has done in this area, beginning with our analysis of the lifecycle GHG impact of the renewable fuel volumes required by the RFS1 program. EPA has expanded the methodology to include secondary agricultural sector impacts and land use changes. The Agency is continuing to further refine and improve our analyses as we prepare to implement the statute's lifecycle GHG performance thresholds.

Given the importance of lifecycle analysis to the success of the RFS2 program and the complexity of this work, the Agency has been working closely with stakeholders. Through multiple meetings with a broad range of groups--including the Departments of Energy and Agriculture, academics and lifecycle experts, environmental organizations, renewable fuel producers, and refiners--we have shared our approach and sought input on the key assumptions and modeling tools necessary to conduct a complete lifecycle analysis that meets the EISA criteria. These discussions have been extremely valuable to the Agency and we plan to maintain this high level of stakeholder engagement throughout the rule development process.

Fifth, RFS2 added a number of other new provisions, including changing the definition of renewable fuel feedstocks in a fundamental manner. The new law limits the crops and crop residues used to produce renewable fuel to those grown on land cleared or cultivated at any time prior to enactment of EISA, that is either actively managed or fallow, and non-forested. EISA also requires that forest-related slash and tree thinnings used for renewable fuel production pursuant to the Act be harvested from non-federal forest lands. Developing appropriate and enforceable regulations addressing these provisions requires extensive dialogue with USDA, USTR, the agricultural community and renewable fuel producers to better understand current practices and changes in practices that can be developed, implemented and enforced. The Agency has started these discussions and plans to continue this dialogue throughout the regulatory process.

Finally, in support of the rulemaking, we are assessing the many impacts of the EISA renewable fuel program. Assessments are underway to understand the impacts on emissions and air quality (greenhouse gases, ozone, particulate matter and toxics), water impacts (including water quality and consumption), agricultural sector impacts (including direct and indirect land use change), energy security, and economic impacts (such as cost of fuels and feedstocks). Detailed information will be needed for the draft regulatory impact analysis (RIA), which we intend to release with the proposed rules. These analyses will provide important information to the public and Congress on the many anticipated impacts of the new legislation.

With respect to other implementation issues, as you are aware, Texas Governor Rick Perry sent a letter to EPA Administrator Johnson on April 25 requesting a partial waiver of the 2008 RFS volume obligations required by EISA. Governor Perry requested the volume requirement be reduced by 50 percent, from 9 billion gallons in 2008 to 4.5 billion gallons, citing an "unnecessarily negative impact on Texas' otherwise strong economy while driving up global food prices". EPA issued a federal register notice on May 22, requesting public comment on this request. The comment period closed on June 23. We received over 15,000 comments, with over 150 substantive comments from a wide range of stakeholders including individual companies and associations representing renewable fuel producers, farmers, cattle, beef and poultry industries, the food and grain industries and many others. We have been evaluating these comments and other pertinent information and conducting the analysis necessary to support a decision by the Administrator. In compliance with statutory requirements, EPA is also consulting extensively with our colleagues at the Departments of Agriculture and Energy.

EPA has also been closely monitoring the aftermath of the mid-west floods to determine to what extent this natural disaster may impact the renewable fuel program. We have had multiple discussions with the USDA, DOE, renewable fuel producers, oil companies, petroleum marketers and state authorities. We are evaluating both impacts on feedstock (e.g. corn, soybeans, etc.) availability for use in ethanol production, as well impacts on fuel production and distribution systems. The extent of these impacts has not yet been fully determined. We will continue to coordinate and collaborate with DOE and USDA closely on this matter.

In closing, the Agency is moving forward with the development of regulations implementing the RFS2 provisions and is utilizing the successful approach we employed in developing the regulations for the original RFS program. We look forward to working closely with members of Congress and our many other stakeholders during this process.

Thank you, Mr. Chairman, and members of the Subcommittee for this opportunity. This concludes my prepared statement. I would be pleased to answer any questions that you may have.

Environment and Public Works Committee Hearing
July 10, 2008
Questions to EPA for the Record

Question # 1

You referred in your written testimony to the recent request by Rick Perry, the Governor of Texas, for an EPA waiver of the RFS for 2008. Assuming the waiver were granted, would that have any practical effect on food prices over the next year, given current levels of production of renewable fuels?

As we describe in our Federal Register Notice, signed on Thursday, August 7, 2008 and published in the Federal Register on August 13, 2008, we do not believe a waiver of the RFS mandate is appropriate at this time. Over the approximately 1,000 scenarios we analyzed, the average impact of granting the waiver would be to decrease corn prices by $0.07 per bushel, which translates to a 0.07% decrease in the Food Consumer Price Index (CPI). Additional data and rationale are available in the Federal Register Notice.

Question #2

There have been several projections of the net impact of granting this RFS waiver on fuel prices. What are EPA's estimates of the potential impact of granting this RFS waiver on fuel prices?

As we describe in our Federal Register Notice, signed on Thursday, August 7, 2008 and published in the Federal Register on August 13, 2008, we estimate that granting the wavier would have a small impact on fuel prices. Our analysis shows that the average impact of granting the waiver would be to increase blended fuel prices by 1/10 of one cent per gallon. Additional data and rationale are available in the Federal Register Notice.

Question #3

What would be impacts of the elimination of the U.S. ethanol tariff on U.S. imports of ethanol?

A variety of studies have sought to estimate the impact of eliminating the U.S. ethanol import tariff on U.S. ethanol imports. A recent study by researchers at Iowa State University (Short-Run Price and Welfare Impacts of Federal Ethanol Policies, McPhail and Babcock, Iowa State University June 2008) predicts that elimination of the U.S. ethanol import tariff would likely increase U.S. ethanol imports from roughly 500 million gallons to approximately 1.6 billion gallons. We are not aware of any official U.S. government estimates.

Senator CARPER. Mr. Meyers, thanks very much for your statement today.

Mr. Chalk, you are recognized. Please proceed.

STATEMENT OF STEVEN G. CHALK, DEPUTY ASSISTANT SECRETARY FOR RENEWABLE ENERGY, OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY

Mr. CHALK. Thank you, Chairman Carper and members of the Committee. Thanks for the opportunity to appear before you today to discuss the renewable fuel standard, or RFS, included in the Energy Independence and Security Act of 2007, the latest energy bill known as EISA, particularly to address the life-cycle analysis of alternative fuel usage and the Department of Energy's research and development of alternative fuels, especially advanced biofuels.

The effect of increased volumes of alternative fuels on air pollutants and harmful emissions are particularly relevant to your Committee's jurisdiction over the Clean Air Act. All of us recognize the national and economic security importance of reducing our dependence on oil. The implementation of the RFS is one way that Congress and the Administration have come together and responded to the urgency of expanding the use of non-petroleum-based fuels to improve energy security and reduce greenhouse gases.

The Department believes that the RFS is critical to scaling up production of the use of current biofuels in the United States and deploying the next generation of biofuels, so creating a predictable policy environment for investors is critical to ensuring growth in all parts of the biofuels supply chain. This is from the feedstocks to the refineries to the delivery infrastructure.

In both the short term and the long term, relaxing the RFS enacted just 6 months ago would likely undercut these investments in new capacity, as well as research, development and demonstration of cellulosic or next-generation ethanol or other advanced biofuels. Additionally, as the RFS included in EISA could act to displace petroleum used in transportation and reduce greenhouse gases, repealing or relaxing that mandate would hinder progress toward these efforts. Right now, in gasoline is the only alternative or substitute today that is making a difference and having a significant impact on reducing oil demand.

DOE has projected that in the short term, the transportation fuel industry has the ability to meet the nine billion gallon requirement for renewable fuels this year, from ethanol, biodiesel, as well as credits from refiners from the 2007 blending levels. However, the effects of the recent flooding in the Midwest are fully analyzed, and of course we can't predict future catastrophic events related to the weather.

Over the long term, to ensure continued availability of resources to meet the RFS volume requirements in an environmentally sustainable manner, the Department is focused on robust empirical validation of all the environmental impacts of bioenergy across the production life-cycle. This is from planting of feedstocks all the way to the tailpipe of a vehicle. We are working with Argonne National Laboratories and Purdue University to address the issues of direct and indirect land use changes that could potentially occur with the

expansion of biofuels. Purdue's model will be expanded to include cellulosic ethanol feedstocks, such as switchgrass, and the results of that model will be integrated and rolled up into Argonne's total life-cycle model known as GREET. This is the overall life-cycle model that is used by the EPA in calculating life-cycle impacts of fuels.

One of the most important ways the Department supports achieving RFS volumes and positively affecting the air and environment is through its activities in research and development and technology deployment in advanced fuels. We have a goal to make biofuels from non-food feedstocks cost-competitive by 2012. We have made a lot of progress over the last 5 years or so, where we have brought the costs of that down by about 60 percent.

Cellulosic ethanol is expected to improve upon the already positive energy balance of today's corn ethanol by delivering four-to six-times as much energy to the vehicle as it took to actually make cellulosic ethanol. Additionally, DOE research has shown that cellulosic feedstocks can reduce life-cycle greenhouse gases by as much as 86 percent compared to gasoline today.

The United States is now recognized as the world leader in committing to advanced renewable fuels as a key component of its energy security strategy. We believe that the expanded RFS creates the predictable investment climate that we need to enable substantial participation of the private sector, whose commitment is essential to scaling our current biofuels use and deploying next-generation renewable fuels necessary to make a large impact on reducing oil use and greenhouse gas emissions.

Mr. Chairman, thank you again for holding this important hearing, and for the opportunity to address EISA's renewable fuel requirements, and the Department of Energy's use in advanced biofuels. This concludes my prepared statement and I would be happy to answer any questions the Committee may have.

Thank you.

[The prepared statement of Mr. Chalk follows:]

STATEMENT OF

STEVEN G. CHALK

DEPUTY ASSISTANT SECRETARY FOR RENEWABLE ENERGY

U.S. DEPARTMENT OF ENERGY

BEFORE THE

SUBCOMMITTEE ON CLEAN AIR AND NUCLEAR SAFETY

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

UNITED STATES SENATE

July 10, 2008

Mr. Chairman, Ranking Member Voinovich, Members of the Subcommittee, thank you for the opportunity to appear before you today to discuss the Renewable Fuel Standard (RFS) included in the Energy Independence and Security Act of 2007 (EISA), particularly life-cycle analysis of alternative fuel usage and the Department of Energy's (DOE) research and development of the next generation of biofuels. All of us recognize the national and economic security importance of reducing our dependence on oil. The implementation of the RFS is one way that Congress and the Administration have recognized and responded to the urgency of expanding use of non-petroleum fuels to improve energy security, reduce costs, and reduce greenhouse gas emissions.

EISA's Renewable Fuel Standard and Life-Cycle Analysis

In the 2007 State of the Union Address, President Bush called on Congress to significantly increase the use of advanced biofuels as part of the Twenty in Ten Initiative. Congress passed and the President signed EISA into law, requiring that U.S. transportation fuels contain at least nine billion gallons of renewable fuels in 2008, growing to 36 billion gallons in 2022. Of the quantity required in 2022, at least 21 billion gallons must be advanced biofuels (non-corn ethanol), and of that 21 billion, 16 billion gallons must be cellulosic biofuels; to meet the RFS, ethanol from corn is capped at 15 billion gallons. DOE and other federal agencies are working to develop diverse, non-food feedstocks that require little water or fertilizer, and to foster sustainable agricultural and forestry practices. Our efforts will help spur the resources, technologies, and systems at the rate and scale needed to enable this mandate to be met.

The Department believes that the RFS is critical in scaling up the production and use of biofuels in the U.S. and deploying next generation biofuels. Creating a predictable policy environment for investors is critical to ensuring growth in all parts of the biofuels supply chain, from feedstocks, to biorefineries, to infrastructure, including pipelines. In both the short and long term, relaxing the RFS would likely undercut investments in new capacity as well as in research, development, and demonstration of cellulosic ethanol and other advanced biofuels. Generally speaking, the RFS included in the EISA can act to displace petroleum used for transportation purposes and to reduce greenhouse gas emissions; relaxing that mandate can hinder progress toward these efforts.

DOE previously projected that the transportation fuel industry had the ability to meet the nine billion gallon requirement for renewable fuels this year, from domestic ethanol and biomass-based diesel production, ethanol imports, and credits accrued by refiners for 2007 blending levels. However, the effects of recent flooding in the Midwest have not been fully analyzed, and we cannot predict future catastrophic weather events that may have an impact. Section 211(o)(7) of the Clean Air Act, as amended by EISA, gives the Environmental Protection Agency (EPA) Administrator the authority to waive, in whole or in part, the total volume of renewable fuel mandated by the RFS if there is inadequate domestic supply to meet the mandate, or if "implementation of the requirement would severely harm the economy of a State, a region, or the United States." The EPA Administrator is required to consult with the Department of Agriculture (USDA) and DOE if he is to consider a petition to waive or reduce the RFS in a given year. The

consultative process with DOE has begun because of a petition submitted by Texas Governor Rick Perry to reduce the RFS from 9.0 to 4.5 billion gallons in 2008.

Over the longer term, to ensure the continued availability of resources to meet RFS volume requirements in an environmentally sustainable manner, we are implementing the sustainability provisions of EISA.

- EPA, in consultation with DOE and USDA has already initiated the development of a methodology to assess the life-cycle greenhouse gas emissions of biofuels production and use to ensure conventional and advanced biofuels meet minimum greenhouse reduction requirements.
- EISA Section 204 requires EPA, in consultation with DOE and USDA to assess and report to Congress on the environmental and resource conservation impacts of the RFS every three years. EPA has initiated this work.
- EISA Section 203 requires DOE, in consultation with USDA and EPA, to contract with the National Academy of Sciences (NAS) to assess the impact of the renewable fuel standard on the industries involved in the production of feed grains, livestock, food, forest products, and energy. DOE and NAS have conducted preliminary discussions to scope this study.

The Department is focused on robust empirical validation of all environmental impacts of bioenergy across the production life cycle, from feedstocks to vehicles. In FY 2008, DOE is funding approximately $1 million worth of research across the national labs and universities to collect and analyze data to assess the indirect impacts of biofuels production. This work is to validate DOE's existing life cycle analysis models as well as inform the development of new analytical tools.

In addition to these analytical efforts, DOE is engaged in field trials to grow and harvest dedicated energy crops into biofuels, to address the lack of data available at a large scale, so that life cycle analysis tools can be adequately validated. A better understanding of carbon and water cycling in environments where dedicated energy crops are produced will increase our ability to model the environmental impacts of large-scale bioenergy production nationally.

The Biomass R&D Board, an interagency coordination group established by the Biomass R&D Act of 2000 and co-chaired by DOE and USDA, is also addressing sustainability issues. The Board recently established a Sustainability Working Group, chaired by DOE, USDA, and EPA. This group is focused on collecting and analyzing existing criteria, benchmarks, and indicators to ensure sustainable production of biofuels. Such indicators may include metrics for water quality and quantity, GHG emissions, and air quality, as well as displacement of fossil-based energy for transportation fuels.

DOE Advanced Biofuels Research, Development, and Demonstration

The Department actively supports biofuels production, from the most basic science research activities to efforts toward the integration of advanced biofuels into the national fuel supply. To help meet our long-term energy needs, the Department's biomass

research and development (R&D) activities are designed to make biofuels from non-food feedstocks cost competitive by 2012.

The biomass feedstocks of today include grains (corn, sorghum, wheat), as well as oilseeds from plants (such as soybeans). Our goal is to allow the feedstocks of tomorrow to come from a variety of sources such as wastes and residues, and fast-growing energy crops. These future feedstocks may consist of agricultural residues like stalks, stems, and other crop wastes, as well as forest resources such as wood waste, forest thinnings, and small-diameter trees. Examples of energy crops include switchgrass, miscanthus, and hybrid poplar trees, in addition to algae and non-edible oilseeds like jatropha. Sorted municipal solid waste may also play a role.

Cellulosic ethanol is expected to improve upon the positive energy balance of today's corn ethanol by delivering four to six times as much energy as needed for production.[1] Additionally, DOE research has shown that cellulosic feedstocks can reduce life-cycle greenhouse gas emissions by 86 percent compared to gasoline.[2]

As a result of research, development, and demonstration efforts to date, I am pleased to report that we have already made significant progress toward the Presidential goal of making cellulosic ethanol cost competitive, which involves technology improvements to the production process that will result in a modeled cost of $1.33 (2007 dollars) per gallon of cellulosic ethanol by 2012.[3] Since 2001, the Federal Government has helped reduce the modeled cost of cellulosic production by 60 percent, from $6.00 to $2.40 per gallon.

The Department plans to invest up to $585 million over five years (FY 2007 – FY 2011), subject to appropriations, in cost-shared, integrated commercial- and demonstration-scale biorefineries that could produce up to 130 million gallons of ethanol from cellulosic biomass when fully operational. These biorefineries will demonstrate a wide range of advanced biochemical and thermochemical conversion technologies and use a wide array of cellulosic feedstocks.

On November 6, 2007, Range Fuels, Inc., became the first of the commercial-scale companies selected by DOE last February, as a part of the EPACT 2005 integrated biorefineries solicitation, to break ground on a commercial cellulosic ethanol plant, one of the first in the Nation. The plant is located near the town of Soperton, Georgia, and will draw on gasification technology to convert wood and wood waste from Georgia's pine forests and mills into 20 million gallons of ethanol per year during its first phase of operation. Construction of the first phase is expected to be completed next year.

---

[1] Source: Wang et al, "Life-cycle energy and greenhouse gas emission impacts of different corn ethanol plant types," *Environmental Research Letters*, May 2007.
[2] Ibid.
[3] Biomass Multi-Year Program Plan, Office of the Biomass Program, Energy Efficiency and Renewable Energy, DOE, March 2008, http://www1.eere.energy.gov/biomass/pdfs/biomass_program_mypp.pdf.

In addition, the Department's Office of Science has recently established three major new DOE Bioenergy Research Centers—led by the University of Wisconsin-Madison, Oak Ridge National Laboratory, and Lawrence Berkeley National Laboratory, respectively—which are bringing together top scientists and researchers in an effort to accelerate the transformational breakthroughs in basic science needed to make next-generation cellulosic biofuels cost-effective. The Department plans to invest over $400 million, subject to appropriations, in the outyears.

Conclusion

The United States is now recognized as a world leader in committing to renewable fuels as a key component of its energy security strategy. Many developed and developing countries now also have renewable fuel standards and targets, including the European Union, Australia, India, and China.[4] As a recent example, on June 26, 2008, Canada, a major oil-producing nation,[5] implemented a renewable fuels standard requiring all gasoline to contain 5% biofuels by 2010 and diesel and home heating oil to contain 2% biodiesel by 2012.

We believe that the expanded RFS creates a predictable investment climate that will enable the substantial participation of the private sector, whose commitment is essential to maintaining U.S. world leadership in the development of next-generation, non-food biofuel feedstocks, and achieving the critical EISA goal of making the use of renewable fuels a standard component of the transportation fuel market.

Mr. Chairman, thank you again for holding this important hearing and for the opportunity to address EISA's renewable fuel requirements and the Department of Energy's work in advanced biofuels. This concludes my prepared statement, and I would be happy to answer any questions the Committee Members may have.

---

[4] Rajagopal and Zilberman, "Review of Environmental, Economic and Policy Aspects of Biofuels," The World Bank, September 2007.

[5] "Country Energy Profiles," EIA, http://tonto.eia.doe.gov/country/index.cfm.

QUESTION FROM SENATOR BOXER

Q1. On June 11, the Department of Energy and the Department of Agriculture sent a letter to Senator Bingaman stating that the growth in biofuels production since 2005 has actually played a very minor role in impacting the price of food, causing far less than 1% of the increase in food prices. Please describe the analysis that supported these conclusions and the data that were considered.

A1. The Department of Agriculture (USDA) conducted the analysis on the estimated increase in the Consumer Price Index for all food, comparing the percentage increase attributed to increased ethanol and biodiesel consumption to the increase resulting from other factors. This analysis was presented in testimony by Dr. Joseph Glauber, Chief Economist at USDA, at a hearing before the Senate Committee on Energy and Natural Resources on June 12, 2008. This testimony can be found at http://www.usda.gov/oce/newsroom/archives/testimony/2008/GlauberSenate061208.pdf.

Factors contributing to higher commodity prices unrelated to biofuels development that were considered in the analysis included record prices for gasoline and diesel fuel that increased the costs of producing, transporting, and processing food products; drought and dry weather; population growth; and depreciation of the dollar. We have attached the Appendices to the letter to Senator Bingaman that contain the analysis that further substantiates the USDA testimony.

QUESTION FROM SENATOR BOXER

Q2. In your written testimony you note that using cellulosic feedstocks can reduce life-cycle greenhouse gas emissions by 86 percent compared to gasoline. What more can be done to pick up the pace of moving to cellulosic biofuels? Please identify any specific programs that need additional support from Congress or focus by the implementing agency, and describe the steps that should be taken to increase the pace and breadth of progress.

A2. We believe work on cellulosic biofuels is moving as rapidly as possible. The Administration has invested more than $1 billion since 2001 to accelerate biofuels research, development, and demonstration, targeting the goal of making cellulosic ethanol cost-competitive by 2012. The Department's Office of Energy Efficiency of Renewable Energy (EERE) is moving forward with four commercial-scale biorefineries and nine pilot scale operations to demonstrate a variety of feedstocks and novel conversion technologies. In addition, EERE research and development solicitations including microorganism and enzyme development and syngas and pyrolysis development have been fast tracked to meet cost goals within the timeframe of the target.

The Department also places a high priority on accelerating basic science research on biofuels in pursuit of the fundamental breakthroughs needed to make production of cellulosic biofuels (biofuels from inedible plant fiber) efficient and cost-effective. In September 2007, the Office of Science (SC) established three major new DOE Bioenergy Research Centers (BRCs), to receive a combined $405 million through the end of FY 2012. Each of the BRCs has mobilized a multidisciplinary team of leading scientists to attack all aspects of the problem: creating suitable plant feedstocks, developing more effective methods of

deconstructing plant fiber into energy-rich sugars (probably the single biggest technological challenge), and researching fundamentally new methods of converting these sugars into liquid transportation fuels, including not just ethanol, but also "green" gasoline, diesel, and jet fuel. All three BRCs are partnerships, and together they incorporate scientific resources and capabilities from major universities, National Laboratories, private firms, and nonprofit organizations. The BRCs are headquartered at Lawrence Berkeley National Laboratory, the University of Wisconsin, Madison, and Oak Ridge National Laboratory.

In addition, SC supports fundamental research on chemical catalytic approaches to producing biofuels. The recent workshop Basic Research Needs on Catalysis for Energy identified key scientific challenges in this area. In FY 2009, DOE proposed Energy Frontier Research Centers (EFRCs) along with a complementary program for Single-Investigator and Small-Group Research, and these efforts offer significant opportunities for expanded research in catalysis and other "grand challenge" areas recently identified in major strategic planning efforts by the scientific community.

The Department has and continues to implement the policies embodied in the legislative initiatives and structure provided by the Energy Policy Act of 2005, the Energy Independence and Security Act of 2007, and most recently, the Farm Bill of 2008. We will look to Congress for continued policy and programmatic support as we move ahead into new areas that are critical to the advancement of the next generation of biofuels, focusing on issues such as sustainability, the

development of new technology pathways for biofuels beyond ethanol (algae-based diesel, green gasoline, biobutanol, etc.) and the development of the infrastructure necessary to support broad and successful deployment.

Going forward, the Biomass Research and Development Board, created by the Biomass Research and Development Act of 2000 and co-chaired by the Department of Energy and Department of Agriculture, developed and will use as a guide the National Biofuels Action Plan. This Action Plan outlines areas where interagency cooperation will help to evolve bio-based fuel production technologies from promising ideas to competitive solutions, resulting in a cohesive vision for deploying advanced technologies in the market and achieving significant production scale in the next 15 years.

Senator CARPER. Thank you, Mr. Chalk. We will be happy to ask some questions. Thank you for a very good statement.

I have just learned, colleagues, that our first and only vote of the morning, a cloture vote on the housing bill, will occur at 10:55, and we may have a couple of nomination votes later this afternoon, but one vote that will probably interrupt this hearing.

I think Senator Inhofe and I might try to do some type of tag-team here where he goes and votes early, and then we start the questioning so we don't have to break, and we can just keep on rolling, so that is what we are going to try to do.

My first question is for you, Mr. Meyers, and it is sort of a two-part question. In your testimony, you outline the steps that EPA is taking to develop the regulations and analyses that are needed to implement the renewable fuel standard. My first question is, do you have the staff resources and expertise that are needed to complete these tasks? And second, when do you expect the proposed regulations to be promulgated?

Mr. MEYERS. Yes, Mr. Chairman.

Senator CARPER. The second question is, when do you expect to propose the regulations for the renewable fuel standard—first to propose—and then second, when do you think they might be finalized?

Mr. MEYERS. Yes.

Senator CARPER. Do you have the resources that you need? And second, the time line for the proposed regulations and the final regulations.

Mr. MEYERS. On the resource question, yes, we do have the resources. EPA has been responsible for fuel regulations for decades under the Clean Air Act, and has substantial expertise. We have a lab facility up in Ann Arbor, Michigan. We have approximately 400 employees working on vehicle and fuel issues, including our headquarters staff.

Of course, we work with the Department of Energy and tap into their resources, too, on these type of rulemaking efforts, and we work with the Department of Agriculture and their experts. So I don't think it is a situation where we lack the staff or resources.

In terms of the proposed schedule, we anticipate the proposed rule will be coming out this fall. As you know, when we put together the RFS1, it took us approximately 18 months from the time the law was passed to get a final regulation in place. Since EISA was passed in December, we anticipate something along that same schedule, even though I think the law itself is much more complex and carries with it new analytical requirements like life-cycle analysis and the definitions I referred to. So the proposal this fall, and then we would be looking to final next year.

Senator CARPER. And what time next year? Spring? Winter?

Mr. MEYERS. I hesitate, since we will be transitioning Administrations during that period, to say what the next Administration will be doing with a rule that is in a proposed form, so I don't think I can project that.

Senator CARPER. OK. I understand.

Mr. MEYERS. But I would say we are devoting the resources to do this as quickly as we can. We believe we will have a final rule by mid-next year.

Senator CARPER. Good. Thanks.

Mr. Chalk, for your question, to what extent is the Department of Energy collaborating with EPA to develop the greenhouse gas life-cycle and analysis?

Mr. CHALK. Very much, sir.

Senator CARPER. Can you talk with us a little bit about that?

Mr. CHALK. Very much. Argonne National Lab, as I said, developed the GREET model, which is the life-cycle analysis used by the EPA. Also, we have two people designated at the Department of Energy to work with the EPA on the rulemaking and on the calculations that would go into analyzing the greenhouse gases. In fact, there is a meeting today on this very subject with DOE, EPA and other agencies.

Senator CARPER. Good. What criteria are you all considering in your modeling? And how do the new models differ from the previous life-cycle analyses that were conducted after the passage of the Energy Act that we adopted in 2005?

Mr. CHALK. The biggest difference that we are adding to the model is indirect land use.

Senator CARPER. Talk with us a little bit about that.

Mr. CHALK. Yes, this is land that may be affected if we grow or use more acreage in the United States. It could impact land use elsewhere in the world. To equalize the supply and demand, it may have impacts elsewhere. So this indirect land use is a very complicated issue. It has not been modeled well, in our opinion. So I think any conclusions today that are drawn from current models are very susceptible. I think the biggest challenge is to incorporate indirect land use into the life-cycle model.

Senator CARPER. OK. A different question, if I could, for you, Mr. Chalk. We have already alluded to this in our earlier comments from the dais here, but biofuels have received some bad press for contributing to global forest loss, for requiring more fossil fuel inputs than they displace, and for driving up food prices. We have a wide range of as much as 3 percent increases in food prices to as much as 75 percent.

What is the potential for producing advanced biofuels that neither weaken food security nor threaten forests and wildlife?

Mr. CHALK. The potential is great. All of our work is focused on non-food-based biofuels, so cellulosic ethanol is what we are primarily concentrating on now because we think it can make the biggest difference in the near future. We are about halfway to our cost goal, so progress is very good. We believe that this will have minimal impact on food prices.

Really the biggest impact so far to date on food prices has been increased worldwide demand for food. It has been energy prices. Oil and natural gas has gone up tremendously. Also, other countries are changing their diets dramatically. So we have calculated, with the U.S. Department of Agriculture, that the contribution of biofuels to driving up food prices is about 5 percent. So it is a rather modest contributor, however I would say that if the price does increase more, there is, I think, even though we are determined to do this, that we have to be very cautious about what it does to livestock feed and things like that. So that is an issue that we have to pay attention to.

Senator CARPER. I have personally visited the DuPont's experimental station and had a chance to witness the partnership between the Department of Energy and the DuPont Company, and then the development of cellulosic ethanol. I certainly applaud that work.

I also learned a couple of months ago from a friend who works at General Motors that GM has taken an equity position in a biofuels company called Coskata. I had never heard of them before, but they apparently developed an advanced biofuel that uses about maybe a little less than a gallon of water to produce a gallon of fuel.

The energy content that is provided by the fuel is about seven times greater than the energy that goes into developing the fuel. We are told it can be developed for about $1 a gallon, and they can create the biofuel out of, among other things, municipal garbage, plant waste, even old tires from the vehicles that we drive. So that kind of stuff is pretty exciting, and I presume that is the sort of things that you are promoting at DOE.

Mr. CHALK. We are. And that is why we think the RFS is really important so the investment keeps coming online. The other thing is we are focused, as I said, on cellulosic ethanol, but we are trying to mitigate our risk, so to speak, by looking at other feedstocks such as algae for producing biodiesel. We are also trying to mitigate our risk by looking at various conversion steps. We are very focused on biochemical, but we expand that to thermochemical processes.

We are also have increased our work in our Office of Science to create what we might call third-or fourth-or fifth-generation biofuels. So I think we have a very comprehensive program to be successful.

Senator CARPER. Good. It sounds like it.

Senator Craig, you are next, and then Senator Boxer.

Senator CRAIG. Thank you very much, Mr. Chairman.

Mr. Meyers, Mr. Chalk, thank you for being with us.

Steve, I am pleased you talk about looking at a variety of things. Waste obviously has its potential. In Idaho, we do have an ethanol plant that operates off of potato waste. So the value of the food is already out there in the market. It is the waste that comes, the trimmings, the skins and all of that, and it is producing several millions of gallons per year in ethanol as a biowaste. It is pleasing for me to see that, and to see that there are diversities out there.

It is also pleasing for me to see you focused on cellulosic. I have spent a good deal of time with it, recognizing that there are a variety of enzymes out there that some like wood, some like straws or other types of cellulosic materials. And we are on the edge of seeing that technology come to market in a variety of ways.

At the same time, I think, Mr. Chairman, what we have to be is careful about our selectivity of feedstocks or our limiting of feedstocks. This last year when we legislated the RFS, I attempted to include biomass from public lands in there, and it was not allowed by this Congress. The environmental community moved in and said, oh no you don't, and stopped it.

Now, if we are really going to get serious about it, biomass from public lands, i.e. forested lands, has great value in cellulosic eth-

anol. It also has another value, Mr. Chairman. You can revitalize your dead and dying forests and make them young and vibrant and capable of sequestering carbon. But somehow we constantly run and get out old ethics in front of our new ethics, or our old policy in front of new policy, and we stumble and fall. In this instance, we stumbled.

I am not going to be here next Congress, but I would hope that Congress gets realistic. I guess my question to both of you would be, if we develop these new technologies, but we limit the feedstocks, and narrow access to abundance of feedstocks, what do we do to the price of feedstocks, No. 1? And what do we do on the investment cycle when the investment community and Wall Street can see no certainty long term in the feedstocks that supply the plant, therefore why finance the plant?

What are the realities there if we create these kinds of political limitations, when in reality we have the technology to do it right?

Mr. MEYERS. Well, Senator, I think you are referencing some provisions of EISA which established a renewable biomass definition. That definition restricts, as opposed to the previous law in 2005, the actual feedstocks that can be used for the production of fuel that would qualify as meeting the mandate. So there are several restrictions with regard to agriculture land-use and its production, as well as I think you referenced the forest provisions. This is a challenge for us, obviously, at EPA.

We need to interpret those provisions when proposing and going final on the regulations, giving full faith, of course, to the law that Congress passed. But certainly there is a difference between the EPACT 2005 in terms of feedstocks that can be used and the more restrictive definitions in 2007, as well as the other elements that I have mentioned with respect to life-cycle analysis that EPA will be utilizing in the evaluation of whether they meet the life-cycle thresholds in the bill.

Senator CRAIG. Thank you.

Mr. CHALK. I guess I would add that it is an improvement that we think would be worth evaluating. There is a precedent set in other industries like the forest products industry where we use public lands. I would say we evaluate it eyes wide open, according to our sustainable practices, which consider land use, soil health, water use, air quality, and greenhouse gas emissions. We ought to at least evaluate that option.

Senator CRAIG. I thank you for those answers. I agree. I think we ought to at least evaluate the options before we deny them politically. Thank you.

Thank you, Mr. Chairman.

Senator CARPER. Thank you, Senator Craig.

Senator Boxer.

Senator BOXER. Just following up on this conversation, what are the reasons that environmentalists give for not wanting to open up the national forests? Maybe I should ask Mr. Meyers?

Mr. MEYERS. I probably could not say exactly the environmental testimony on this point when Congress considered the provision. So I do not know the rationale of the provision. I think the rationale of some of the land use provisions obviously relates to the environmental purposes of the RFS.

Senator BOXER. But isn't it true that the RFS does allow some use of the forests?

Mr. MEYERS. Yes, it does.

Senator BOXER. OK. That is good. I think that is kind of a strawman issue myself. There is so much that is available and that is open.

I want to talk about this business of putting tariffs on imported ethanol. Are either of you aware of how much that could potentially let in to our Country?

Mr. MEYERS. I am sorry. Is the question how much is being imported now?

Senator BOXER. How much is being kept out, do we think? How much ethanol is being kept out?

Mr. MEYERS. I am not sure we have an analysis of what is being kept out. I think last year somewhere around 430 million gallons was imported, from my memory.

Senator BOXER. About 400 million gallons were imported last year?

Mr. MEYERS. I believe around that figure. I think the figure may be up this year. As part of the implementation standard, obviously we will be looking at the entirety of the economics here in a regulatory impact statement. So when we analyze the overall costs, we will take account for different policies.

Senator BOXER. OK. If you don't mind getting back to me on that.

Mr. MEYERS. Sure. I would be happy to.

Senator BOXER. I have a chart here that shows how much we import, but it could be more if we didn't have tariffs. So I would just like to get your analysis of that, if you could do that.

Mr. Chalk, what could be done to speed our transition to cellulosic biofuels? In your written testimony, you note that using cellulosic feedstocks could reduce life-cycle greenhouse gas emissions by 86 percent compared to gasoline. That is a tremendous reduction. So what could we do more here to speed our transition to cellulosics?

Mr. CHALK. I think, as I talked about before, expanding the potential feedstocks, putting more effort on different conversion techniques.

Senator BOXER. What do you mean by that?

Mr. CHALK. Well, right now we are looking at grasses. There are potential feedstocks like algae that I mentioned, or other potential grasses to look at, or other types of woody biomass. There is a lot of work going on in our Office of Science on developing new microorganisms that actually work better to speed along enzyme processes or processes to ferment the sugar. So there are a lot of things that are coming along.

We have really tried to emphasize in the last couple of months developing what we could call pilot plants—10 percent scale plants—where we have awarded about a half-dozen or so new technology grants, all with different types of feedstocks and conversion process. So we are broadening our portfolio, so to speak, in terms of how we are converting the feedstock into ethanol or into an advanced biofuel.

Senator BOXER. How do we broaden your portfolio?

Mr. CHALK. Pardon me?

Senator BOXER. How do we do that? What could we do to do that? I am confused about it.

Mr. CHALK. Right now, we are focused mainly on cellulosic ethanol. We don't want to lose a grip on that focus because that is our best bet for large quantities in the next three or 4 years. But over time, I think we want to broaden that out and find more areas that go into different feedstocks as we get successful on cellulosic ethanol.

Senator BOXER. Well, so you are doing a lot of work right now, and you mentioned what that work is. I am asking you, can we do anything to speed up that work? Do you need more funding? What do you need? Do you need Manhattan Project? What do you need?

Mr. CHALK. The funding right now is appropriate. I think what we need to see is over the next year or so how this progresses, but we are really I think in all fronts attacking this.

Senator BOXER. Good.

Mr. CHALK. So I think we are in very good shape, but these six or seven grants that I mentioned that we just awarded, and we are about to award two more grants, we have to see how they progress.

Senator BOXER. OK. And so you will know more in the next year?

Mr. CHALK. Yes, we will know a lot more.

Senator BOXER. Good. OK, my last question: Is EPA devoting enough resources to the project you are supposed to be working on, developing the biofuels life-cycle analysis? And are you on track to complete that rulemaking by this December?

Mr. MEYERS. As I mentioned, we are looking to propose a rule this fall. The timeframe in which we do the RFS rulemaking is approximately 18 months. Congress did establish a 1-year deadline, but with the substantial complexities that I think we have referred to here in life-cycle analysis, with the additional fuel categories, with the other legal definitional legal issues, as well as the analytical challenges, we are moving very fast, I think, with all due speed, but the complexity of the task requires a complexity of effort on our part, so we anticipate a proposal this fall, but it would be difficult to meet the statutory deadline by the end of the year.

Senator BOXER. OK. What is your date for that, meeting the deadline?

Mr. MEYERS. As I mentioned, I think we will be transitioning Administrations between this period of time, but in terms of our projections we believe we can go final next year, somewhere in the middle of the year.

Senator BOXER. Thank you.

You are in charge.

Senator INHOFE.

[Presiding.] Well, first of all let me apologize to the panel here. We were to have a vote that was delayed a minute at a time until it was about 20 minutes late, so we are trying to work this all the way through. I believe that the Chairman has further questions.

Mr. Meyers, in your testimony you State that if the E10 blends are used nationwide, it would utilize just 15 billion gallons of ethanol. The new mandate requires 36 billion gallons of ethanol. Are you concerned with the Nation's ability to absorb more than 15 billion gallons of ethanol?

Mr. MEYERS. Well, certainly that will be a challenge in the program and there will be the necessity for new outlets. That can happen in several ways. The E85 vehicles certainly use a higher blend rate and flexi-fueled vehicles use higher blend rates. There are infrastructure issues with regard to the E85 and its distribution.

Also, we are actively working. There are some efforts out in the State of Minnesota to look at intermediate blends above E10. Currently, we do not have an active request that is necessary under law to proceed on that, but we have been cooperating with DOE and others in private industry out there to look at that. But when we look at approving above E10, we have to consider its utilization in not only cars, but other vehicles that use off-road equipment, power equipment, lawn mowers—the whole host of engine uses. So we have to look to make very sure of its effect in different engines and different utilizations. That is part of the process contemplated by the law when we receive the application.

Senator INHOFE. The newly revised RFS includes requirements for studies on various aspects of biofuels, to include impacts on feed grain. As you heard me mention in my opening statement, that is something that is certainly of great concern in my State of Oklahoma. But also it impacts on not just feed grains, but livestock food, forest products and the energy industry, and its environmental and resource conservation impacts.

Now, if the results of these studies were found to be negative and produce harmful impacts on industries or the environment, does the bill require the EPA Administrator to adjust the mandate to prevent unintended consequences?

Mr. MEYERS. There are several provisions that allow for waivers of either the general applicable volume or for specific fuel categories. I mentioned in my testimony we are in receipt of a waiver request from the State of Texas right now. There are also individual waiver provisions that are applicable and assessment requirements that are applicable to cellulosic volumes.

Additionally, apart from that, as part of the energy law section 1541 passed in the 2005 law, EPA has certain emergency authorities for fuel supply issues. So there are a number of different authorities. Of course, we will look closely at the statutory terms that are provided to us in evaluating any request we get under that or are required to do.

Senator INHOFE. Do you think it would be helpful to have, or beneficial for the EPA to have the authority to alter a mandated RFS if these studies showed——

Mr. MEYERS. Well, there is an ability, depending on the existence of previous waiver activity, to adjust the applicable volume after two consecutive years. That is already existing in legislation. So there is a trigger and then there is an ability for the EPA to adjust that volume on a forward-looking basis.

But again, these are all issues that will have to be considered in the context and time in which they are raised. Right now, we have one waiver request which we are studiously reviewing and going through the comments on. So I would not want to speculate as to any action EPA would take on future waiver requests.

Senator INHOFE. As you know, the ozone air quality standards have been changed. I would ask you the question, what are the

ozone air quality impacts of large increases of ethanol and biodiesel consumption? And also, was that taken into consideration at any time back in 2005?

Mr. MEYERS. Yes, it was, sir. In the 2005 analysis, we saw various effects from the modeling we did there. In terms of looking at the volumes, we did a 7.5 billion case, and then a 9.8 billion case for our air quality analysis. But when we looked at those volumes, we saw some reductions in CO, carbon monoxide. We also saw some reductions in benzene. But we did project also volatile organic and NOX increases from the mandate, mostly in the areas that had not used ethanol previously. So if an area had not mixed ethanol previously in, we saw NOX increase on the order of about 4 percent to 5 percent on the limited modeling we did then. Of course, we will be doing more extensive analysis as part of the 2007 law.

Senator INHOFE. OK.

Mr. Chalk, as of today, the AAA states that E85 on an mpg-BTU-adjusted basis cost 26 cents more per gallon than regular gasoline. That is despite a 45-cent blended credit and a 54-cent import tariff. Will consumers be willing to pay more for E85 and what will it take for E85 to be cost-competitive without subsidies? And about how long would that be?

Mr. CHALK. Our goal is to have cellulosic ethanol cost-competitive by 2012, so in another 4 years we believe we will be there, so on an energy basis, it is cost-competitive with gasoline. As you point out, ethanol has less energy than a gallon of gasoline, so we are trying to do that on a gasoline-equivalent basis. We should be there by 2012.

Senator INHOFE. Good, good. Well, this is an interesting hearing. In my opening statement, you heard me say that we should have been having these hearings all along. I think a lot of the unintended consequences come because we are not really sure and we didn't have a chance to have the hearings before these decisions were made.

This is also kind of interesting in another way because things in this Committee get pretty partisan. In this case, I don't think this is. I think I agree with the Chairman more than I do with the Senator from Missouri in this rare case, so it is an interesting case.

Now, what we are going to do, I was hoping we would get to the next panel and get started on the next panel. However, Senator Carper had one more question to ask. He is going to be back after this vote, so I am going to put us into a not more than a 3-or 4-minute recess at this time, and then we will call back to order.

[Recess.]

Senator CARPER.

[Presiding.] We will resume our deliberations now. The first vote is over. I think we are clear through noon. This will be really our second round of questions.

I think what I want to do is go back and talk about the work that—DuPont is doing a lot of work on biofuels. We will hear about some of it from one of the witnesses on our next panel from DuPont, with I think an $18 million grant from the Department of Energy about four or 5 years ago. A lot of work has been done on cellulosic ethanol. I think a pilot plant has been built I want to say out in Iowa, if I am not mistaken.

DuPont is also working in partnership I believe with BP to develop something called biobutanol, which has better energy density than does traditional corn ethanol. It travels better in pipelines. I think ethanol does not travel well in pipelines. I understand that the biobutanol mixes better with gasoline at different temperatures than does ethanol.

Has the Department of Energy been involved at all with developing a biofuel-like biobutanol? Or has your focus been more exclusively on cellulosic ethanol?

Mr. CHALK. We have been to date very focused on cellulosic ethanol. As I was responding to Senator Boxer, what we are doing in the future is expanding our feedstocks, but also expanding the number of advanced biofuels we are working on. So ethanol is not the end-all of all fuels. In fact, biobutanol in this case that DuPont is working on is, as you stated, very much more compatible with the existing infrastructure, with existing gasoline engines and so forth.

So as our work matures, especially in the Office of Science, and our thermochemical conversion process, we have more ability to synthesize molecules from the ground up, if you will, to make them longer-chain and more like a diesel molecule today, more like a gasoline molecule, and they can still be carbon-neutral.

So I think that is sort of the next generation after cellulosic ethanol. We are looking to ramp-up our work in that area. As we become more successful with getting cellulosic ethanol, that work completed, we are focusing on that right now because we have to get that out to meet the mandate. But these other fuels, these other feedstocks are very, very important. You can just call them other energy carriers, if you will. These higher-chain molecules are more fungible in the current system and they act more like what we are used to. So this is definitely a consideration in the future is to expand our work in that area.

Senator CARPER. Mr. Meyers?

Mr. MEYERS. Yes, I would say from EPA's perspective, we meet with a number of companies. Some are working on very advanced technologies. Part of our responsibility in terms of implementing the RFS is we have to look at down the road we have various mandates coming up, the sub-mandates I referred to before. So we have to essentially analyze what fuels we think will be available and when in order to do this sort of sophisticated economic and environmental monitoring and modeling that we need to do.

So we are also looking at the issue of availability of future biofuels in the context of the regulations and the regulatory effort we have ongoing.

Senator CARPER. OK. Coming back to us in the Congress, these hearings are helpful because we hear from you, we hear from industry groups. They give us advice and counsel on what we need to be doing in the legislative branch of our government to help make sure that we—and it is all well and good that we set the mandates for 36 billion gallons I think by 2022, but we have to do more than just say eat your spinach and produce. We have to help provide the support that we can.

What are we doing that is helpful to getting us toward heading in the right direction toward meeting those mandates? What further do we need to do in the next several years?

That would be really for Mr. Chalk.

Mr. CHALK. As I said in my testimony, we think that the RFS as it is, it is really important to keep the investment going—about $500 million invested last year in venture capital into the technology; about $4 billion invested in plants and so forth. So we think that assured market is critical for industry to invest. So I think keeping that in place is very important to us. Otherwise, it will undercut the investment that is occurring.

The other issue is to keep supporting the cellulosic ethanol, which has been very well supported by Congress in the appropriations. So I think we won't have lack of resources. We will be able to put the right programs in place. We have a lot of confidence that we are going to be successful in making it cost-competitive with gasoline today.

Senator CARPER. All right. Good.

I am going to yield to my friend, Senator Craig. Any more questions for this panel?

Senator CRAIG. In the discussion you have just had with the Chairman, I think all of us look at the reality of where our Country wants us to be with clean energy sources and abundant energy sources. We understand the carbon footprint that exists today with corn-based ethanol. I have spent a good deal of time looking at cellulosic and see that as a more closed cycle, if you will, from the standpoint of generating its own energy and therefore the carbon footprint goes down substantially in the actual process of making it.

These other types of alternative fuels you are talking about, are they similar in their character as it relates to a carbon footprint? Or are they fairly consumptive of other forms of energy to create the energy they provide?

Mr. Chalk.

Mr. CHALK. They are very similar. The carbon absorbed by the plant is eventually going to be emitted out the tailpipe no matter what the form of the carrier is. So they would be very similar to what we would call carbon-neutral.

Senator CRAIG. Yes. OK. That is good to hear.

I don't believe I have, Mr. Chairman, any further questions of these gentlemen.

Thank you again for the work you do and your involvement. We appreciate your presence.

Senator CARPER. I do have maybe one more. Maybe it was Senator Boxer who was asking about transporting these biofuels. I mentioned earlier the biobutanol developed by DuPont has the advantage of being able to transport through pipelines. I am told that corn ethanol does not.

This is mostly for you, Mr. Chalk. What thoughts do you have on what we need to be doing, you and us, in this Country, and the private sector, in order to address the issue of transporting the fuels? It is all well and good that we produce it in some part of the Country, but if we can't get it efficiently to other parts of the Country, it is not as great a value.

Mr. CHALK. What we see as a potential option is higher blends of ethanol. Right now, we are using roughly E10 and gasoline when it is reformulated in cities that have requirements for that. If we went to E15 and E20, we believe it would be pretty much compatible with existing infrastructure, and we can increase the amount of ethanol in gasoline by another 50 percent or perhaps double it to 100 percent. So we are working with the EPA now to see what contribution higher levels of ethanol have on emissions like NOX and so forth.

We are fairly confident that for most vehicles that they will still be in spec if we were to increase, say, from E10 to E15 of E20. The smaller engines like weed whackers and things like that are air-cooled get a lot hotter. They could have NOX emissions issues. But I think that could be addressed. I wouldn't want to let that issue, with no disrespect to the small-engine manufacturers, but have that get in the way of solving a national problem, and the amount of wealth that we transport every day to the Middle East. So I think that can be solved and it could be solved with time, just making changes.

I think the big issue of going with the higher blends will be what do we do with the legacy vehicles. Will they still be under warranty if we introduce a new fuel? And again, I don't think that is insurmountable, but I think that is something that has to be part of any solution to go to higher blends.

Senator CARPER. And the last question I want to ask, and it could be of either of you, but just clarify for me if you will, we are expecting to reduce greenhouse gas emissions—maybe more than expecting—requiring reduction in greenhouse gas emissions from ethanol by roughly 25 percent below gasoline, and roughly 50 percent reduction in greenhouse gas emissions from cellulosic ethanol, maybe even higher for other kinds of biofuels?

Mr. CHALK. Well, corn-based, it depends on how the factory making the ethanol is powered, but roughly 19 percent or 20 percent better than gasoline today on a life-cycle basis for greenhouse gases. With cellulosic, it was about 86 percent better than gasoline.

Senator CARPER. Mr. Meyers.

Mr. MEYERS. Senator, I would say those are issues we are looking at. I think it is very important. When we are looking at the legislative provisions that we have to interpret, we have to look at the full life cycle. So how the ethanol facility is powered, for example, makes a difference. If it is a coal-based facility versus a natural gas-based facility, you have some differences there.

With respect to the parameters you are talking about, the bill did create thresholds with regard to cellulosic. There is a 60 percent threshold for greenhouse gas life-cycle performance, and when we get to biomass-based fuels, 50 percent. And with regard to existing corn-based ethanol, there is a grandfather for existing facilities, but for new facilities that is a 20 percent requirement. So these are sort of essentially hurdles that the law puts there that will need to be cleared. That is the type of analysis we are doing now. So I think we have not settled in.

We have done a lot of life-cycle analysis before with respect to the RFS1. We did a lot of improvements last year. But these are issues that we will be studying and actually as part of our proposed

rule, and part of the analysis, they have legal import. So I think that it is important that we, on a going-forward basis, are using the best information. But that will be part of our public comment process going forward on our analysis in terms of how we evaluate the different fuels.

Senator CARPER. Thank you.

I will close out this panel with this thought, and maybe a question for Mr. Chalk, and just a brief response would be helpful.

In our efforts to reduce greenhouse gas emissions, particularly from coal-fired utility plants, which provide about half of our electricity, but also provide a whole lot of our greenhouse gases, as you know, I have heard some more than talk, but ideas of trying an experiment where we use the carbon dioxide that flows off a coal-fired plant in conjunction with algae or with fast-growing plants that could then be used to provide a biofuel. Are you all looking at anything like that at DOE?

Mr. CHALK. Yes, we are. In our Office of Science, we have three Bioenergy Research Centers. You can use carbon dioxide as a fuel. So essentially you are using that as a fuel, and you can synthesize fuel molecules by reacting it with other things. So we are very much looking at that. I would say that is very much a long-term technology, not something we will have within 5 years, but perhaps 10 or 15 years that we could have demonstration of that.

Senator CARPER. All right.

Thank you, gentlemen. Thank you very much for your testimony and responding to our questions. We will have some members of our Committee who were here, and maybe some who weren't, who will have some additional questions. We would just ask that you respond to those in a timely way. But thank you so much for joining us.

We welcome our second panel here today. This is actually a panel that I have looked forward to with a lot of anticipation. I hope it is matched by your anticipation in being here. We welcome you.

On the panel, we have three witnesses. Our first witness is John Pierce, Vice President of DuPont Applied Biosciences Technology. Welcome, John. It is nice to see you. I am glad you are here.

And we have Scott Faber, Vice President for Federal Affairs, Grocery Manufacturers Association and Food Products Association. Mr. Faber, welcome. We are happy you could join us.

And Nathanael Greene, Director of Renewable Energy Policy, Air and Energy Department, Natural Resources Defense Council. Mr. Greene, welcome. We are happy to see you.

Again, your entire statement will be made a part of the record. If you would like to summarize it, feel free. I would ask you to stay fairly close to 5 minutes, but we won't cut you off right there.

Mr. Pierce, you are recognized to lead off. After you guys have concluded, we will have some questions. Thank you.

STATEMENT OF JOHN PIERCE, VICE PRESIDENT, DUPONT APPLIED BIOSCIENCES TECHNOLOGY

Mr. PIERCE. Good morning, Chairman Carper.

Senator CARPER. Just make sure your button is pushed so everyone can hear you.

Mr. PIERCE. Can you hear me?

Senator CARPER. I can hear you now.

Mr. PIERCE. Good morning. I am Vice President for Technology for Applied Biosciences at DuPont, which includes our biofuels and biomaterials business. I am pleased to be here today to talk about the renewable fuel standard.

DuPont spans the biofuels value chain. Our seed business, Pioneer Hi-Bred, sells corn, soybean and other crop seeds to farmers. With BP, we are developing biobutanol, a high-performance biofuel, and with Genencor, we are developing cellulosic ethanol technology.

Our existing biofuels policies, including the RFS, have been successful in standing up a U.S. ethanol industry that offsets a variety of the security, environmental and economic impacts of our dependence on petroleum.

Today, U.S. ethanol production decreases petroleum demand enough to lower gasoline prices by 25 cents to 40 cents a gallon, which is a significant savings for American consumers. Next-generation biofuel technologies will expand upon the solid foundation we have built with grain-based ethanol.

U.S. agriculture has a long track record of expanding the production of crops used for food, fuel and fuels. Back in 1915, some 90 million acres were used to grow feed for horse and mules, which was our transportation at that time. When Henry Wallace formed our Pioneer subsidiary in 1926, corn yields were about 27 bushels per acre and corn was about three times more expensive than petroleum by the pound. Today, corn yields are five times higher and even with current corn prices, a pound of corn is three times cheaper than a pound of petroleum.

We expect to see U.S. corn yields grow from today's 150 bushels to 200 bushels per acre and more in 2020. The rest of the world lags U.S. productivity, often by large margins, so there are dramatic opportunities to expand global agricultural production from existing acreage. Agriculture can provide for our food and fuel needs. We simply do not need to make artificial choices among these uses.

The RFS provisions enacted last year recognized the need for more technology in feedstock-neutral approaches to producing biofuels. For example, our cellulosic ethanol technology using the non-food parts of the corn plant as feed stock will be producing fuel at pilot scale next year and at commercial scale soon thereafter. By modifying existing bio-refineries, we will be able to increase the amount of ethanol from an acre of corn by about 25 percent to 35 percent. The technology can be applied to other cellulosic feedstocks.

We are fleet-testing biobutanol and are on-target to be at pilot scale in 2010. We heard that biobutanol is compatible with existing fuel and pipeline infrastructure, has higher energy density and lower air emissions than ethanol, and also improves ethanol-gasoline blends. This advanced biofuel provides great opportunities for expanded biofuels use. There are now literally hundreds of biofuel developers intent on producing cellulosic ethanol and advanced biofuels in the next few years, utilizing an impressive array of feedstocks and a multitude of processing technologies. These trends suggest that the RFS targets are within reach.

As we consider the sustainability of biofuels and their feedstocks, we need to ensure that policies are based on solid understanding of issues like the role of agriculture in land use. Farmers grow and have always grown crops that serve multiple markets. We run the risk of balkanizing agriculture if we set standards for biofuels-related agriculture that differ from those of agriculture generally. Rather, we should continue to advance the sustainability of agriculture as a whole and avoid multiple standards for crops destined for different end-uses.

Last, some want to attribute rising global food prices to ethanol-driven corn demand and suggest that the RFS be stalled or decreased. As a member of the Grocery Manufacturers Association, we are sorry to see GMA take that position. Others have detailed the variety of factors that have caused the prices of a wide range of commodities to rise, from steel and copper to cement, energy, and yes, grains and other foods.

I would simply observe that in 2007, when ethanol production consumer about one-fifth of the U.S. corn crop, the U.S. had its largest corn export volumes ever and we finished the year with unused corn stocks.

Senator CARPER. Excuse me. Would you just make that last statement again please?

Mr. PIERCE. I would simply observe that in 2007, when ethanol consumed about one-fifth of the U.S. corn crop, the U.S. had its largest corn export volumes ever and we finished the year with unused corn stocks.

Senator CARPER. Thank you.

Mr. PIERCE. Rising global food prices are a real and important concern, but slowing U.S. biofuels production is not the solution. Agriculture can supply the solution providing adequate resources for food, feed and fuel far into a sustainable future, just as it has done for as far back as we care to look.

In closing, the current policy framework provides a sound basis for developing a robust biofuels industry and should continue to evolve to be more performance-based. We look forward to working with Congress through that process, and thank you for the opportunity to speak with you today.

[The prepared statement of Mr. Pierce follows:]

Statement of John Pierce
Vice President For Technology
DuPont Applied BioSciences
E.I. DuPont de Nemours and Company, Inc
Regarding the Renewable Fuels Standard
before the
Subcommittee on Clean Air and Nuclear Safety
Committee on Environment and Public Works
U.S. Senate
July 10, 2008

Good morning Chairman Carper, ranking member Voinovich and members of the committee. My name is John Pierce, and I am the Vice President for Technology for DuPont Applied Biosciences, which includes our biofuels and biomaterials businesses. I am pleased to be here today to discuss the Renewable Fuels Standard. In my testimony I will provide our views of the future of biofuels, and the role of the Renewable Fuels Standard in that future.

DuPont brings a broad perspective to bear on biofuels issues, as we span the biofuels value chain. Our seed business Pioneer Hi-Bred is the world's largest seller of seed corn and the second largest seller of soybean seed to farmers. Our seeds have enabled steadily rising yields, or production per acre, for over 80 years. We sell over 170 corn varieties specifically for ethanol production, varieties that produce high fermentable starch, yielding more gallons of ethanol per acre. With our Partner BP we are developing bio-butanol, a higher alcohol fuel produced by fermenting biomass. Biobutanol is more like gasoline than is ethanol, with higher energy density and the ability to be distributed via the existing gasoline infrastructure, including pipelines. Biobutanol also improves ethanol-gasoline blends as a co-blending component. It reduces the volatility of the blend, allowing butanol-ethanol-gasoline blends to be used in the summer season where air quality concerns currently limit the use of ethanol-gasoline blends. And with our partner Genencor we will next year pilot a cellulosic ethanol technology based on corn stover, with commercial quantities produced in 2012. This technology will quickly provide expanded ethanol production from the existing agricultural and biorefinery infrastructure employing a non-food feedstock. We also have biomaterials and food ingredients businesses. Across our entire business portfolio we are experiencing the impacts of rising input prices, from energy to steel to agricultural commodities, and understand the strains they impose. That is why we are producing materials that help to reduce the supply-demand imbalances that contribute to these price rises.

The existing suite of biofuels policies, of which the RFS is a significant component, has been very successful in standing up a US ethanol industry that is making a meaningful contribution to US energy security and the environmental footprint of transportation. We have to remember that we started down the road of alternative transportation fuels because of the variety of security, environmental and economic ramifications of our dependence on petroleum. Those challenges have only grown more acute. And we are

making solid progress. Today, ethanol production in the US offsets over 7 billion gallons of petroleum demand. A recent analysis from Iowa State University estimates that the presence of ethanol in the US fuel pool is lowering gasoline prices on the order of 25 to 40 cents per gallon. That is a significant savings for American consumers and businesses. Because energy costs are also a major element of manufacturing costs this is also helping to restrain inflationary pressures.

The Role of Biofuels

We believe that biofuels can serve an expanded role in fueling transportation in the US and elsewhere while contributing to reducing the carbon intensity of transportation. We also believe this can be done without increasing the environmental footprint of the agricultural enterprise. Steadily increasing agricultural productivity, which we are helping to achieve, and the use of non-food feedstocks, such as cellulose, to produce biofuels are important to this future. Ensuring a viable biofuels market will be critical to ensuring the substantial private sector investments that are required to bring these second generation biofuels technologies to market in the next several years.

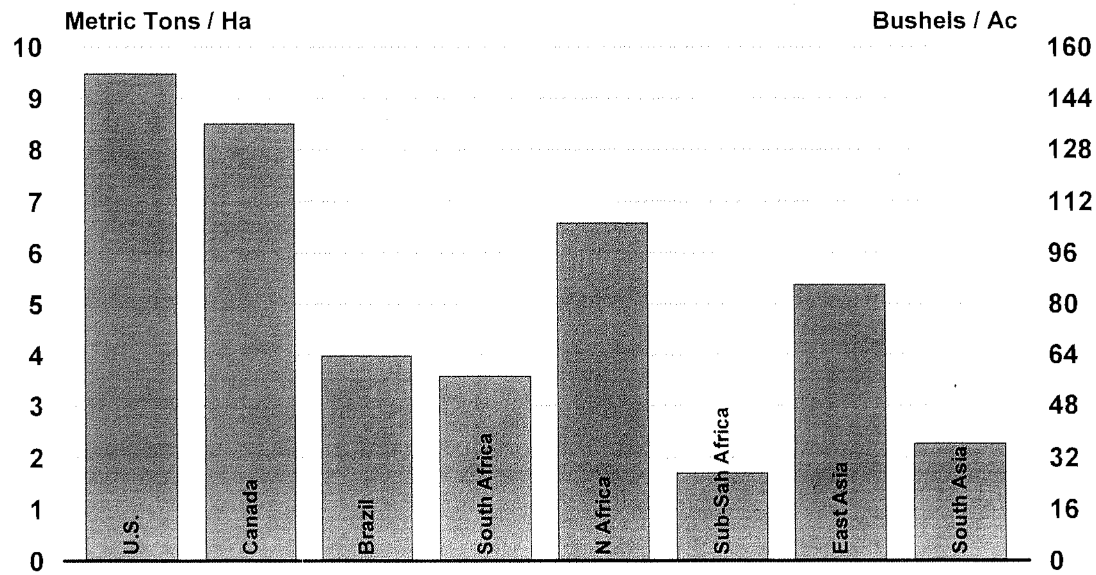
Why are we bullish on biofuels? First, because we see agricultural productivity as an engine than can provide abundant food, feed, fuel and materials globally. And second because we see the promise of next generation biofuels technologies to expand upon the solid foundation we have built on grain based ethanol. DuPont and BP will be producing biobutanol at pilot scale in 2010 and commercial scale in 2012. We have already performed fleet testing and are on track to bring to market a biofuel that is completely compatible with the existing petroleum infrastructure, has high energy density and thus good fuel mileage, and improves ethanol-gasoline blends. Next year our joint venture with Genencor will start up a pilot plant producing ethanol from corn stover, which is the cob, stalk and leaves of the corn plant, with commercial production in 2012. This fuel will have a carbon improvement over gasoline on the order of 80 to 90%.

Why corn stover? Because it capitalizes on the existing infrastructure to provide rapid expansion in ethanol production with no potential competition for food and feed uses of corn. The same equipment that goes into the field to harvest corn grain for ethanol will harvest an appropriate amount of stover, leaving behind enough for soil conditioning and erosion control. The stover will be transported to an existing biorefinery where it will be fed to a parallel processing and fermentation unit integrated with the existing facility. The result will be a 25-30% increase in ethanol production from the existing acreage. The stover from corn fields that are currently producing for food and feed uses will be able to produce additional biofuels volumes, further expanding the ability of agriculture to produce food, feed and fuel. While other cellulosic feedstocks have promise, and we are working on them as well, corn stover offers the most rapid deployment.

The Role of Agricultural Productivity

As for agricultural productivity, the US has a long track record of continually expanding production from the existing agricultural acreage, and producing a wide variety of

John Pierce July 10 Testimony Exhibit 1
Corn Yield 2007
North America, Brazil, Africa and Asia



Source: USDA

products for food, feed, fuel, and industrial uses. At the turn of the 20th century, 25% of all energy used in the US came from burning wood, and in 1915, some 90 million acres of US cropland were used to grow feed for horses and mules – our transportation at that time. A major, new innovation of the last century was to learn to use fossil fuel based sources for our transportation, energy, and material needs. While hugely transformational for the world's economy, limitations of our dependency on fossil fuels are increasingly apparent. Concurrently with the huge transition to this fossil based economy, agricultural productivity also increased by leaps and bounds. When our Pioneer subsidiary began operations in 1926, corn yields were about 27 bushels per acre and petroleum was relatively cheap – you could buy 3.5 pounds of petroleum for the cost of one pound of corn. Today, corn yields in the US average about 150 bushels per acre. Corn, at $7/bushel, is 3.5 times <u>cheaper</u> than petroleum, instead of being 3.5 times more expensive as it was in 1926 – a remarkable testament to agricultural productivity.

Agricultural yield and productivity has steadily increased in the US, with notable gains in a few other areas of the world, allowing significantly expanded production from the same acreage (see exhibit 1). In the last 25 years improved corn yields from existing acres in the US have resulted in corn production that would have required an additional 150 million planted acres had yields not steadily improved. In essence, better yield has created 150 million "virtual acres", about the amount of planted land in the US today. In the last ten years global soybean production has increased 56% and corn production has increased 32%, while the total acres of land used for such production has increased only 6% (see exhibit 2). Such is the power of agricultural yields. This has come from steadily improving plant varieties that produce more, require less inputs and are less susceptible to insects, disease and weather variations. For example, in 1983, 1988 and 1994 the US experienced droughts that reduced average corn yield 25-30%. In the 2003 drought the yield declined only about 7%. So we are seeing higher upside and lower downside in agricultural production. Further, we expect within the next ten years to see a further 40% increase in this rate of annual gain. In 1985 average corn yield in the US was about 100 bushels per acre. In 1995 that value was 130 bushels per acre, and in 2005 it was 150 bushels per acre. We think 2020 will see average yields of 200 bushels per acre (see exhibit 3). This enhanced productivity from existing acreage with more efficient use of inputs such as water, fertilizer and crop protection chemicals also contributes to more sustainable agriculture.

However, much of the rest of the world lags US productivity by large margins, even after significant gains in some regions. In the last ten years Brazil has increased its corn yields by 50% and South Africa almost 70%, yet they still have yields less than half of those in the US, as do South and East Asia (see exhibit 4). This means that there are dramatic opportunities to expand global agricultural production from existing acreage by bringing modern farming practices to other parts of the world (see exhibit 5). This is why we believe that agriculture can continue to provide for our food, feed, fiber <u>and</u> fuel needs.

The RFS

Now let me turn my attention to some of the specifics of the Renewable Fuels Standard. As the RFS was developed we encouraged Congress to emphasize policies that were feedstock, technology and fuel type neutral, and to focus on desired fuel attributes such as energy density, low carbon content and infrastructure compatibility. The RFS provisions enacted last year made significant steps in this direction, and are helping to motivate the right kinds of market transitions. In fact, there are multiple technology developers intending to produce cellulosic ethanol in pilot or demonstration quantities from a range of feedstocks over the next 24 months. The economics and carbon performance of grain ethanol continues to improve as well, as does agricultural productivity and sustainability in the US. These trends suggest that while the RFS targets are aggressive, as they should be, they are not out of reach. The integrated strategy of the U.S. is exemplified by the RFS and the related investment strategies of US DOE and USDA, which have supported a variety of alternative fuels technologies. As a result, numerous companies and institutions are now involved in biofuels work looking at a variety of different technologies, approaches, and feedstocks, and we can confidently look to US-derived technology to make the seminal contributions to renewable fuels.

We would like to see biofuels policies continue to evolve to be more performance based, to provide the right market signals for the production and use of fuels with the most beneficial attributes. For example, a low carbon fuel standard would create incentives for a fuel blender to purchase biofuels with the lowest life cycle carbon content. That would create greater market value for such low carbon fuels, and thus market incentives for fuel producers to develop the lowest carbon biofuels. Single value threshold carbon standards, such as a minimum percentage improvement over gasoline in life-cycle carbon content, run the risk of blunting that market signal. If biofuels producers don't see higher market value for fuels with better carbon performance than a bright line standard they will be less likely to develop such fuels. A low carbon fuel standard or other "sliding scale" approach better incents the market to produce the best fuels possible. However, we recognize that having an efficient and functional low carbon fuel standard will require streamlined and standardized life cycle assessment tools that are not yet available, which I will return to in a minute.

Comment [JP1]:

We also think it is in the national interest to help further accelerate the development of cellulosic biofuels. There are a number of things Congress can do in this regard. You can help to ease the financing risk of new biorefineries, such as through loan guarantees and accelerated deprecation. There is also a significant need to develop the know how and infrastructure for growing, harvesting, transporting, storing and processing cellulosic feedstocks, as this remains one of the least developed areas for this emerging technology. The Farm Bill made progress in these areas. Continued federal encouragement to growers and further R&D attention to cellulosic feedstocks would be very beneficial.

That being said, we think the current policy framework provides a sound basis and is helping to develop a robust biofuels industry. We look forward to continuing to work with Congress to improve this framework over time while avoiding sudden changes that

2

John Pierce July 10 Testimony Exhibit 2

The Ability of Increasing Agricultural Yield to Meet the Growing Demand for Corn & Soybean

+13% The growth in world **population** over the last 10 years	+36% The growth in global **income** over the last 10 years	+21% The growth in **meat** consumption (Beef +14%, Pork +11%, Chicken +45%) over the last decade
+34% The growth in world **corn** consumption over the last decade	+52% The growth in world **soybean** consumption over the last decade	+6% The growth in world **crop area** harvested over the last decade

DUPONT

would disrupt our path to broader use of biofuels. However, there are some potential storm clouds on the horizon.

Biofuels Sustainability

One of the benefits of, and appropriate goals for, biofuels is enhanced sustainability, including a lower carbon footprint, than the incumbent hydrocarbon fuels. Given the nature of the biofuels value chain it is important that we consider the carbon ramifications of the various elements of that value chain, from the production of feedstock through their harvest and transportation through the biorefinery process. This is typically done through life cycle modeling, which is an area under rapid development and where common methodologies have not yet emerged. We will have to get to standardized and streamlined life cycle tools before we can fully utilize the market power of something like a low carbon fuels standard. The US currently consumes almost 150 billion gallons of gasoline a year, a staggering amount. As biofuels become an increasingly prominent part of that fuel pool, it will mean many, many batches of biofuels from many, many producers. Current life-cycle tools are quite complex, and can look more like a mini-PhD thesis than the kind of real-time tool that will be necessary for evaluating and certifying these batches of biofuels. The tool will also have to allow for ready differentiation amongst fuels on things like carbon content so fuel producers can capture value for fuels with better attributes.

Of course, the implementation of a coherent market based carbon reduction program, such as cap and trade, for fossil-based carbon emissions provides perhaps the most straightforward way to accomplish the goals of reducing fossil CO_2 emissions in that it would incent all users of fossil-based fuels – including biofuels producers – to find ways to lower their fossil CO_2 footprint.

Congress has tasked EPA with making life cycle analysis considerations at a broad policy level as it implements the "RFS II", including the consideration of what are termed indirect land use effects. These are land use changes that are not directly attributed to the production of biofuels feedstocks but that in some manner can be inferred to be indirectly attributed.

What is well known is that converting certain kinds of ecosystems to agricultural or other use, such as tropical forests and peat bogs, can release significant amounts of stored carbon and reduce future carbon storage potential, as well as reducing habitat and having other deleterious effects. We have, for example, seen such effects in parts of Southeast Asia where forests have been felled for logging as well as for palm oil monoculture. What is much less understood is the potential for expanded agricultural production to more generically result in such land use changes, which are second, third or even fourth order effects. There are multiple factors that influence land use – human population growth, rising standards of living, traditional subsistence farming practices, global demand for timber and minerals, etc. The role of agricultural production in motivating such land use changes is an area of much speculation, including speculations from some recently publicized analyses and media stories, but very little real knowledge. While we

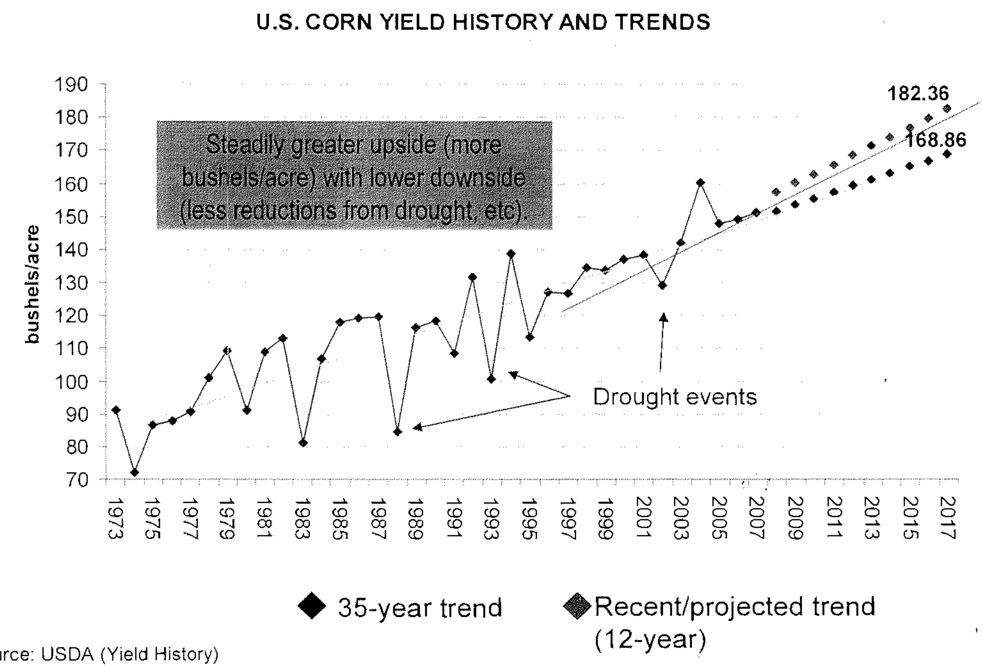
think that understanding the negative aspects of inappropriate disturbance of these most sensitive ecosystems provides a cautionary tale of how to regulate land use and how not to produce timber, biofuels feedstocks, and other agricultural commodities, we do not see such outcomes as either desired or inevitable in our future.

It appears that EPA intends to apply potential indirect effects of biofuels feedstocks production generically to biofuels. In large measure this is due to the significant difficulty of relating a particular feedstocks production to land use changes that might occur thousands of miles away. This approach could result in some sort of generic carbon "penalty" being applied to biofuels. We are concerned that this generic carbon penalty, by discounting the actual carbon performance of a given fuel batch, could serve to mute the market signal that properly constructed policy would send to encourage the production and consumption of the lowest life-cycle carbon fuels. We think that considerations of directly attributable land use changes should be included in the life cycle considerations of particular fuels, and that the potential for indirect land use changes are best controlled through other policies that more directly address and prevent deleterious changes.

We would also caution that biofuels feedstocks are only one market for agricultural products. Farmers do not grow just for the food, feed, materials, or fuel markets. They grow-and have always grown- crops that serve all of these markets. If we begin to set standards for agricultural practices for biofuels feedstocks that differ from those for agriculture generally we run the risk of balkanizing agricultural production, and in the process creating disincentives for production for certain end uses. It would be like establishing different mail delivery standards for every tenth house on a mail route. Continually improving the sustainability of agriculture is important, and we are seeing steady improvements in agricultural practices, hardier plants, and lower inputs such as water and fertilizer. We should continue to advance the sustainability of agriculture as a whole, and not fall prey to multiple and potentially conflicting sustainability standards for crops going into different end uses. The end uses may be different, but the crops and the growing are the same.

Another area where caution is warranted is the current attribution by some of rising global commodity prices, particularly food commodity prices, to ethanol driven corn demand, and the resulting suggestion that the RFS be stalled or decreased. Many others have noted the variety of factors that have caused the prices of a wide variety of commodities, from steel and copper to cement, energy and, yes, grains to rise. Prices for foods derived from wheat, corn, and rice have all risen over a similar period, though these crops have dramatically different food, feed, and fuel uses. The primary drivers for these price increases can be found in higher demand resulting from population growth, higher per capita income and rising standards of living, and overall higher fossil fuel energy costs. I would simply observe that in 2008 ethanol production in the US is anticipated to consume about 19% of US corn production, which is about 10% of global corn production. Corn into animal feed, including exports (17% of production), will consume 70% of US production (taking into account the ethanol co-product DDG that goes back into animal feed). Direct food uses comprise the other 11%. In 2007, when ethanol

John Pierce July 10 Testimony Exhibit 3
US Agriculture Yield Trends



Source: USDA (Yield History)

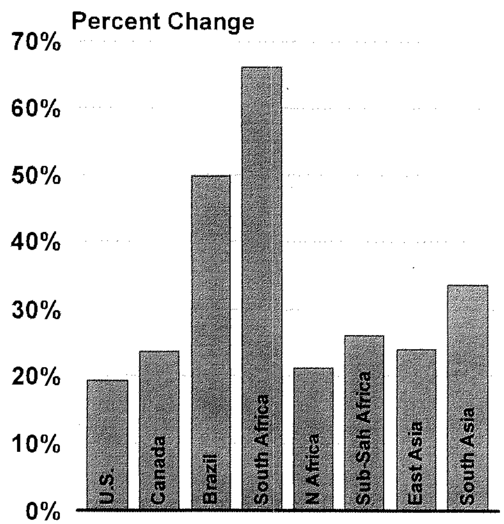
production consumed about a quarter of the US corn crop, the US had its largest corn export volumes ever, and we finished the year with unused corn stocks. The market has not been short on corn

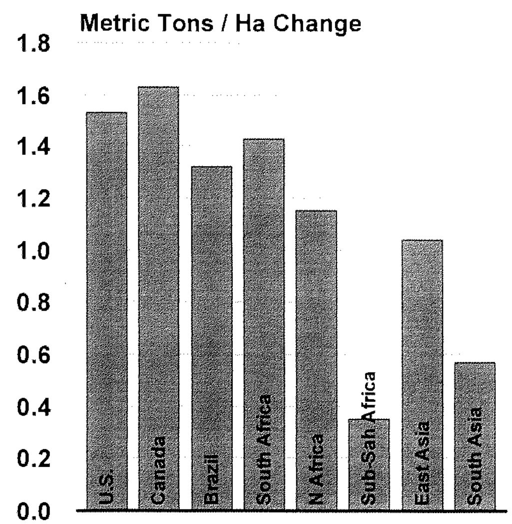
Rising global food prices are a real and important concern, particularly in the developing world where food can be a very significant portion of a family budget. Agriculture and associated advances in processing technologies can supply the solutions, providing adequate resources for food, feed, materials, and fuel far into a sustainable future – just as they have done for as far back as we care to look. Slowing US biofuels production is not the solution. Let's not take actions that will do nothing to solve food price inflation but will certainly harm the advancement of next generation biofuels. Let us instead continue to expand agricultural production from the world's existing farm acreage, a goal we are already addressing and which we can readily accomplish.

Thank you for the opportunity to speak with you today on this important topic, and I look forward to your questions.

John Pierce July 10 Testimony Exhibit 4

Corn Yield Change: 1997-2007
North America, Brazil, Africa and Asia



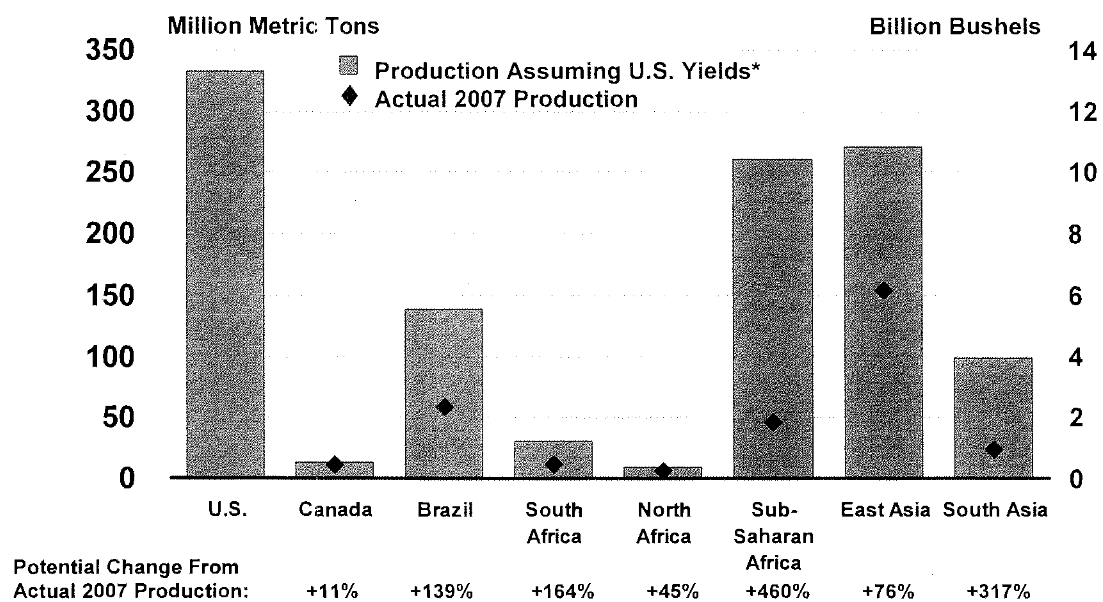


Source: USDA

DUPONT

John Pierce July 10 Testimony Exhibit 5

Corn Production 2007: Actual & Potential With U.S. Yields*



*Scenario assumes same area planted in each country but with the ability to achieve U.S. yields.

Response to Follow-Up Questions from Senator Barbara Boxer
Re Senate Environment and Public Works Committee Hearing
July 10, 2008
Provided by Dr. John Pierce, DuPont

Question # 1
Do you believe that with the current pace of technology development we are on track to hit the targets for advanced and cellulosic biofuels that were created by last year's Energy
Bill?

A: In our database of commercial and pre-commercial biofuels activities we have almost 200 firms working on next generation biofuels technologies. These firms are evaluating a whole variety of thermochemical and biochemical approaches for producing a range of renewable fuels utilizing a wide array of different biomass feedstocks. Like our joint venture DuPont Danisco Cellulosic Ethanol, several are intending to demonstrate their cellulosic biofuels production technology within the next year, and enter commercial scale production shortly thereafter.

In addition, the agriculture community is responding to rising global demand for agricultural commodities, driven by rising populations, improving diets and greater biofuels production, and are increasing agricultural production, which means more biofuels feedstocks. In addition to traditional crops, there is a renewed focus on biomass crops purposefully grown for high yields of cellulosic biomass for the production of biofuels, and these efforts will undoubtedly result in new opportunities for renewable biofuels production.

Significant investments continue in biorefinery infrastructure, and the auto companies continue to increase the number of flex fuel vehicles they produce.

So while the volume targets in the Renewable Fuel Standard are appropriately aggressive, we think the market is responding appropriately and that we are currently on track to meet the targets. In any event we think it is decidedly premature to consider changing the targets before the first generation of commercial scale cellulosic and other next generation biofuels plants begin production.

Question # 2
What kinds of policies would help expand the production of agricultural resources globally, for both food and fuel, while maximizing environmental protection and reducing greenhouse gas emissions?

A: Recently some have posited that we are facing a competition between the use of agricultural production for food or fuel. This ignores the long standing gains in agricultural yield and productivity we have experienced in North America and recently in parts of South America and Africa, and the opportunity to bring similar improvements to other areas of the world where significantly expanded production can be achieved. These greater agricultural

yields (production per acre) are fundamental to sustainable agriculture as they allow more production per unit of land, reducing pressures for land conversion to agricultural use. The attached graphics (*figures 1&2*) shows how improvements in yield have allowed the world to significantly increase total food production while land area used per unit of agricultural production has actually decreased over time. This reflects steadily rising yield, or production per acre, for major crop varieties. Increasing yield, which allows greater production from the currently cultivated acres, reduces pressures for converting additional land to agricultural purposes. In addition, developments in seeds for major crops increasingly reflect greater natural pest and disease resistance, drought tolerance and fertilizer use efficiency, furthering the trend of producing more food with fewer inputs. These trends are steadily improving agricultural sustainability.

These significant gains have occurred primarily in the developed world, where yield and productivity gains have grown year on year. We have not seen similar gains in the developing world, where food and energy needs are often most acute and yields are often a small fraction of those in the US. This suggests that there is significant potential to expand sustainable agricultural production. Brazil, after deciding to invest substantially in agriculture as a growth market, increased its corn yields by 50% in just ten years.. *Figure 3* shows current corn production for major growing regions in the world and *figure 4* demonstrates the kinds of production that could be achieved were yields similar to those in the US. This demonstrates that there is tremendous opportunity to produce more agricultural resources for food and fuel. Doing so would reduce global hunger and poverty, promote social and political stability and help reduce global petroleum demand.

Policies that would help advance agricultural productivity in the developing world include:

- Refocusing USAID on agricultural development. USAID's agricultural development budget peaked in 1992 and is now a third of that peak in real dollars. It should be a minimum of $600 million
- Ensuring that infrastructure investments by the Millenium Challenge Account are coordinated with agricultural development aims so that additional production can get to market.
- Bolster agricultural extension services in the developing world to help teach farmers how to get the best from seeds, fertilizers, irrigation and farming practices.
- Expanding agricultural research and development at the University level in developing countries so that work can be done on local crops and local agronomic conditions.
- Providing farmers access to credit so that they can finance the necessary purchases. Today, without credit, when input prices rise farmers actually plant and produce less at a time when the need is for more.

What policies would help address the issue of global land use changes, such as deforestation?

Tropical deforestation is a complex and significant challenge with serious ramifications for carbon emissions and habitat and species diversity loss. It has been going on for many decades, and its causes are manifold. They include population growth, the economic value of

forest resources, growing global trade in consumer goods, governance gaps and agricultural pressures, particular subsistence (rather than production) agriculture (see attached study).

Given this diversity of causes, many of which are economically driven, policies that make it as economically beneficial to preserve as to log forests will be most effective, coupled with improving local governance. We believe the creation of agricultural and forestry offset opportunities in greenhouse gas cap and trade legislation is an important element of creating the financial motivations for forest preservation.

We do not believe that biofuels policies can be an effective mechanism for reducing deforestation pressures. Biofuels.consume a very small fraction of global agricultural production, making biofuels a small part of just one potential driver of deforestation and an ineffective route for addressing the issue. In addition, farmers do not grow agricultural commodities for one end use such as biofuels, they grow for the full variety of end use markets. Developing agricultural policies for biofuels feedstock production would create significant problems for farmers as they could face different sets of criteria for the same crop for different end uses, impeding their ability to readily serve changing market demands.

<u>Question # 3</u>

Please describe efforts DuPont and others in the agriculture value chain are undertaking to help increase agricultural productivity while improving sustainability (e.g., use of water, fertilizer, and energy inputs), and your expectations for the future with respect to this issue.

Improving agricultural yield is fundamental to sustainability, as it allows the production of ever greater quantities from the same acreage. This relieves pressure for conversion of additional lands to agriculture. DuPont's seed company Pioneer Hi-Bred began in 1926 to advance yield growth through the broad introduction of hybrid varieties of corn. In recent years we have helped bring to market corn and soybean varieties that are naturally resistant to pests and disease, reducing the need for agri-chemical applications. Our product pipeline include varieties that are more drought resistant and less water intensive, as well as more efficient in their use of fertilizer, further reducing the inputs needed per unit of production. We are "stacking" these traits so that a single plant will exhibit multiple qualities that improve productivity while reducing the rate of inputs per unit of production.

In addition, we are bringing to market cellulosic ethanol technology that will produce biofuels from corn stover and switchgrass, enhancing the fuel production from the current agricultural acreage and allowing production from a feedstock that can be grown on marginal lands.

<u>Question # 4</u>

What kinds of policies would help speed the development of cellulosic and advanced biofuels?

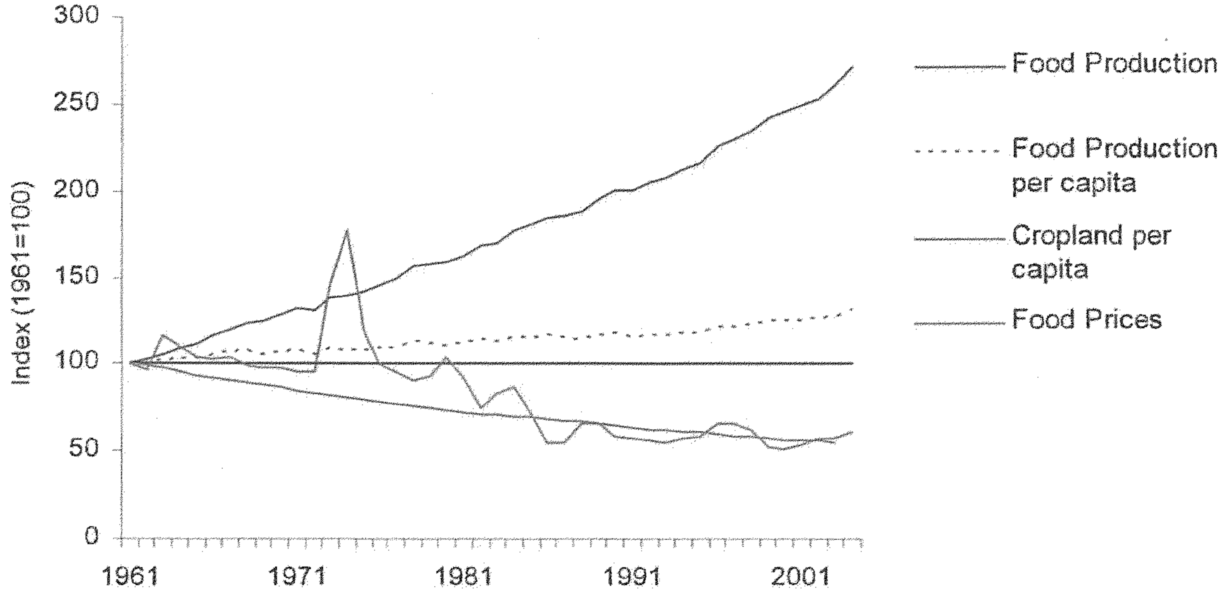
Next generation fuels are critical to sustainably displacing significant volumes of biofuels in transportation. Those include biofuels from cellulose and biofuels such as biobutanol that are fungible with the current fuel pool and therefore reduce needed infrastructure investments. These technologies are now getting close to commercialization, but

significant private investments remain to be made, and Congress should be cautious about any policy changes that would chill that investment and slow the demonstration and deployment of these new technologies.

One element of cellulosic biofuels technologies that requires greater elaboration, and is well suited to public investment, is the production, harvest, transportation and storage of cellulosic feedstocks. Significant uncertainties remain regarding the methods and cost of providing cellulosic feedstocks. This is one of the reasons why DuPont Danisco Cellulosic Ethanol recently announced a partnership with the University of Tennessee for the demonstration of ethanol production from corn stover and switchgrass. The University has developed an integrated switchgrass supply chain with local farmers that will allow us to refine the economics of cellulosic feedstocks. Expanding and intensifying federal R&D investments on cellulosic feedstocks production, methods for harvesting, transporting, and storing such feedstocks, and creating grower incentives to encourage their production would be appropriate. Expanding agricultural research and development at the University level to assess the utility of new biomass crops such as switchgrass and miscanthus to deliver very high yields of biomass on marginal lands that do not compete directly with croplands would also help to speed the commercial development of these important feedstocks.

In addition, ensuring adequate funding of grant programs and providing accelerated depreciation to spur investments in the first generation of advanced biofuels facilities will help speed their deployment.

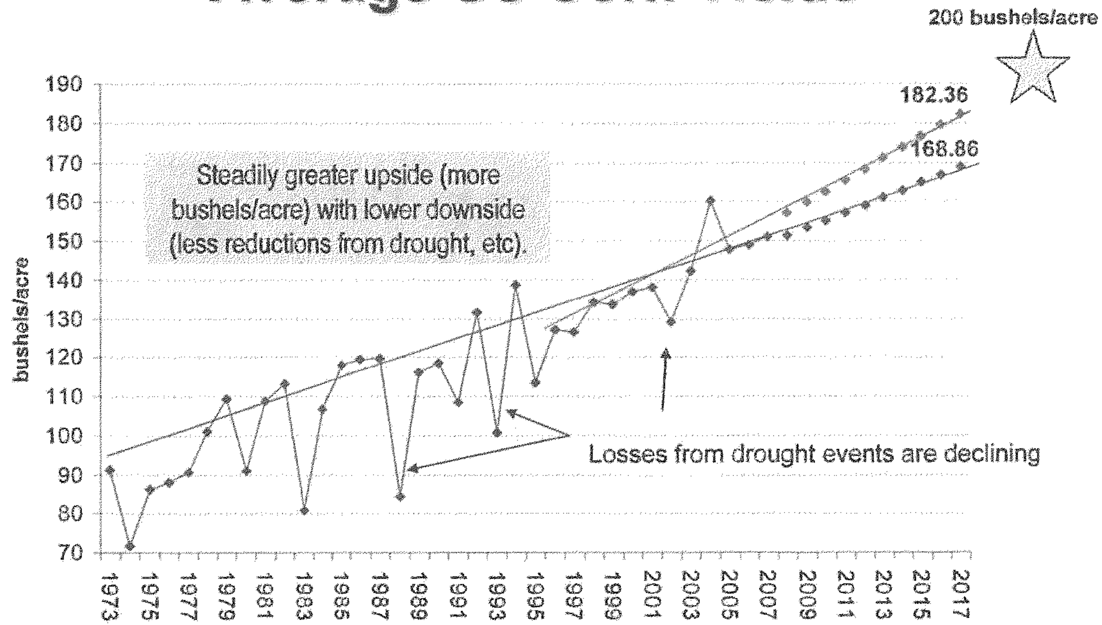
Global Agricultural Productivity Means More Food and Lower Prices With Less Cropland



Source data from The World Bank, as reported in The World Development Report 2008 by CGIAR

During the last 45 years, global food production has increased dramatically.

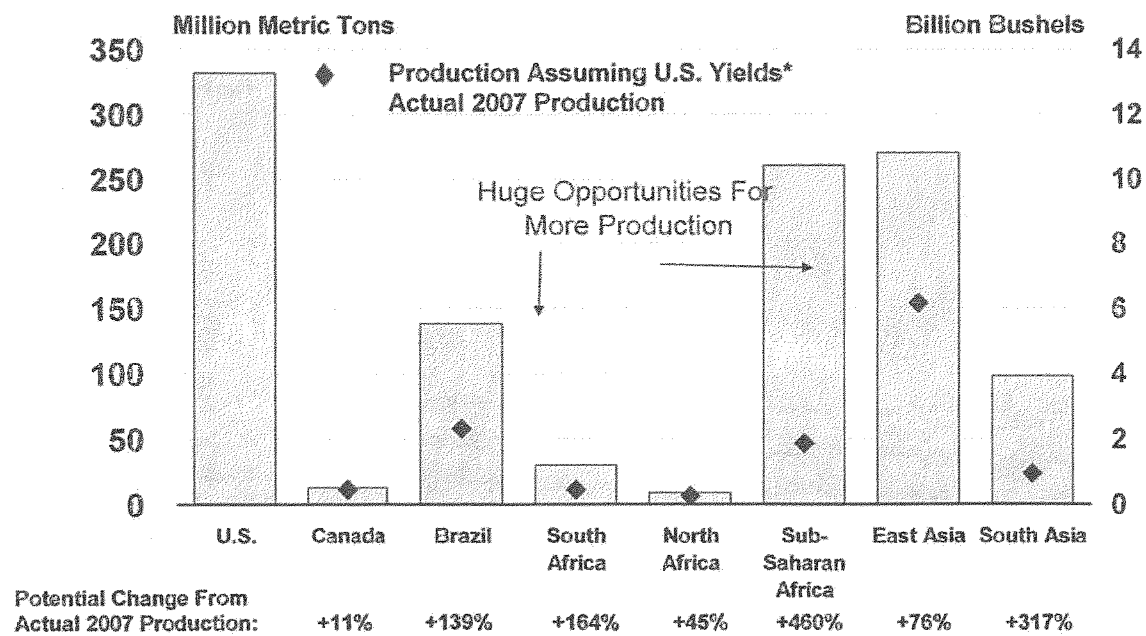
Agriculture Yield Growth Example
Average US Corn Yields



Source: USDA (Yield History)

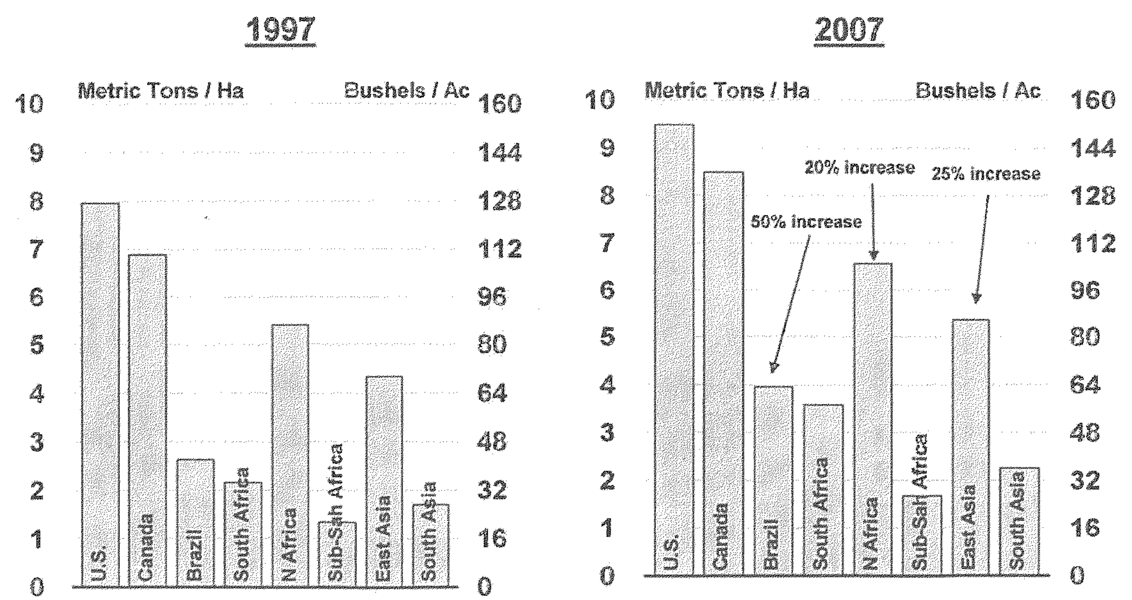
Yields (bushels/acre) have consistently improved. In the next ten years it will increase even faster.

How Much Could We Produce With US Yields and No Extra Acres?



There are significant opportunities for expansions in agricultural productivity in the developing world.

Corn Yield Growth – 10 Year Snapshot



Some regions of the world have seen significant productivity gains in a short time.

Source: USDA

Senator CARPER. Mr. Pierce, thank you so much.
Scott Faber, you are recognized for your testimony. Welcome.

STATEMENT OF SCOTT FABER, VICE PRESIDENT FOR FEDERAL AFFAIRS, GROCERY MANUFACTURERS ASSOCIATION/FOOD PRODUCTS ASSOCIATION

Mr. FABER. Thank you, Mr. Chairman. Thank you for the opportunity to testify today.

I think you are well aware that food prices are now rising twice as fast as inflation by about 5 percent last year, and are expected to rise by about 6 percent this year. This is obviously a serious challenge for poor Americans. The poorest 20 percent of Americans spent about one-third of their after-tax income on food. It is a life-or-death challenge for many in the developing world who spend up to 70 percent of their income on food.

Let me just be very clear. There are many factors contributing to the rising price of commodities and the rising price of food, including poor weather in some parts of the world, export restrictions, rising demand for food globally, the weak dollar, higher energy prices, and changes in our commodities markets. But the most significant new factor and the only factor affecting food and feed prices that is under the control of the Congress is the significant and sudden increase in food-to-fuel production.

This year, corn ethanol production will divert roughly one-third of our corn crop, up from actually 24 percent in 2007. This rapid expansion of corn ethanol production in the last few years is the dominant factor in a 200 percent increase in corn prices since the 2005 crop year. Experts, including former USDA Chief Economist Keith Collins, estimate that ethanol production is responsible for as much as 60 percent of the increase in corn prices between the 2006 and 2008 crop years.

Just in the last few days, a World Bank paper was released, and I would just like to quote from it really quickly. "The World Bank's index of food prices increased 140 percent from January 2002 to February 2008. This increase was caused by a confluence of factors, but the most important was the large increase in biofuels production in the U.S. and E.U. Without the increase in biofuels, global wheat and maize stocks would not have declined appreciably and price increases due to other factors would have been moderate."

There is another quote that I would just like to quickly read to you because I think it is really fascinating, again, bolded in the World Bank Study, increased biofuel production has increased the demand for food crops and been the major increase in food prices. This expansion not only impacts corn, but also creates a competition for land that increases the cost of other commodities including soybeans.

I am sorry to say that this problem is not going to get better. It is going to get significantly worse. As food-to-fuel production increases in response to Federal mandates and subsidies and more corn and more vegetable oil are diverted to our fuel supplies, food prices will continue to increase over the next few years. About 40 percent of our corn crop and about 30 percent of our vegetable oils will be diverted from food and feed to fuel. As a result, independent experts predict that annual food inflation will average about 9 per-

cent between 2008 and 2012 as the impact of commodity prices are slowly reflected in retail food prices.

In particular, the price of milk, meat and eggs, basic staples consumed in every home in America will rise dramatically in response to higher feed prices and reductions in herd size. For every corn farmer who is enjoying record profits, there are many more livestock farmers facing record losses or even bankruptcy. In Delaware, for example, the cost of producing a chicken has increased 45 percent just in the last year alone.

One problem with these mandates, Mr. Chairman, is that ethanol takes the same share of the corn crop regardless of supply and this year serves as a perfect example. Although the wet spring and floods have reduced expected yields, ethanol mandates require that ethanol will still consume about four billion bushels of corn, forcing food and feed to compete for the balance, driving up the price of food.

That is why, Mr. Chairman, a broad coalition of environmental, labor, industry, farm and anti-hunger interests believe that Congress should revisit and restructure our food-to-fuel policies to ensure that we are not pitting our energy needs against the needs of the hungry of the environment.

The first step is to freeze our food-to-fuel mandates. Freezing these mandates would immediately address runaway food inflation. What is more, freezing the mandates would give EPA and other experts the necessary time to carefully assess the environmental impacts of food-to-fuel production.

The second step, as Senator Boxer had mentioned, is reevaluating our tax credits and tariffs to accelerate the development of second-generation fuels.

So let me just conclude by reiterating that many factors are contributing to high food prices, including dramatic increases in global demand and the rising cost of energy. Food-to-fuel production is clearly not the only culprit, but it is precisely because of these other factors that we should revisit policies that artificially and needlessly increase the price of food.

Thank you.

[The prepared statement of Mr. Faber follows:]

Testimony of Scott Faber
Vice President for Federal Affairs

On Behalf of the
Grocery Manufacturers Association

Before the Senate Committee on Environment and Public Works

On

"Environmental Protection Agency Oversight: Implementing the Renewable Fuel Standard"

July 10, 2008

Thank you for the opportunity to testify on the implementation of the Renewable Fuel Standard by the Environmental Protection Agency.

Food and beverage companies strongly support the development of sustainable bio-fuels that contribute to America's energy security and that do not pit the nation's energy needs against the needs of the hungry or the environment. We are working with a broad coalition of industry, farm, labor, anti-hunger, consumer, minority, and environmental organizations to urge Congress to revisit our food-to-fuel policies in light of runaway food inflation and new questions and concerns regarding the environmental costs of food-to-fuel production.

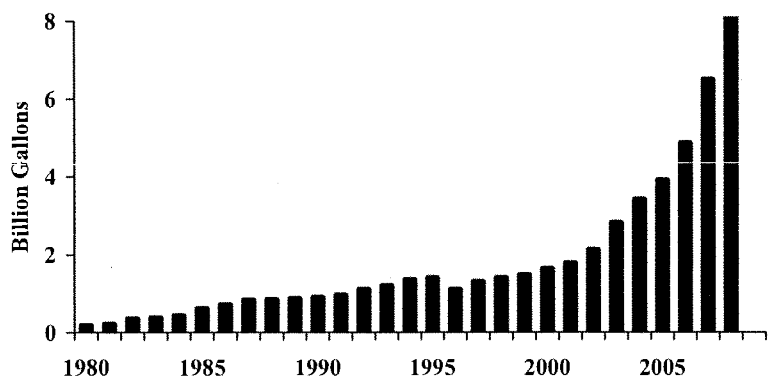
While there are many factors contributing to the sharp increase in US and global food prices – including poor weather, export restrictions, rising demand for food globally, the weak dollar, higher energy prices, and changes in commodities markets -- the most significant new factor and the *only* factor affecting food and feed prices that is *under the control of the Congress,* is the sudden and significant increase in food-to-fuel production. I have attached analyses by the World Bank,[1] IMF,[2] UN FAO,[3] CRS,[4] USDA-ERS,[5] IFPRI,[6] Oxfam[7] and by former USDA Chief Economist Keith Collins[8] which document the combination of factors contributing to US and global food prices and the significant role of food-to-fuel production. In general, the rapid expansion of corn ethanol and bio-diesel production has increased demand for corn and vegetable oil, increased the price of products which use corn and vegetable oil as ingredients, and increased the price of other crops that compete with corn and soybeans for land.

Commodity prices are rising at dramatic rates. Since the 2005 crop year, farm-level corn prices have increased more than 200 percent, and farm-level soybean prices have increased more than 135 percent.[9] Although there are many factors contributing to increases in commodity prices, the recent surge in ethanol production is one of the most significant factors. Between 2006 and 2008, US corn ethanol production accounted for 75 percent of the growth in global demand for coarse grain and 50 percent of the growth in demand for all grains.[10] Collins estimates that corn ethanol could be responsible for as much as 60 percent of the expected increase in corn prices between the 2006 and 2008

[1] "Rising Food Prices: Policy Options and World Bank Response," World Bank, April 2008.
[2] International Monetary Fund, "World Economic Outlook, Globalization and Inequality," October 2007.
[3] UN FAO, Soaring Food Prices: Facts, Perspectives, Impacts and Required Actions, June 2008.
[4] CRS, High Agricultural Prices: What are the Issues?, May 6, 2008.
[5] USDA, ERS, Global Agricultural Supply and Demand: Factors Contributing to The Recent Increase in Food Commodity Prices, May 2008.
[6] Von Braun, Joachim. "Biofuels, International Food Prices, and the Poor." International Food Policy Research Institute (IFPRI). June 12, 2008.
[7] "Another Inconvenient Truth: How biofuel policies are deepening poverty and accelerating climate change," Oxfam International, June 26, 2008.
[8] Collins, Keith. "The Role of Biofuels and Other Factors in Increasing Farm and Food Prices," prepared for Kraft Global Food, June 2008. (Hereinafter "Collins")
[9] USDA, World Agricultural Supply and Demand Estimates, June 2008.
[10] Id.

crop years.[11] As Collins notes, "the increase in corn demand due to ethanol is rising faster than growth in corn yields per acre. So long as that situation continues, corn will have to attract acreage from other crops to meet its expanding demand. This shift will mean higher prices for all crops that compete, directly or indirectly, for acreage with corn."[12]

U.S. Ethanol Production 1980-2008



Food prices are now rising at twice the overall rate of inflation. Because the price of basic commodities has dramatically increased, domestic food prices rose by 4.9 percent during 2007 – twice as fast as inflation and the largest increase in 17 years. Food prices for the previous three months have increased at a seasonally adjusted annualized rate of 6.3 percent, and studies predict that annual food price inflation will average 9 percent between 2008 and 2012 as the impact of rising commodity prices are slowly reflected in retail prices.[13] Although there are many factors contributing to food price inflation, the rising cost of commodities – driven in large measure by growing food-to-

---

[11] Collins. Collins finds that ethanol could account for 60 percent of the expected increase in corn prices between 2006/07 and 2008/09 when market demand and supply are inelastic with respect to price – that is, a period when stocks are very low, feed use is slow to respond, export demand is strong due to foreign agricultural policies, and acreage is very constrained.

[12] Id.

[13] Advanced Economic Solutions, Rising Commodity Prices and their Impact on US Food Inflation, June 2008.

fuel production – is expected to cause food prices to rise 23 to 35 percent faster than historical increases in food prices.[14] In particular, the price of animal products will continue to rise dramatically in response to higher feed prices.[15] Between May 2005 and May 2008, food-to-fuel production contributed to increases in the costs of basic staples like eggs (62.8 percent), whole milk (17.2 percent), and whole chicken (13.5 percent).[16]

Rising food prices fall most heavily on the poor. These price increases fall most heavily on the poorest 20 percent of Americans who spend roughly one-third of their after-tax income on food and on the global poor who spend as much as 70 percent of their income on food. Rising commodity prices have pushed global food prices up 83 percent over the last three years[17] - and by 57 percent in the last year – pushing 50 million people into poverty in 2007 alone, according to the UN FAO. In combination, rising prices and declining commodity stocks have forced global food aid programs to ration food, and have contributed to food riots and protests in more than 30 countries. Rising food inflation in the developing world is not merely a food security issue, but is a national security issue. The World Bank warns that 33 nations are at risk of social unrest because of the rising price of food.[18]

Rising food prices pose significant budgetary challenges. Although potential outlays are difficult to estimate, government spending will increase significantly as food prices rise. Many federal programs linked entirely or in part to the Consumer Price Index (CPI), including anti-hunger assistance programs and child nutrition programs. The CPI is often used to adjust federal payments, determine program eligibility, and to provide

---

[14] Collins. If food-to-fuel production accounts for 60 percent of the expected increased in feed grain and oilseed product costs between 2006/07 and 2008/09, and these increases are passed on to retail consumers, these increases would increase baseline US expenditures on food by 1.8 percent over a 2-3 year period. This increase is significant in light of the fact that long-term annual average food inflation is about 2.5 percent. Thus, the increase in retail food prices due to biofuels is estimated to be 23-35 percent above the normal increase in food prices that would occur over 2-3 years.

[15] Elam, Thomas, "Biofuels Support Policy Costs to the U.S. Economy," *FarmEcon LLC*, March 24, 2008 (Hereinafter "Elam")

[16] Consumer Price Index – Average Price Data (retrieved for most requested statistics), Bureau of Labor Statistics, available at http://www.bls.gov/data/home.htm.

[17] Bob Davis and Douglas Belkin, Food Inflation, Riots Spark Worries for World Leaders," Wall Street Journal, April 14, 2008. A1.

[18] "The World Food Crisis," *New York Times*, Editorial, April 10, 2008.

cost-of-living adjustments to millions of workers. Overall, the CPI affects the income of about 80 million people, including 51.6 million Social Security beneficiaries, 21.3 million food stamp recipients, about 4.6 million military and civil service retirees or survivors, and more than 2 million workers impacted by collective bargaining agreements. In particular, changes in the CPI affect the cost of school lunches for 28.4 million children.[19] Rising food prices will impact federal outlays in three ways: by automatically increasing federal expenditures on programs linked all or in part to the CPI; by reducing the number of households and students that can be served by programs, such as the national school lunch program; and by forcing appropriators to reduce discretionary spending for other programs to address shortfalls.

Rising feed prices are causing severe economic harm for livestock producers. Although some crop farmers have benefited from high commodity prices, many more livestock producers are facing unprecedented losses. The higher costs of corn and soybean meal[20] have translated directly into higher feed costs for all livestock producers.[21] Feed costs climbed by over $15 billion between 2005 and 2008 due to higher prices for corn and other grains.[22] Moreover, feed costs will continue to remain well above historic levels through 2017 as food-to-fuel mandates are fully implemented.[23] In 2008-09, for example, food-to-fuel mandates are estimated to increase the cost of

---

[19] BLS, at http://www.bls.gov/dolfaq/bls_ques1.htm

[20] Elevated corn prices in response to increasing biofuels demand also contribute to the historically high prices of soybeans because soybean cropland must compete with corn for cropland. Indeed, the price of soybeans has risen even though stockpiles of soybean oil are also at near record levels. USDA reported that the price of soybeans per bushel was $6.43 in 2006/2007, but shot up to $9.00 in 2007/2008. USDA Projections, at 35 (Table 7). Prices of soybeans and soybean-derived products (*e.g.*, soybean meal and soybean oil) are projected to increase and remain well over 2006/2007 levels over the long-term due to continued increased demand for biofuels, with even greater price increases likely as a result of the strengthened biofuels mandates enacted by Congress in 2007. USDA Projection, at 23 and 41 (Table 13).

[21] Food and Agricultural Policy Research Institute, *2008 U.S. Baseline Briefing Book* (March 2008) (hereinafter "FAPRI Report"), at 3, available at http://www.fapri.missouri.edu/outreach/publications/2008/FAPRI_MU_Report_03_08.pdf.

[22] FAPRI Report, at 60.

[23] FAPRI Report, at 60. *See also* USDA Projections, at 4, 49 and 60. In fact, USDA acknowledges that its own projections likely underestimate the anticipated increases in costs of animal feed because, although they account for the biofuels mandates created by the Energy Policy Act of 2005, they do not account for the strengthening of those mandates by Congress in December 2007, which has added to the unprecedented demand for corn. USDA Projections, at 23.

livestock production by as much as $17.7 billion.[24] Ultimately, the increased cost of feed will be passed on to consumers in the form of higher food prices. As feed costs rise, meat and poultry production will decline and many livestock farmers will be forced out of business. Producers at greatest risk of failure are poultry, dairy, hog and beef producers who do not produce their own feed grains.[25]

Historically low commodity stocks pose severe economic consequences. Global stocks of several major commodities are at or near historic lows – particularly when measured as a share of total usage.[26] For example, global end-of-year stocks for coarse grains and wheat are projected to drop by mid-2008 to the lowest levels since 1977, while ending stocks of total grains will fall to the lowest levels since 1981. In particular, a rapid increase in the production of ethanol combined with a decline in corn plantings will likely result in the second lowest level of corn stocks relative to consumption in 49 years. Increasing the use of corn for ethanol by 33 percent in 2008 will contribute to a 40 percent reduction in the corn inventory.[27] For most commodities, annual prices tend to have a strong negative correlation with the ending stocks-to-use ratio.[28] Reduced yields in 2008 caused by a wet spring and flooding combined with surging ethanol production and low commodity stocks are already resulting in dramatic increases in crop prices.

Food prices will continue to rise as more and more corn and soybean oil are diverted to our fuel supplies. Unless the Congress and the Administration act this year to revise federal food-to-fuel mandates, commodity prices will continue to rise as more and more food is diverted to our fuel supplies. In 2008, roughly one-third of U.S. corn supplies will be diverted to produce fuel. In the coming years, 40 percent or more of the U.S. corn crop and as much as 30 percent of U.S. vegetable oils will be diverted from our

---

[24] Elam at 28,

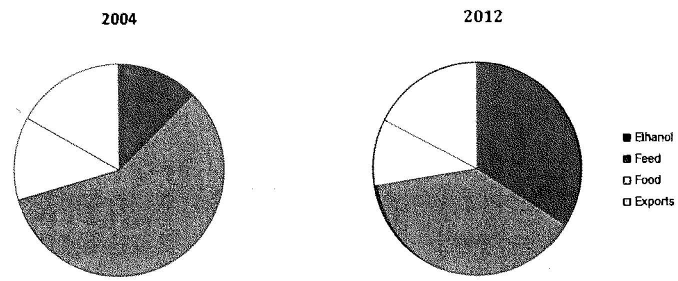
[25] Elam at 28. *See also* FAPRI Report, at 42 (suggesting that beef producers will experience financially difficult times in the next few years as they face high and rising input costs); *see also* FAPRI Report, at 50 (stating that higher feed costs have contributed to increases in the costs of producing milk).

[26] CRS, High Agricultural Prices: What are the Issues?, May 6, 2008.

[27] USDA-ERS, *Feed Outlook*, May 13, 2008.

[28] CRS, High Agricultural Prices: What are the Issues?, May 6, 2008.

food supplies to our fuel supplies. Because commodity prices will remain high in response to these mandates, food prices are expected to increase by 9 percent annually between 2008 and 2012.[29]



Because ethanol displaces a small fraction of the US gasoline supply and a tiny fraction of global crude supplies, food-to-fuel mandates currently have no impact on gasoline prices. Overall, ethanol production in 2007 displaced less than 4 percent of the nation's gasoline supplies in 2007, when relative energy values are considered. Consequently, freezing the mandate at the levels blended in 2007 – that is, reducing the mandate from 9 and 10.5 billion gallons to levels produced in 2007 – would not increase gasoline prices. In fact, failure to revise food-to-fuel mandates could marginally increase gasoline prices under some scenarios. Eventually, rising demand for corn to produce ethanol will increase the cost of producing ethanol and result in higher prices at the pump.[30]

Recommendations

We urge the Committee to revisit and restructure our food-to-fuel policies to accelerate the development of fuels that do not pit our energy needs against the needs of the hungry and the environment. In particular:

[29] Advanced Economic Solutions, The Impact of Rising Commodity Prices on Food Inflation, June 2008
[30] Elam, Thomas, "Biofuels Support Policy Costs to the U.S. Economy," *FarmEcon LLC*, March 24, 2008.

Congress should freeze food-to-fuel mandates. In light of crop reports and perilously low commodity stocks, Congress and the Administration should act now to reduce the federal food-to-fuel mandate for 2008 and 2009 to production levels for 2007 and should revisit and revise food-to-fuel mandates, subsidies and tariffs to reflect changing economic conditions and new questions regarding the economic and environmental costs of fuels made from food crops. Freezing the mandate would result in immediate reductions in the price of corn. A recent study by FAPRI estimated that implementation of the RFS increased corn prices by 19 percent.[31] A separate study by IFPRI concluded that a freeze of biofuel production at 2007 levels would reduce global corn prices.[32] What's more, these studies do not take into account significant declines in yields in 2008, which are amplifying the impact of increased ethanol production on corn prices.

Congress should carefully evaluate the environmental impacts of food-to-fuel policies. Diverting food crops to our fuel supplies has artificially increased the price of commodities, accelerating the conversion of pasture and forest lands to crop production at home and around the globe. Current and expected conversion of pasture and forest lands will release carbon into the atmosphere and reduce the availability of carbon "sinks" that help sequester carbon. In addition, increased production of row crops has increased water pollution, compounded water shortages, and contributed to the loss of habitat for wildlife. In particular, increased fertilizer use associated with expanded crop production has increased the amount of nitrogen and phosphorous being washed into rivers and bays, including the Chesapeake Bay and the Gulf of Mexico, and will increase ground-level ozone in some regions. Increasing the use of distiller's grain – a byproduct of ethanol production that is fed to animals but has less nutritional value than feed - increases the amount of phosphorous reaching waterways.

In particular, Congress should freeze food-to-fuel mandates to carefully assess the life-cycle emissions caused by bio-fuels. Reducing emissions from

[31] FAPRI-MU, The Energy Independence and Security Act of 2007: Preliminary Evaluation of Selected Provisions, January 2008.
[32] Rosegrant, Biofuels and Grain Prices: Impacts and Policy Responses, May 5, 2008.

transportation fuels involves the consideration of numerous factors, including a common set of accounting principles and the ability to verify emissions reductions. Because the development of these accounting principles and verification methods are still underway, Congress should freeze our food-to-fuel mandates to ensure that EPA and other policymakers and experts have ample time and resources to adequately assess and verify potential emission reductions from bio-fuels. Significant questions regarding the life-cycle environmental effects of biofuels, including the significant effects of land cultivation, remain unresolved.

Congress should accelerate the development of advanced and cellulosic bio-fuels. Congress should revisit and reform food-to-fuel mandate schedules, subsidies and tariffs to gradually reduce our reliance on food as an energy feedstock. In particular, Congress should accelerate the development of cellulosic and advanced bio-fuels derived from fuel feedstocks that do not increase food or fiber prices and that improve the environment. Many of these fuels can be produced from feedstocks that do not compete with food crops, provide significant reductions in emissions when compared to gasoline, can be distributed through existing infrastructure, and could displace a significant share of our gasoline supplies. To accelerate the development of such fuels, Congress should eliminate the tariff on imported bio-fuels, should consider reforms to federal tax credits to reward the production of sustainable bio-fuels, and should adopt a technology neutral standard for life-cycle reductions in emissions that applies to all fuels, including all corn ethanol and bio-diesel produced regardless of the date of plant construction. Setting a lower bar for conventional bio-fuels – by setting lower emissions requirements or by exempting production from emissions requirements altogether – creates a competitive disadvantage for advanced and cellulosic biofuels that should be addressed.

Congress should accelerate global agricultural development. Congress should take steps to expand hunger assistance programs to help address the impact of food-to-fuel policies on food inflation at home and abroad. What's more, Congress should also provide new funds to increase the productivity and sustainability of agricultural lands in the developing world. Between 2003 and 2007, global usage of coarse grains like corn

grew by 3.4 percent. At the same time, annual growth in agricultural productivity is slowing. Between 1970 and 1990, production rose by an average of 2.2 percent per year. Since 1990, the growth rate has declined to about 1.3 percent. Projections for US and world agriculture see the rate declining to 1.2 percent per year between 2009 and 2017.[33]

In conclusion, we urge Congress to revisit the food-to-fuel policies in light of dramatic increases in food prices and new questions about the environmental costs of fuels derived from food crops. Although there are many factors contributing to record food inflation – including increasing global demand, export restrictions, poor weather, commodity speculation, and higher energy prices – a significant new factor and the *only* factor affecting food and feed prices that is *under the control of Congress* is food-to-fuel mandates and subsidies diverting food into our fuel supplies.

[33] USDA, ERS, Global Agricultural Supply and Demand: Factors Contributing to The Recent Increase in Food Commodity Prices, May 2008.

Responses by Scott Faber to Additional Questions from Senator Boxer

Question 1. What proportion of retail food costs is attributable to purchases of agricultural commodities such as com, wheat and soybeans?

Response. The portion of retail food costs that can be attributed to the cost of food ingredients varies greatly from product to product. For example, the retail cost of meat and animal products such as milk and eggs is much more sensitive to changes in the price of commodities than packaged goods. Overall, the cost of food ingredients and labor are the most significant factors in retail prices – far more significant than transportation and energy costs. A recent CRS report documents this conclusion and I have attached this report for your review.

Question 2. What role has rising energy costs played in the increases in food prices over the last few years? Please compare the relative effect of rising energy prices to rising agricultural commodity prices on retail prices.

Response. Rising energy cost impact all manufacturers and food manufacturers are no exception. As mentioned above, the challenges presented by rising energy and commodity costs vary from product to product, but food manufacturers have generally found rising commodity costs to be a more significant factor in the rising cost of food production.

Question 3. Do you agree that we should be moving as quickly as possible towards greater reliance on cellulosic and advanced biofuels?

What additional steps can you recommend to increase development and use of cellulosic and advanced biofuels?

Response. The food and beverage industry strongly supports the transition to biofuels derived from feedstock's that do not pit our energy needs against the needs of the hungry and the environment. In particular, we strongly support efforts by the Department of Energy and the Department of Agriculture to provide grants and loan guarantees for the development of promising new cellulosic and advanced biofuels. To accelerate the development of these biofuels, GMA strongly supports additional federal resources for grants and loan guarantees as well as need resources for research and development. In addition, GMA urges Congress to eliminate the tariff on imported biofuels and urges Congress to restructure tax credits to reward the development of cellulosic and advanced biofuels.

Question 4. How should a Low Carbon Fuel Standard be structured to encourage the development of advanced biofuels?

Response. While GMA has not adopted a formal position on a Low Carbon Fuel Standard, a well-designed LCFS could accelerate the development of advanced and cellulosic biofuels and gradually reduce our dependence on food crops to produce fuel. By contrast, a poorly designed LCFS could increase demand for fuels derived from food crops and increase the cost of food ingredients. We are currently developing principles for an LCFS and look forward to sharing our views with the Committee.

Senator CARPER. Thank you for that testimony.

Mr. Greene, you are our cleanup hitter here. Welcome.

STATEMENT OF NATHANAEL GREENE, DIRECTOR OF RENEWABLE ENERGY POLICY, AIR, AND ENERGY DEPARTMENT, NATURAL RESOURCES DEFENSE COUNCIL

Mr. GREENE. I will try and do my best.

Mr. Chairman, members of the Committee, thank you for this chance to share my views regarding biofuels and renewable fuels standards. My name is Nathanael Greene. I am the Director of Renewable Energy Policy for the Natural Resources Defense Council.

At NRDC, we believe that biofuels produced following environmental safeguards, produced and processed efficiently, and used in efficient vehicles, can reduce our dependence on oil, reduce emissions of global warming pollution, contribute significantly to a vibrant farm economy, and avoid food price impacts. However, pursued without adequate safeguards and standards, large-scale biofuels production carries grave risks to our lands, forests, water, wildlife, public health, and climate.

As of late, this potential for biofuels to be destructive has captured the headlines. Without a doubt, concerns about food availability and global warming pollution require proactive measures. Both concerns should be addressed head-on through agricultural trade and food aid policies, and by adopting an economy-wide cap-and-trade policy for greenhouse gas emissions.

They should also be addressed proactively through our biofuels policy. The most important step that Congress must take at this point is to make sure that the EPA aggressively and effectively implements the safeguards in the renewable fuels standard.

The latest research confirms Congress's foresight in crafting the RFS to do the following three things. First, set minimum life-cycle greenhouse gas emissions standards for all biofuels from new facilities with the vast majority required to come from renewable cellulosic biomass with life-cycle emissions of at least 60 percent less than gasoline.

Second, define life-cycle emissions to include all of the emissions, including specifically the direct and indirect emissions from land use change. Accounting for emissions from land use change is the most important step to producing low-carbon biofuels that take biofuels out of the food price equation. It is by increasing the competition for arable land that biofuels face the greatest risk of increasing global warming pollution and disrupting food supplies.

Third, encouraging the production of plentiful feedstocks, including woody biomass, while ensuring the mandate does not drive the destruction of old-growth forests, native grasslands, imperiled ecosystems, or the degradation of our Federal forests.

The effectiveness of the RFS depends entirely on EPA's implementation of these critical provisions. Congress should make sure EPA is fully funded and monitor EPA's progress closely to ensure that science, rather than politics, drives the resulting regulations, so hearings like this are really critical.

The second proactive measure that Congress should take at this point is to replace the various existing biofuels tax credits and import tariffs with a single technology-neutral performance-based

credit. The existing biofuels tax credits and import tariffs are blunt, volume-based policies that try to pick winners solely based on feedstocks. In doing so, these policies provide equal incentives for biofuels that cause negative environmental impacts and food displacement as to biofuels that use the most beneficial practices and technologies and have no food impact on food supplies.

It is time to use these tax dollars in a better way. I recommend that we use the performance-based tax credits and import tariffs to encourage water efficiency, reduce water pollution, better soil management, enhanced wildlife management, and avoid food price disruption. With the RFS mandate in place, we should require better environmental performance for our money.

New crops and conversion technologies are developing rapidly that will make it easier to produce lots of biofuels with a smaller environmental footprint, without impacts on food prices. But technologies are not a guarantee of environmental performance. Just because we can do it right, doesn't mean that we will. We need to shift our tax policy so that they pay for performance and defend the environmental safeguards in the RFS to guide the market so that innovation and competition will drive biofuels to provide the greatest benefits.

Thank you again for this opportunity.

[The prepared statement of Mr. Greene follows:]

NRDC
THE EARTH'S BEST DEFENSE

NATURAL RESOURCES DEFENSE COUNCIL

Statement of

Nathanael Greene

Director of Renewable Energy Policy

Natural Resources Defense Council

Before the

Committee on Environment and Public Works

Subcommittee on Clean Air and Nuclear Safety

United States Senate

July 10, 2008

Table of Contents

Summary

- Biomass feedstocks produced with environmental safeguards, processed efficiently and used in efficient vehicles can reduce our dependence on oil for transportation, reduce emissions of heat-trapping carbon dioxide, contribute significantly to a vibrant farm economy, and avoid impacting food prices.
- Pursued without adequate guidelines, large scale biofuels production carries grave risk to our lands, forests, water, wildlife, public health and climate.
- The current ethanol excise tax lacks any food security or environmental safeguards. Congress should replace the current tax credit, the ethanol import tariff, and the biodiesel blending tax credit with technology-neutral, performance-based incentives that reward the production of biofuels that avoid food disruptions, increase water efficiency, reduce water pollution, improve soil management, and enhance wildlife management.
- The Renewable Fuel Standard contained in Energy Independence and Security Act of 2007 contributed important advances to our energy and climate policy that can help mitigate global warming, reduce the environmental impacts of biofuels, and start to take biofuels out of the food price equation. The latest research confirms Congress' foresight in establishing provisions to:
    - Require conventional biofuels from all new facilities to achieve at least a 20 percent reduction in lifecycle greenhouse gas emissions compared to conventional gasoline and advanced biofuels to achieve at least a 50 percent reduction.
    - Define lifecycle greenhouse gas emissions to include the full cultivation, production, and combustion cycle of fuels and the emissions from direct and indirect land use change caused by this cycle. This critical step helps ensure biofuels produce real climate benefits and provides a direct disincentive to displacing food.
    - Encourage production of plentiful biofuels feedstocks—including woody-biomass—while ensuring the RFS mandate does not result in the loss of old-growth forest, native grasslands, "critically imperiled", "imperiled", "vulnerable" ecosystems pursuant to a State Natural Heritage Program, the degradation of our federal forests[1], or conversion of natural forests on non-federal lands.
    - Require the vast majority of new biofuels required under the law to be advanced biofuels derived from renewable cellulosic biomass with a 60 percent lifecycle greenhouse gas emissions reduction.

---

[1] Biomass obtained from the immediate vicinity of buildings and other areas regularly occupied by people, or of public infrastructure, at risk from wildfire is excepted from these restrictions, on both federal and non-federal lands.

- Establish a no-backsliding requirement to protect air quality by directing EPA to adopt regulations that "mitigate, to the greatest extent achievable ... any adverse impacts on air quality."[2]

- Congress should reject current efforts—like H.R. 5236 and S. 2558—to revoke, repeal, or dilute the renewable biomass protections, as well as any efforts to repeal the GHG standards. These provisions are not only critical to keeping biofuels production from producing negative impacts today, but they also represent the foundation for any successful biofuels policy going forward. New crops and conversion technologies are developing rapidly that will make it easier to produce lots of biofuels with a smaller environmental footprint and without impacts on food prices, but the technologies are not a guarantee of good environmental performance. We need to maintain the environmental safeguards and performance standards in the RFS and build on them, guiding the market so that innovation and competition will drive biofuels to provide the greatest benefits.
- The RFS also includes important requirements for studies of various aspects of current and future biofuels. Seemingly every day now, we learn of new technologies that promise to improve the performance of biofuels and of new negative impacts that biofuels can have if pursued carelessly. These studies are critical to ensure that we identify unintended consequences of our policies as soon as possible and get the greatest good from our policies.
- Congress should make sure EPA is fully funded to aggressively and effectively implement these critical safeguards and should monitor their progress closely to ensure that science rather than politics drives the resulting regulations. The effectiveness of EPA's implementation of the RFS will entirely determine the law's success.
- Congress should build on the foundation of the RFS by:
  - Adopting a low-carbon fuel standard that requires progressive reductions in the average greenhouse gas emissions per gallon of all transportation fuels sold, as California and Massachusetts are planning to do.
  - Passing comprehensive climate legislation built around a comprehensive mandatory cap on global warming pollution and an emission allowance trading system, such as that contained in the Climate Security Act reported by this Committee, with the value of allowances dedicated to public benefits.

[2] Section 211(v)(2)(A) of the Clean Air Act (42 U.S.C. 7545) as amended by Section 209 of EISA07.

Introduction

Thank you for the opportunity to share my views regarding the opportunities and challenges of implementing the Renewable Fuels Standard (RFS). My name is Nathanael Greene. I'm a senior policy analyst for the Natural Resources Defense Council (NRDC) and our director of renewable energy policy. NRDC is a national, nonprofit organization of scientists, lawyers and environmental specialists dedicated to protecting public health and the environment. Founded in 1970, NRDC has more than 1.2 million members and online activists nationwide, served from offices in New York, Washington, Los Angeles, San Francisco, Chicago, and Beijing.

Mr. Chairman, as you know, U.S. energy policy must address three major challenges: reducing America's dangerous dependence on oil, reducing global warming pollution, and providing affordable energy services that sustain a robust economy. Biofuels have the potential to contribute significantly to all three of these goals. Sustainably produced biomass feedstocks, processed efficiently and used in efficient vehicles can reduce our dependence on oil for transportation, reduce emissions of heat-trapping carbon dioxide, and contribute significantly to a vibrant farm economy. Pursued without adequate guidelines such as those contained in current law, however, biofuels production carries grave risk to our lands, forests, water, wildlife, public health and climate.

The potential for biofuels to be done right or wrong is reflected in recent headlines, which just a few months ago, regularly hailed biofuels as the solution to our oil addiction and now, roundly condemn biofuels in light of high food prices and recent

studies that show how biofuel can increase global warming pollution and contribute to environmental degradation. While these concerns certainly should motivate greater efforts to get biofuels right, we need to be careful not to throw the baby out with the bathwater. We should go beyond all or nothing headlines and pursue a transition to biofuel strategies that realize the compatible objectives of replacing oil, expanding opportunities for biofuels producers, and securing both food supplies and a broadly sustainable future.

Replace existing biofuels tax credits and tariffs with a single technology-neutral, performance based incentive

The existing biofuels tax credits and import tariffs are blunt, volume based policies that try to pick winners solely based on feedstocks. In doing so, these policies provide equal incentives to biofuels that cause negative environmental impacts as to biofuels that use the most beneficial practices and technologies. Similarly, while there is much debate about how big an impact today's biofuels have on food prices, these policies provide the same incentive to those biofuels that cause the most impact on food prices as those that cause none. For instance, the volumetric ethanol excise tax credit (VEETC) gives a fixed tax credit of $0.46 per gallon of corn ethanol and $1.02 per gallon of cellulosic ethanol regardless of how the ethanol was produced. Furthermore this tax credit is unavailable to butanol or biomass derived synthetic gasoline. Similarly the biodiesel blending tax credit is awarded on a per gallon basis regardless of whether the biodiesel is derived from palm oil grown in just cleared rainforests or waste grease diverted from a landfill. It's also not available to synthetic diesel. And our ethanol import tariff is similarly blunt.

With a mandate in place, and a biofuels industry with a track record of surpassing these mandate levels each year, it is time to reward performance and make sure we are not causing unintended consequences. Moreover, as the RFS ramps up the existing tax credits will become extremely expensive.

All these antiquated biofuels tax credits and tariffs should be replaced by a single technology-neutral performance based incentive. Building off of the lifecycle GHG accounting protocol being developed for the RFS (discussed later), it would be relatively easy to link these incentives to improved GHG emissions, but I suggest that we go further. After all the RFS already starts us down the path towards biofuels with better GHG emissions and there are plenty of other ways that biofuels can help or hurt our environment and public health. I recommend that we use the tax credits and tariffs to encourage water efficiency, reduced water pollution, better soil management, enhanced wildlife management, and production of biofuels that do not displace food supplies, or better still produce more food and fuel. Developing accurate and workable accounting metrics for these impacts would be a non-trivial challenge, but many of the tools we have developed to implement farm bill conservation programs could be used here.

While agriculture policy is the best place to deal with agriculture's environmental impacts on a broad basis, our biofuels policies should not be exacerbating these challenges. Perhaps most importantly, while the RFS will drive improvements to the performance of biofuels from new facilities, a new set of tax policies would drive improvements to our existing production as well.

Environmental Safeguards in the RFS

In contrast to the excise tax credit, the updated RFS represents an important step forward for biofuels policy in that it contains the basic minimum performance standards and incentives needed to promote biofuels that are part of the solution, rather than part of the problem. The challenge before us is to ensure that the law's critical safeguards are maintained and implemented aggressively and effectively.

I'd like to call your attention to four requirements under the updated RFS that were particularly far sighted of Congress to embrace and are critical to the law's success:

- Requiring conventional biofuels from all new facilities to achieve at least a 20 percent reduction in lifecycle greenhouse gas emissions compared to conventional gasoline and advanced biofuels to achieve at least a 50 percent reduction.
- Defining lifecycle greenhouse gas emissions to include the full cultivation, production, and combustion cycle of fuels and the emissions from both the direct and indirect land use change caused by this cycle. This critical step helps ensure biofuels produce real climate benefits and provides a direct disincentive to displacing food.
- Encouraging production of plentiful biofuels feedstocks—including woody-biomass—while ensuring the RFS mandate does not result in the loss of old-growth forest, native grasslands, "critically imperiled", "imperiled", "vulnerable" ecosystems pursuant to a State Natural Heritage Program, the degradation of our federal forests[3], or conversion of natural forests on non-federal lands.
- Requiring the vast majority of new biofuels required under the law to be advanced biofuels derived from renewable cellulosic biomass with 60 percent reduction in lifecycle greenhouse gas emissions.

The importance of the RFS's minimum lifecycle GHG requirements

Section 201 of the RFS established minimum lifecycle GHG requirements for advanced and cellulosic biofuels. Section 202 established similar standards for

[3] Biomass obtained from the immediate vicinity of buildings and other areas regularly occupied by people, or of public infrastructure, at risk from wildfire is exempted from these restrictions, on both federal and non-federal lands.

conventional biofuel. To the best of my knowledge, these are the first lifecycle GHG standards established under any federal law. Under these standards, all renewable fuels from new facilities have to have lifecycle GHG emissions that are at least 20 percent lower than gasoline or diesel, depending on which they are replacing. In order to comply with the "advanced biofuels" definition, fuels need to have emissions that are at least 50 percent lower and to comply with the "cellulosic biofuels" definition, fuels need have emissions that are 60 percent lower.

This is the first time that biofuels policy in the US has required renewable fuels to proactively show an environmental benefit in return for benefiting from a government incentive program such as the RFS. Nowhere is the need for better performance more evident and urgent than when considering the global warming pollution impacts of biofuels. It is possible to produce ethanol derived from corn in ways that produce dramatically less lifecycle greenhouse gas emissions than the industry average for corn ethanol today. Conversely it is possible to produce ethanol from cellulosic feedstocks in a manner that produces far more lifecycle greenhouse gas emissions than gasoline (per BTU of delivered fuel). Unless our policies value, encourage and ultimately require biofuels to produce greenhouse gas reductions as the RFS has done for the first time, the market will provide whatever is cheapest and fastest. There is no reason to believe that the fuels the market would provide will be better than gasoline and plenty of reason to believe they would be worse.

The RFS gets the definition of lifecycle GHG emissions right

Of course, the minimum lifecycle GHG standards for biofuels in the RFS would mean little without a good definition of lifecycle emissions. This is an area of the law where Congress showed particular foresight. Section 201(1)(H) of the RFS defines lifecycle GHG emissions as follows:

> *'(H) LIFECYCLE GREENHOUSE GAS EMISSIONS.—The term 'lifecycle greenhouse gas emissions' means the aggregate quantity of greenhouse gas emissions* ***(including direct emissions and significant indirect emissions such as significant emissions from land use changes)****, as determined by the Administrator, related to the full fuel lifecycle, including all stages of fuel and feedstock production and distribution, from feedstock generation or extraction through the distribution and delivery and use of the finished fuel to the ultimate consumer, where the mass values for all greenhouse gases are adjusted to account for their relative global warming potential.*[4] *[Emphasis added.]*

Less than two months after this definition became law, two articles that appeared in *Science* made it clear that the direct and indirect emissions associated with changes in land-use could dominate the lifecycle emissions of biofuels. The first article, "Land Clearing and the Biofuel Carbon Debt," addresses the direct greenhouse gas emissions from growing biofuel feedstocks on land recently converted from natural ecosystems to managed agriculture.[5] This article is authored by a team from the Nature Conservancy and the University of Minnesota including Dr. David Tilman. The second article, "Use of U.S. Croplands for Biofuels Increases Greenhouse Gases through Emissions from Land Use Change," addresses the emissions from land use change induced by the economic pressures when crops and land are diverted from

---

[4] "Energy Independence and Security Act of 2007," Title II, Section 201(1)(H), signed into law on December 17, 2007.

[5] Fargione, J., et al., "Land Clearing and the Biofuel Carbon Debt," *Science* [DOI: 10.1126/science.1152747] February 7, 2008.

food, feed, and fiber to fuels.[6] This article is authored by a team lead by Tim Searchinger from Princeton with other authors from the Woods Hole Research Center and Iowa State's CARD.

While there is little controversy over the notion that the emissions from lands converted specifically to produce biomass for renewable fuels should be accounted for in the lifecycle of those fuels, the first of these articles showed how large these emissions could be. For example, Fargione et al. estimate that burning a rainforest in Malaysia or Indonesia and converting it to a palm oil plantation and then using that oil to make biodiesel results in a release in carbon from the soil and the trees and other above ground biomass that takes 96 years to balance out through avoided emissions from petroleum based diesel. If the rainforest happens to have peat soil and that is drained and burned during the conversion, the breakeven period stretches out to 423 years. In other words, replacing petroleum based diesel with biodiesel from palm oil cultivated on land cleared from a peat soil rainforest will increase global warming pollution for the 423 years that the palm-oil biodiesel is produced.

The second article broke newer ground, pointing out that land conversion could be induced by biofuels if they increase the competition for arable land. Thus Searchinger et al. argue lifecycle accounting needs to look beyond just direct conversion of land for biofuels. Devoting an increased share of U.S. agricultural output to fuel production rather than food and livestock feed will result in increased

[6] Searchinger, T., et al., "Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land Use Change," *Science* [DOI: 10.1126/science.1151861] February 7, 2008.

demand for food and animal feed from sources abroad. If any significant portion of this additional food or feed is obtained by burning mature forests and converting them into pasture or cropland, the CO_2 emissions from this land use change could greatly exceed the emission reductions from the use of biofuels.

The Argonne GREET model and most lifecycle analyses conducted to date have either ignored these land use related emissions or minimized them. These emissions, however, are driven by inevitable market economics when certain crops and types of land are use as biofuels feedstocks, and these economically mitigated emissions have the potential to negate all of the global warming benefits of poorly designed biofuels policies.

A recent letter in *Science* does a particularly good job of showing how complicated but important these indirect land-use impacts can be. The letter explains how increased demand for corn to make ethanol is reducing domestic production of soy beans and thus driving up the production of soy beans in Brazil. The letter details how increased Brazilian soy farming leads directly and indirectly to clearing of Brazilian rainforests:

> *Some Amazonian forests are directly cleared for soy farms. Farmers also purchase large expanses of cattle pasture for soy production, effectively pushing the ranchers farther into the Amazonian frontier or onto lands unsuitable for soy production. In addition, higher soy costs tend to raise global beef prices because soy-based livestock feeds become more expensive, creating an indirect incentive for forest conversion to pasture. Finally, the powerful Brazilian soy lobby is a key driving force behind initiatives to expand Amazonian highways and transportation networks in order to transport*

> *soybeans to market, and this is greatly increasing access to forests for ranchers, loggers, and land speculators.* [Footnotes not included.][7]

Not all biomass material leads to increased demand for new agricultural lands and not all lands brought into production are rainforests. Fargione et al. and Searchinger et al. acknowledge that global warming pollution reductions can be achieved from biofuels done right. Nevertheless, it is important to understand the scale of impact that greenhouse gas emissions from these indirect land-use changes can have. Looking at a number of estimates, new very efficient corn ethanol refineries should be able to produce about 420 gallons of ethanol from an average acre of corn. Putting aside emissions from land-use change, this ethanol would reduce greenhouse gas emissions by about 37 percent per gallon or about 2,500 pounds worth of CO2 per acre each year. Now, according to another article in *Science*, one acre of tropical rainforest burned and used to grow crops will release about 655,000 pounds worth of CO2 over 30 years or an average of nearly 22,000 pounds per year.[8] In other words, if the conversion of an acre of corn from food and feed to fuel resulted indirectly in the conversion of just one-tenth of an acre of rainforest all the greenhouse gas emissions benefits of the ethanol would be wiped out for the first 30 years.

Of course, there are many more types of land being converted to agriculture than just rainforests. And the marginal impact of land-use changes here in the United

[7] Laurance, W.F., "Switch to Corn Promotes Amazon Deforestation," *Science* 318, no. 5841 (December 14, 2007): 1721, DOI: 10.1126/science.318.5857.

[8] Renton Righelato and Dominick V. Spracklen, "ENVIRONMENT: Carbon Mitigation by Biofuels or by Saving and Restoring Forests?," *Science* 317, no. 5840 (August 17, 2007): 902, doi:10.1126/science.1141361.

States on land-use in the rest of the world is extremely hard to predict with economic equilibriums and agricultural and trade policies all interacting in complex ways. But to ignore these indirect emissions is to assume they are zero, which could easily lead to the government subsidization of fuels that are worse for global warming than gasoline or diesel.

While these two articles have already stirred a lot of debate about the specific amounts of carbon released from different land types, the amounts of different lands being cleared, and the exact economics driven by growth in biofuels production, three conclusions are clear now: 1) absent the GHG standards in the RFS and the carefully crafted definition of lifecycle emissions, these two dynamics make it very likely that most biofuels would be responsible for greenhouse gas emissions significantly higher than gasoline or diesel; 2) the fundamental dynamics addressed by these two articles (direct land use emissions and economically induced land use emissions) are driven by the fundamentals of soil science and the laws of supply and demand; and 3) the importance of implementing the minimum GHG emissions standards and land-use safeguards in the RFS aggressively and effectively is clearer than ever. I return to this last point later in my testimony.

Finally, it is important to emphasize the direct relationship between land-use change, GHG emissions, and food price disruptions. The same economic factors that link biofuels to indirect emissions from land-use change also link biofuels to food price increases. It is the diversion of food and feed crops and land that could produce food crops that drive up the competition for land and subsequently land-

use change and drive up the competition for food and feed and subsequently their prices. Requiring land-use change to be included in the lifecycle definition provides a direct disincentive to divert food crops to fuel, and an incentive to produce biofuels from feedstocks that do not disrupt food production—such as crop residues, biomass grown on degraded or marginal land, or feedstocks that produce more food than current crops and fuel from the same acre of land.

The RFS includes critical land and wildlife safeguards

In addition to the minimum GHG standards, the RFS includes a definition of renewable biomass that provides essential safeguards for wildlife, native grasslands, old-growth, natural forests, and federal forests. At the same time, it is broadly inclusive of the kind of material that typically provides the biggest sources of biomass, assuring diverse opportunities for landowner participation and a wide diversity of feedstocks.

- ***Eligible Biomass***

The renewable biomass definition includes:

- All crops and crop residue from current agriculture land and non-forested, fallow land
- All crops and crop residue from any non-forested land cleared prior to the enactment of the Energy Independence and Security Act of 2007 (EISA07), including newly established tree plantations[9]
- All trees and logging residue from non-federal tree plantations, excluding those converted from natural forests after passage of EISA07 (See below)

[9] While I recognize that the term "plantation" carries negative historical connotations, it is used throughout my testimony because "tree plantation" it is a technical term distinct from "tree farm". "Tree plantation" is also the term used in the Renewable Biomass definition legislative text.

- "Slash and pre-commercial thinnings" from non-federal natural forests, which, importantly, constitute the lion's share of woody-biomass from natural working forests that are expected to be economically viable options for biofuels, while keeping forests from being converted
- All material removed from the immediate vicinity of homes and communities at risk from wildfire, on federal and non-federal lands
- Animal waste and animal byproducts
- Waste material, including separated yard waste, food waste, and cooking and trap grease

- ***Protecting Wildlife***

The definition of renewable biomass ensures the RFS does not encourage biomass harvesting from sensitive wildlife habitat. The RFS employs the State Natural Heritage programs to identify critically imperiled, imperiled and vulnerable wildlife habitat. The Natural Heritage programs are readily accessible, widely recognized, and embraced by all 50 states. They are the leading sources on the precise locations and conditions of rare and threatened species and ecological communities found within each state. These databases and ranking systems are used effectively for forest management and in partnership with many forest-product industry leaders.

The ecosystems identified by the RFS as off-limits are home to our most rare, threatened, and imperiled wildlife. While tree plantations and young forests are increasing in parts of the United States, older forests that provide critical wildlife habitat and store tremendous amounts of carbon are disappearing faster than they are being regrown, both nationally and globally, and loss of native habitat is the greatest threat to biodiversity here and abroad. Animals are currently going extinct at a rate nearly 1,000 times higher than they have historically, and under current

trends that may increase to 10,000 times over the next century.[10] Moreover, as global warming escalates, wildlife is increasingly threatened by loss of safe harbors and migration routes, making habitat protection even more important. The RFS safeguards ensure that the law's new demand for feedstocks does not translate into irreversible loss of these at risk habitats.

- ***Native Grasslands and Old-Growth Forest***

The RFS safeguards also protect against the use of biomass harvested from native grasslands and old-growth and late successional forest. Native grasslands represent one of the most threatened ecosystems in the world. Less than 4 percent of our country's original native prairies exist today. These imperiled ecosystems represent a last remnant of our natural heritage and provide invaluable habitat for migrating birds and other endangered species. Similarly, our remaining old-growth trees constitute a rare and vulnerable ecosystem type that provides unique wildlife habitat, water filtration, and ecosystem resiliency. Nationally, old-growth forests are severely diminished. In the lower 48 states, old growth forest makes up just 2 percent of the remaining forest.[11] As we struggle to maintain and restore these ancient forests, it is imperative that federal policy not further their endangerment.

---

[10] "Environmental Science and Engineering for the Twenty-First Century: The Role of the National Science Foundation," National Science Foundation, February 2000; Peter Raven, "Plants in Peril: What Should We Do?" Missouri Botanical Garden, 1999.

[11] Palmer, T., *The Heart of America: Out Landscape, Our Future*, Island Press, 1999.

- ***Conversion of Natural Forests***

Loss of forests is one of the greatest threats to biodiversity worldwide and a major contributor to global warming.[12] Natural forests are under severe threat from unsustainable logging practices, global warming, and real estate development. While deforestation is the most dramatic example of this growing crisis, equally critical is the conversion of natural forests to single-species tree plantations. Plantations may look like "forests," but they are biological deserts when compared to the natural forests that they replace—lacking the diversity of species, structure, and ecological functions that make natural forests so important.

A potent example of conversion's sweeping impacts can be found in the forests of the Southern United States which contain some of the most biologically rich forests in North America, housing an abundance of plant and animal diversity that exist nowhere else in the world. Unfortunately, these unique forests are under increasing pressure from the wood products industry as well as urban sprawl and development. Pine tree farms have been displacing natural forests for the past 50 years and now occupy 32 million acres (15 percent) of the current Southern "forest."[13] Seventy-five percent of the pine plantations established in the last two decades were carved out at the expense of natural forests. Moreover, 40 percent of the region's native pine forests have already been converted to single-species plantations, eliminating the rich diversity that the area is known for.

---

[12] Intergovemental Panel on Climate Change, *Climate Change 2007: Synthesis Report Summary for Policymakers*, pg. 5. Available at http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf
[13] See USFS SFRA 2001 Summary-Section 3.2.2

The RFS definition of renewable biomass does not by any means exclude woody biomass, but does ensure that federal policy is not making this bad situation worse. The RFS renewable biomass definition includes all biomass from existing tree plantations, new tree plantations established on previously cleared non-forested lands, and "slash and pre-commercial thinnings" from natural forests. In concert, these provisions allow woody-biomass to contribute to biofuels, while protecting against the clearing of forests or the conversion of natural forests to monoculture tree plantations, thus losing their natural ecosystem functions. It is important to emphasize that we believe the term "slash and pre-commercial thinning" should be interpreted with substantial flexibility - allowing the use of all harvest byproducts, as well as small and low-value trees from natural forests, as long as the forest is naturally regenerated after harvest as opposed to converted into a tree plantation or other crop.

Sustainable forestry practices that identify and protect high conservation values such as old-growth or late successional forest and specific wildlife habitat, and avoid conversion, are well established. These practices allow natural forests to remain working forests, without sacrificing critical wildlife habitat and other important environmental values. For example, Forest Stewardship Council certification, a global standard used in the forest products industry, incorporates these considerations.

- ***Federal Forests***

Our federal forests represent unique reservoirs of biologic diversity, genetic diversity, significant carbon stores, and many other ecological services, and stand to play a critical role in the face of global warming's growing impacts, including loss of biodiversity, decreased ecosystem resilience, and the spread of invasive species.[14] It is therefore becoming commensurately more important that our federal forest resources are managed and preserved for their numerous non-commodity values and that we assiduously avoid policies that would impose additional pressures on these already stressed, and increasingly crucial, public resources.

In this context, proposals like those contained in H.R. 5236 and S. 2558 to use "preventative thinnings" from national forests as a biofuels source make little economic or ecologic sense. First, it is important to understand that preventative thinning—the removal of forest biomass including anything from small brush to large trees to address forest health—is essentially logging and thus not devoid of ecological impacts, such as soil compaction, spread of invasive species, hydrologic disruption, and in the case of associated road building, increased fire risk due to lost resiliency and increased human traffic.[15]

---

[14] See, for example, Lovejoy, Thomas, *Climate Change and Biodiversity*, Yale University Press, August 2006.

[15] The literature on the ecologic impacts of logging and road-building is extensive. For a collection of independently reviewed material, see http://www.nrdc.org/land/forests/roads/eotrinx.asp. *See also* USDA. "Roadless Area Conservation Final Environmental Impact Statement." US Forest Service. Vol. 1. (November, 2000). pp. 3-116. Eastman, J. C., et al. "Roadless Areas and Forest Fires in the Western United States." American Geographical Union Spring Meeting. (May 29, 2002). Pyne, S. J. *Tending Fire: Coping with America's Wildland Fires*, Island Press, 2004, p. 208.

The argument for the production of biofuels from national forest preventative thinnings hinges on three basic assumptions, all three of which would have to be valid for the proposition to be worth the impacts and risks of logging: first, preventative thinnings based biofuels do not negatively impact global warming; second, preventative thinnings will safely and sustainably produce a meaningful volume of biofuels; and third, biomass removal is beneficial to addressing wildfire. Unfortunately there is uncertainty and debate around each of these assumptions.

The GHG benefit of preventative thinnings for biofuels is highly uncertain. As noted above, preventative thinning represents the removal of biomass—or stored carbon—through mechanical harvest. For preventative thinnings to make sense from a GHG perspective, the fuel produced would have to be "better" than the lost carbon storage, including soil carbon, the emissions resulting from the removal, transportation, and processing of the biomass, and the burning of the final fuel. It is also important to note that fire risk reduction thinning, even where appropriate (see below), is successful only to the extent that occasional intense burns are replaced by cooler burns that occur perhaps 20 to 25 times more often. While ecotype specific data are still not available, on the face of it, the much more frequent burns are likely, if anything, to result in greater emissions.

Even if preventative thinning were ecologically necessary, most scenarios indicate a limited supply of material within economic haul distances, making biofuels from

preventive thinning at best a drop in the overall bucket.[16] Preventative thinnings are single-entry activities pursued for restoration purposes and do not provide a renewable resource from any given location. Thus they are severely constrained by the energy and economic costs of transporting biomass from individual sites to central processing facilities. Incenting the establishment of a whole industry in order to supply a negligible volume of fuel from a time-limited supply of any arguably legitimate feedstock presents likely negative outcomes, including either a boom-bust cycle, or future pressure to shift to an unsustainable scale of extraction. This is particularly unappealing considering there are other, proven, and more readily scalable uses for harvest and preventative thinning byproducts where it is economic to remove them from the woods, such as community heat and electricity production and manufactured products. These factors are particularly important when considering utilization of slash and byproducts from sources other than preventive thinning, including any backlog like slash piles. While this material may be available for the short term, it would soon be exhausted, representing a nonrenewable supply far more appropriate for more scalable uses than biofuels.[17]

Finally, while intuitively appealing, the empirical evidence is mixed at best on whether backcountry logging and preventative thinning effectively reduces fire

---

[16] For example, the DOE "Billion Ton Study" available at http://www1.eere.energy.gov/biomass/pdfs/final_billionton_vision_report2.pdf reports only 11.7 million dry tons of biomass available from national forest preventative thinnings. Even this estimate may be optimistic due to economic costs, haul distances, and serious questions regarding ecological impacts.

[17] See DOE "Billion Ton Study "estimate of only 1.5 million dry tons of national forest logging residue, under future optimistic conditions.

risk[18], and indicates it may in fact increase the chances of uncharacteristic fire.[19] Furthermore, it is a mistake to conceive of national forests as uniformly overgrown thickets in need of preventative thinning to restore prior forest structure and fire regimes. While evidence suggests some lower elevation, dry forests could benefit from restoration treatments, many other sites across the country, including lodgepole pine, spruce-fir forests, subalpine forests, piñon-juniper, mixed conifer systems, and ponderosa pine, are adapted to intense, stand-replacing fires, and in these dense stands preventative thinning is contraindicated.[20] The empirical

---

[18] See, Martinson, E. J. and P. N. Omi. 2003. Performance of Fuel Treatments Subjected to Wildfires, in Omi, P. N.; Joyce, L. A., technical editors. Fire, fuel treatments, and ecological restoration: Conference proceedings; 2002 16-18 April; Fort Collins, CO. Proceedings RMRS-P-29. Fort Collins, CO: U.S. Forest Service, Rocky Mountain Research Station. pp. 7-8. *See also* Carey, H. and M. Schumann. 2003. "Modifying Wildfire Behavior-The Effectiveness of Fuel Treatments." The Forest Trust. p. 16. Available at www.theforesttrust.org/images/swcenter/pdf/WorkingPaper2.pdf. p. 15 ("The proposal that commercial logging can reduce the incidence of canopy fire appears completely untested in the scientific literature"). *See also* Cram, D.S., T.T. Baker, and J.C. Boren. 2006. Wildland Fire Effects in Silviculturally Treated vs. Untreated Stands of New Mexico and Arizona. Research Paper RMRS-RP-55. Fort Collins, CO. U.S. Forest Service, Rocky Mountain Research Station. p. 1. ("information comparing fire behavior and fire effects on treated versus untreated forest stands following wildland fire remains largely anecdotal.")

[19] Martinson and Omi, *supra* note 1. p. 7. U.S. Forest Service. 2000a. Final Environmental Impact Statement for the Roadless Area Conservation Rule ("FEIS"), volume 1. Online at: http:/www.roadless.fs.fed.us/documents/feis. p. 3-110. Collins, B.M. et al. 2007. Spatial patterns of large natural fires in Sierra Nevada wilderness areas. Landscape Ecology 22:545-557. p. 554. Whitehead, R.J. et al. 2006. Effect of a Spaced Thinning in Mature Lodgepole Pine on Within-stand Microclimate and Fine Fuel Moisture Content, in Andrews, P. L. and B.W. Butler, comps., Fuels Management-How to Measure Success: Conference Proceedings. 28-30 March 2006; Portland, OR. Proceedings RMRS-P-41. Fort Collins, CO: U.S. Forest Service, Rocky Mountain Research Station. Online at http://www.fs.fed.us/rm/pubs/rmrs_p041/rmrs_p041_523_536.pdf. p. 529. Keeley, J.E., D. Lubin, and C.J. Fotheringham. 2003. Fire and grazing impacts on plant diversity and alien plant invasions in the southern Sierra Nevada. Ecological applications 13:1355-1374. p. 1370. FEIS, *supra* this note, Fuel Management and Fire Suppression Specialist's Report. Online at: http://www.roadless.fs.fed.us/documents/feis/specrep/xfire_spec_rpt.pdf. p. 21 ("Fahnstock's (1968) study of precommercial thinning found that timber stands thinned to a 12 feet by 12 feet spacing commonly produced fuels that 'rate high in rate of spread and resistance to control for at least 5 years after cutting, so that it would burn with relatively high intensity;'" "When precommercial thinning was used in lodgepole pine stands, Alexander and Yancik (1977) reported that a fire's rate of spread increased 3.5 times and that the fire's intensity increased 3 times"); id. At 23 ("Countryman (1955) found that 'opening up' a forest through logging changed the 'fire climate so that fires start more easily, spread faster, and burn hotter").

[20] See Christensen, N, et al. 2002. Letter to President George W. Bush http://docs.nrdc.org/land/lan_07062801g.pdf; Romme, W. et al. 2006. Recent Forest Insect

evidence on both the efficacy and necessity of preventative thinning suggests it is still experimental, poses significant risks, is constrained to limited areas at best, and therefore should be pursued only on an investigational basis.

In sum, none of three underlying assumptions related to producing biofuels from preventative thinnings reflect the best available science or pragmatic, on the ground scenarios. To contribute a negligible amount of fuel, we would have to risk further degraded forests, exacerbating fire risk, reducing carbon storage, increasing GHG emissions, and establishing an unsustainable industrial demand for continued commercial exploitation of vital public resources.

The RFS correctly focuses primarily on biofuels from renewable cellulosic biomass

While the RFS requires 36 billion gallons of biofuels by 2022, only 28.5 of this is additional to the previous RFS and only about 24 is in addition to what the market would have almost certainly provided on its own. The new RFS requires that at least 22 billion gallons of the 36 billion total be "advanced biofuels," which are basically defined as not being ethanol from corn. As mentioned earlier, these advanced biofuels must provide at least a 50 percent reduction in global warming pollution

---

Outbreaks and Fire Risk in Colorado Forests: A Brief Synthesis of Relevant Research. Colorado State University, Fort Collins, CO. Online at http://www.cfri.colostate.edu/docs/cfri_insect.pdf. Schoennagel, T., T.T. Veblen, and W.H. Romme. 2004. The interaction of fire, fuels and climate across Rocky Mountain forests. BioScience 54: 661-676. p. 666. Romme, W., et al. 2003. Ancient Piñon-Juniper Forests of Mesa Verde and the West: A Cautionary Note for Forest Restoration Programs, in Omi, P. N.; Joyce, L. A., technical editors. Fire, fuel treatments, and ecological restoration: Conference proceedings; 2002 16-18 April; Fort Collins, CO. Proceedings RMRS-P-29. Fort Collins, CO: U.S. Forest Service, Rocky Mountain Research Station. Baker, W.L. and D.S. Ehle. 2003. Uncertainty in Fire History and Restoration of Ponderosa Pine Forests in the Western United States, in Omi, P. N.; Joyce, L. A., technical editors. Fire, fuel treatments, and ecological restoration: Conference proceedings; 2002 16-18 April; Fort Collins, CO. Proceedings RMRS-P-29. Fort Collins, CO: U.S. Forest Service, Rocky Mountain Research Station. p. 330.

compared to petroleum fuels. Of the advanced biofuels, at least 16 billion must be from cellulosic feedstocks and at least 1 billion must serve as an alternative to petroleum diesel. The advanced biofuels from cellulosic feedstocks must provide at least a 60 percent reduction in GHG emissions.

Much has been written and said about the promise of advanced, second generation biofuels technologies. These technologies do appear poised to greatly increase the amount of biofuels we can produce and make it easier to produce them in a sustainable way. It is critical to realize, however, that these technologies will not be available overnight and just because we can produce biofuels sustainably does not mean that we will.

When I first started looking at biofuels in 2002, all of the cutting edge expertise was in academia and the national energy labs. You could talk to these experts, and they would tell you where the technology stood. Over the last 2 years, however, all of the cutting edge research has moved into the private sector and is proprietary. So while it's now much harder to know where things stand, we know that a lot of investor dollars are being bet on near-term commercialization. The research is being driven by venture capitalists and private investors.

Combine these developments with the very impressive number of projects proposed in response to recent government solicitations, and it's hard not to believe that things are moving along quickly. Within the past year, New York issued a solicitation for two pilot cellulosic biofuels projects and DOE issued a solicitation for six small commercial scale cellulosic projects and seven more pilot scale cellulosic

projects. All of these solicitations required significant private sector investment and a number of major market players responded. Cellulosic biofuels projects announced in recent months include a new pilot cellulosic plant in Nebraska that will be built by Abengoa, a plant using switchgrass as a feedstock that will be constructed in Tennessee by Mascoma and a commercial line of cellulose processing enzymes by Genencor. International developments include a recent announcement by Royal Nedalco in the Netherlands that it will skip the pilot scale and go straight to building a small commercial scale 50 million gallon a year cellulosic plant. There are also advances being made in radically different technologies including the use of microorganisms in existing ethanol facilities to produce fuels similar to gasoline such as biobutanol, bacterial and catalytic conversion of biomass into renewable diesel and gasoline, and the use of algae to make a synthetic diesel fuel.

It is my understanding, however, that none of these projects will come on line until late next year at the earliest. Assuming a few of them perform very well, they could be expanded, but it is really the second generation plant that investors will consider a potential cookie-cutter model. Being optimistic, assume that we go into 2013 with three different technologies that can compete with corn ethanol or gasoline, each with an operating second generation plant of about 50 million gallon per year capacity for a total of 150 million gallons annual capacity. Even if the technologies are so promising that orders for more plants are actually placed in 2012, how fast will capital and engineering capacity flow into the sector? How long will siting and permitting lead times be? One billion gallons of capacity by 2016 seems eminently achievable to me assuming we have at least one clear success on line by 2010. Three

billion would be absolutely fantastic. Such a result would require that by 2013 the cellulosic industry grows as fast as the corn ethanol industry grew from middle of 2006 to middle of 2007.

In comparison, the RFS requires 1 billion gallons of cellulosic biofuels by 2013 and 3 billion by 2015. These levels are extremely aggressive, which is why EISA07 explicitly allows EPA to reduce the levels if the forecasted production levels are below the forecasted production levels. This effectively provides producers of all the capacity that is likely to come on line between now and 2015 with a guaranteed market.

The ability to convert cellulose into fuels opens up the possibility of using new feedstocks such as cellulosic crops—including switchgrass—that use significantly less chemical inputs and water, agricultural residues and organic waste. However, as we discussed earlier, it is also possible to cultivate and harvest cellulosic biomass in extremely destructive and carbon intensive ways. One of the easiest ways to do cellulosic biofuels wrong is by harvesting feedstocks from inappropriate areas such as our public forests, old growth forests, or other imperiled and fragile ecosystems. Federal policies should not incentivize the use of such feedstocks. To the contrary, our policies should encourage the best practices and the best choices in feedstocks through technology and crop neutral, performance based standards and incentives. Environmental safeguards and performance standards are necessary to ensure that federal policy promotes the best production standards for biofuels and then let the market decide which feedstocks can compete.

Given the emissions from land-use change associated with food crops and arable land, many wonder if there is enough truly low-carbon biomass available to make biofuels that comply with the RFS's minimum lifecycle GHG standards. There are two reasons to be very cautious about making any forecasts about the supply of low-carbon biomass. First EPA has not written its regulations, so it is impossible to know exactly which types of biomass will be able to comply. Second, the market has never faced the combination of commodity food prices and regulation driven prices. This combination makes any feedstock that reduces food or fiber production highly unattractive, economically—even if a farmer or a forester was willing to forego the market value of food or fiber, the greenhouse gas emissions that would be associated with displacing those products would probably make the resulting biofuels non-compliant with the RFS standards. This means that farmers and foresters will have a strong incentive to innovate and to find ways that produce biomass without reducing food and fiber production or, better yet, produce more of both. We can articulate examples of what this type of innovation might look like, but the reality is that there inevitably will be innovations that we can't currently imagine and it's impossible to predict which innovations will triumph.

Nevertheless, a preliminary and partial assessment of potential sustainable and truly low-carbon feedstocks does suggest that we have more than enough cellulosic biomass to meet the RFS's 16 billion gallon requirement for 2022. For example, cover crops have long been recommended as a conservation practice to reduce soil erosion and fertilizer runoff, but only about 10 million acres are cover cropped each year and most of the biomass that is produced is plowed under. The right price for

biomass could lead to a great expansion in the number of acres and the development of cover crops that can yield 2 to 4 tons per acre. The challenge to regulation is to encourage this expansion to happen in a way that maintains as much of the conservation value as possible and minimizes any reduction in yield of the primary crop. The US has nearly 400 million acres in annual row crops. If just 25 percent of this could be cover cropped with a yield of just 2 tons per acre on average, that would produce about 200 million tons per year. At a conversion rate of 80 to 100 gallons of ethanol per ton, this would supply between 16 and 20 billion gallons—equal to or greater than the RFS requirement—and potentially help greatly reduce soil erosion and water pollution.

In *Growing Energy*, my coauthors and I wrote about another example.[21] Farmers currently grow about 70 million acres of soybeans primarily for feed. Switchgrass provides equal or great yields of feed protein per acre as soybeans and on average 5 tons per acre of biomass today. Switchgrass is also a perennial that increases soil carbon, needs less water, and can provide a better wildlife habitat. If 40 million acres of soy beans were converted to switchgrass, this would also provide about 200 million tons per year—equal to or greater than the amount needed to comply with the RFS—and improving soil quality and wildlife habitat.

Add to these examples, agricultural residues, forest residues, construction and demolition wood waste, and other clean biomass waste and it becomes clear that the supply of sustainable, low-carbon biomass need not be a limiting factor for

[21] Greene, N. *et al.*, "Growing Energy: How Biofuels Can Help End America's Oil Dependence," Natural Resources Defense Council, December 2004. http://www.nrdc.org/air/energy/biofuels/biofuels.pdf

advanced biofuels for a long time to come. However it also becomes clear that we have a lot to learn about how to cultivate and manage these types of feedstocks. In fact, especially in light of the private sector's major push to develop conversion technologies, the most important role for federal R&D dollars right now is helping to develop innovative, broadly sustainable, and truly low-carbon biomass supplies.

The RFS's environmental safeguards can and must be effectively implemented by EPA

While Congress deserves much credit for carefully crafting the standards, safeguards, and study provisions of the RFS, none of these will amount to a hill of beans unless they are aggressively and effectively implemented. Under the RFS, EPA is directed to promulgate regulations to implement these GHG performance standards and the environmental safeguards by the end of 2008. EPA's task is complex, but hardly insurmountable. There are essentially four parts of the legislative requirements that EPA's regulations must knit together. First, they must provide a methodology for assessing the indirect emissions. This is likely to start off as something relatively simple such as a look up table with different feedstocks and land types having different values. It should include, or evolve to include, a method for certifying a unique value to accommodate innovations.

Next the feedstock must be certified in compliance with the definition of renewable biomass in EISA07 and the emissions associated directly with the cultivation and harvesting of the feedstock must be calculated. Again there is likely to be a relatively simple set of default values for most feedstocks with the option for customized values. Importantly though, this stage does require site specific certification to

ensure compliance with the definition of renewable biomass. There are many examples of certification and information tracking that EPA can use as a model for its regulations. Third-party certification, in which certifiers are trained and "accredited" to evaluate and verify management standards has been widely adopted by the forest products and organic agriculture industries. The third-party certifiers, who do site visits and verify claims, include major auditing firms that we have all heard of such as PricewaterhouseCoopers. Similarly, The National Organic Program (NOP), administered by the Agricultural Marketing Service of the USDA, is carried out by state, private, and foreign organizations or individuals that AMS accredits to become "certifying agents." These agents are responsible for receiving producer/handler applications, certifying them, and verifying that they are complying with the NOP standards.

Third the emissions of the conversion facility must be included in the lifecycle calculations. These are much simpler in many ways because they are point-source emissions and overwhelmingly a function of the type of fossil fuels used and the equipment in which the fossil fuels are used.

Finally, once the feedstock has been certified as "renewable biomass" and the lifecycle GHG emissions have been calculated, this information must be attached to each gallon or batch of gallons of fuel and tracked through the wholesale market and the oil companies must be held accountable for compliance with the RFS gallon requirements. Fortunately, EPA's existing "Renewable Identification Number" system is in place and easily amended to include this additional information.

In implementing the RFS, EPA should strive to meet the following three criteria to ensure the standards are applied in the most technology neutral, performance based, and fair manner:

- ***EPA should use on the best available science and modeling to determine lifecycle GHG emissions and when confronted by uncertainty not assume there are no impacts***

Perhaps the most complicated part of this is developing the accounting protocol to measure and certify the lifecycle greenhouse gas emissions of different renewable fuels. Fortunately, EPA has a head start in this effort. Early in 2007, President Bush directed EPA, in coordination with other federal agencies, to promulgate regulations to reduce US gasoline use by 20 percent within 10 years and to do so in a way that complied with the federal court ruling that CO2 is a pollutant. Before the passage of the EISA07, EPA was on track to issue a notice of proposed rulemaking to implement the so called 20-in10 executive order around the end of 2007. As part of these draft rules, EPA had done significant work developing a lifecycle accounting methodology.

While there is every indication that EPA is bringing together the best science and, for the indirect emissions, the best economic modeling, there will no doubt be some that will argue that the agency should abandon this and either permanently or temporarily ignore certain sources of emissions. Some will argue that the indirect emissions, in particular, are too uncertain and the modeling too new and therefore these emissions should not be included. Others will argue that either Congress did

not mean for EPA to include international emissions in the lifecycle of domestically produced fuels or that EPA does not have the authority to include international emissions. EPA should reject these arguments.

EPA regularly has to assign values to impacts that are uncertain and as discussed earlier, the scale of the land-use emissions can be so large that to ignore it or assume it is zero would be to turn a blind eye to what will be the largest source of emissions in many cases. Therefore the uncertainty must be weighed against the potential scale of impacts. Assuming the indirect emissions are zero clearly risks sending grievously wrong signals to the market. Some might look at this uncertainty and argue that instead of zero, we should assign an infinite value and simply stop implementing the RFS. However, this ignores the important options for doing biofuels in the right way. Only by using the best science and modeling to assign values to as many different options as possible can EPA give guidance to the market while allowing innovation.

Excluding the international component of indirect emissions would be arbitrary and would effectively exclude a large portion of these emissions. In the definition of lifecycle GHG emissions (see quote above), Congress directed the EPA to include the "*aggregate*" emissions "related to the *full* fuel lifecycle." The plain text reading of this includes international sources especially in light of the fact that Congress specifically included and excluded domestic and international items from other programs under EISA07.

Nor does including economically induced, international emissions violate EPA's authority. To be clear, NRDC does not advocate, and believes that EPA does not contemplate, *direct* regulation of international land use change. EPA does, however, have the authority to recognize indirect emissions induced through international economic markets in its analysis of lifecycle greenhouse gas emissions. Furthermore, agencies regularly recognize the economic and market impacts of their regulations, and may modify their regulations according to these considerations.

- ***EPA should regularly update RFS regulations***

While the various elements of science and modeling that EPA is likely to use in developing default values for the lifecycle GHG emissions of different feedstocks have been widely used and studied, there can be no doubt that the combination needed to implement the RFS is novel. Furthermore, in trying to get regulations in place in a timely manner, EPA is necessarily going to be limited by the amount of customization that it can allow in the first generation of regulations. Overtime, as innovations proliferate, rigidness in the first generation of EPA's rules could act as a significant barrier to new paths. Thus to incorporate the best new science and modeling and expand the options for new and different biofuels' pathways, EPA should regularly update its regulations. These updates should draw on external science advisors such as the National Academy of Sciences and on the studies that EPA must carry out under EISA07. I recommend that an initial update be planned for roughly 3 years after the first regulations are promulgated.

- ***EPA should require site specific, audited information as the basis of certifying lifecycle GHG emissions and compliance with the definition of "renewable biomass"***

Much of the information that EPA, or accredited certifiers, will need to determine the lifecycle GHG emissions of different biofuels and compliance with the definition of "renewable biomass" can only be gathered on the farm, in the forest, or at the biofuel refinery. As discussed earlier, there are a variety of working models for auditing and certification of this type of information. Farm Bill conservation programs may provide further examples of ways to collect and verify site specific information. While we recognize that this will pose an implementation challenge to EPA and a new cost of doing business on the biofuels industry, we believe that it is the only way to ensure the RFS GHG standards and environmental safeguards are effectively implemented. Congress must make sure EPA is fully funded to both develop the implementing regulations and then carry out the enforcement and studies. As for the cost to industry of compliance, we believe it is a small price for the industry to pay compared to the benefits it gets from the federal mandate for biofuels.

Our discussions with staff within EPA give us confidence that the agency is make real progress towards a workable, science-based set of regulations. Under EISA07, technically EPA should promulgate these regulations by the end of this calendar year. Given the genuine complexity of the issues that have to be addressed, this timing seems unrealistic, but given the progress that we see EPA making, we're confident that they're on track to finish the rules within a reasonable period.

Nevertheless, we encourage Congress to monitor their progress closely to ensure that science rather than politics drives the resulting regulations.

The effectiveness of EPA's implementation of the RFS will entirely determine the law's success.

Congress should build on the foundation laid by the RFS

I recommend the following steps to build on the foundation of the RFS:

- ***Congress should adopt a low carbon fuel standard like California and Massachusetts are doing***

Adopting a low-carbon fuel standard (LCFS) that requires progressive reductions in the average greenhouse gas emissions per gallon of all transportation fuels sold, as California and Massachusetts are planning to do. The LCFS is a technology-neutral, performance based approach to reducing the greenhouse gas emissions from transportation energy. This would be an important improvement over the technology specific, volume incentives and mandates that until recently dominated US biofuels policies.

The way a LCFS works is that the full lifecycle GHG emissions from the fuels each oil company is selling are added up and divided by all the energy in that fuel. This becomes the company's average fuel carbon intensity. Overtime under the LCFS, the oil companies have to reduce this average carbon intensity by mixing in sources of transportation energy with lower lifecycle GHG emissions. In California, which was the first to move towards a LCFS and is now in the process of developing the

regulations, the goal of the LCFS is to require a 10 percent reduction in carbon intensity by 2020. In other words, a company could replace all of their current fuel with an alternative that has 10 percent lower lifecycle GHG emissions, or half with a 20 percent lower alternative, and so on. The LCFS rewards the sources of energy that have the lowest lifecycle GHG emissions. Just as importantly, it penalizes high carbon fuels such as liquid coal.

This is in contrast to the original RFS, which was simply a volume mandate that almost totally ignored how the biofuels were produced. Our current tax credits for ethanol and biodiesel and our import tariff on ethanol are similarly blunt, ignoring the impacts or benefits of the fuels' lifecycle. While the current RFS is the first step towards setting performance based requirements, it is still a volume mandate for a specific set of fuels and these standards are floors. Electricity and natural gas can't be used to comply and there's no incentive for producing biofuels that perform better than minimum standards.

- ***Congress should pass comprehensive climate legislation adopting a carbon cap and trade system***

It is much harder to get biofuels right in the context of a broader economy where greenhouse gas emissions are not regulated. In order to meaningfully level the field between oil and renewable fuels and encourage the economy-wide changes in practices needed to drive a sustainable transportation sector, we need comprehensive approach to global warming. In addition to a low carbon fuel standard this should include an economy-wide carbon cap and trade system. Senate

bill S.2191, the Lieberman-Warner bill, includes both, Congress should pass this bill and the President should sign it as soon as possible.

Conclusion

Renewable fuels hold great promise as a tool for reducing global warming pollution, breaking our dangerous oil addiction, and revitalizing rural economies, as long as appropriate standards and incentives are used to shape the nascent bioenergy industry to provide these benefits in a sound and truly sustainable fashion. Congress deserves credit for the foresight it showed in starting to build these standards and safeguards into the new RFS. We should build on this foundation by making over the rest of our biofuels policies to be technology neutral and performance based. I look forward to working with the EPA to implement the RFS and with the Committee to continue to improve our biofuels policies.

Environment and Public Works Committee Hearing
July 10,2008
Follow-Up Questions for Written Submission
Questions from:
Senator Barbara Boxer

Responses of Nathanael Greene
Natural Resources Defense Council

Question # 1
What role does the RFS program play within our broader efforts to fight global warming?

If the environmental safeguards and minimum lifecycle GHG standards in the RFS are effectively and aggressively implemented the RFS will play two important roles in our efforts to stop climate change. First, the implementation of the biomass safeguards and lifecycle GHG standards are critical foundational tools needed to make sure biofuels are part of the solution and not part of the problem. The effective implementation of these tools will require the development of a lifecycle GHG accounting system and a claims tracking and verification system allowing regulators and the market to differentiate between good biofuels and bad. Without these tools, we will be unable to harness the competitive and innovative energies of the market to develop more sustainable and truly low-carbon biofuels. This would likely result in the deployment of biofuels that can make global warming worse and contribute to major non-climate environmental impacts like deforestation, biodiversity loss, and the decrease of ecosystem resilience and integrity.

Second, the RFS is overwhelmingly focused on requiring the development of second generation biofuels. Of the 36 billion gallons required under the RFS, 21 billion must be advanced biofuels and provide at least a 50 percent reduction in GHG emissions compared to gasoline. Of this 21 billion, at least 16 must be cellulosic biofuels and provide at least a 60 percent reduction. Unless Congress acts to encourage improvements and conversions of existing and under construction corn ethanol plants, the benefits of these advanced biofuels will be reduced by the emissions from these first generation fuels. Nevertheless, by driving the commercialization of these advanced fuels, the RFS will make a major contribution to our broader fight against global warming.

Question # 2
Will passing a broader global warming bill, such as Lieberman-Warner, help achieve the goals of the RFS program, and if so how?

A comprehensive, economy-wide carbon cap and invest policy that includes complementary policies such as a low-carbon fuel standard, as Lieberman-Warner did, would certainly help achieve the goals of the RFS program. Including transportation fuels under the capped emissions would provide a financial value to reduced emissions from these fuels and an incentive to shift to low-carbon fuels. However, it is important to realize that even relatively high values for carbon will not be sufficient to drive research, development, and adoption of low-carbon fuels.

Simply too much capital inertia exists in the transportation fueling infrastructure for the price signal from the likely carbon prices to drive an orderly transition away from petroleum fuels. In other words, a carbon cap is necessary but not sufficient.

In addition to the cap, we need to use the revenues and value from auctioning and allocating carbon credits to drive innovation and we need complementary policies such as the low-carbon fuel standard. By reinvesting the value of the carbon credits in driving technological innovation in our economy, we can bring better fuels to market quicker, maintain our technological leadership in advanced fuels, and grow green, clean tech jobs. The low-carbon fuel standard is a technology neutral, performance based complement to market incentives for innovation. The standard requires steady improvement in the average performance from transportation fuels in a technology-neutral way that encourages the market towards best technologies.

Question # 3
Do you think we are in range of moving from mostly com ethanol to a substantial use of cellulosic biomass sources?

I think we are on the verge of this transition, but even once it starts, it is likely to take nearly a decade to complete and ultimately the proof will be in the pudding. There are at least a half a dozen projects that are vying to be the first to produce commercial quantities of cellulosic biofuels. On Wednesday, August 13, the major US corn ethanol producer announced that it would start producing the equivalent of about 20,000 gallons of cellulosic ethanol later this year. (See Reuters.)

But no amount of speculation or press releases will launch this transition nor would such a transition be inherently a good thing. Without safeguards, cellulosic and other second and third generation biofuels can lead to similar, if not identical, environmental and social impacts as conventional feedstocks. This is why we must continue to shift our fuels policies to a technology-neutral and performance basis. We need to make sure our policies drive the best technologies that really work and avoid picking "cellulosic," as promising as the technology is. We must also be sure to impose the same environmental safeguards and performance standards on cellulosic fuels. While these fuels promise to make it easier to produce large quantities of biofuels with a smaller environmental impact, they are no guarantee of good performance.

How do you see this transition unfolding and what do you expect the timeframes will be?

If we maintain or improve our incentives and with a little luck, I think it is realistic to assume we will have at least two successful projects making cellulosic biofuels by early 2011 and at least one more operating by 2012. Not all of these will prove viable, but between additional first of a kind projects and one or two second iterations, we could easily have a fleet of four projects by 2013, seven by 2014, 14 by 2015, and sustained exponential growth for a few years after that. The average size of these project will probably start on the smaller size, say 30-50 million gallons and then grow to 100-250 million per plant.

Questions for Written Submission
EPW Committee Hearing July 10, 2008

Response of Nathanael Greene
Natural Resources Defense Council

Question # 4
What additional approaches, beyond biofuels policies, would be effective in addressing global land use changes and related greenhouse gas emissions issues?

Global land use change is driven by many factors. Thus a broad array of domestic and international policies is needed to comprehensively address the issue. We should begin, of course, with assiduously protecting our own intact ecosystems from further degradation. Critical actions include upholding laws and regulations like the Roadless Rule that protect our undeveloped national forests; providing increased funding for land-acquisition; encouraging sprawl reduction; supporting afforestation programs; and expanding the effectiveness and breadth of our agriculture conservation programs.

Ultimately, international agreements and treaties that prioritize preserving biologically diverse and carbon rich landscapes will be critical to addressing GHG emissions from land use changes. Given that these emissions make up 10 to 20 percent of anthropogenic GHG emissions, with or without biofuels, we need to find ways to reduce and ultimately reverse these changes if we are going to avoid catastrophic climate change. Our need to find low-carbon alternatives to petroleum fuels only makes this more urgent and more complicated.

Question # 5
How important will low carbon cellulosic and advanced biofuels be in achieving emissions reductions in the transportation sector?

NRDC's modeling suggests that achieving about an 80 percent reduction in transportation sector GHG emissions by 2050 is eminently achievable, but will require significant contributions from all of the solutions of which we are currently aware. Improved vehicle efficiency, reduced driving through more livable communities and more use of mass transit and electrification of transportation will all need to play a critical role. However, even with all of these options deployed aggressively, we still forecast a need for about 20 percent further reductions from low-carbon fuels. In our modeling these low-carbon fuels need to provide at least an 80 percent reduction in lifecycle GHG emissions per gallon equivalent compared to gasoline. The only liquid fuels of which we are aware that have the potential to provide these reductions are advanced biofuels.

Getting the market place to deliver biofuels that provide this level of emissions reductions will be challenging. Biofuels are one of the few potential solutions to climate change that has the potential to actually increase emissions if not done carefully. This is why we believe it is so critical to continue to shift our biofuels policies to technology-neutral, performance based standards and incentives. This approach ensures that our policies only encourage technologies that move us in the right direction and let the market decide the best options.

Question #6
What tools do you recommend for evaluating and minimizing the potential environmental impacts, beyond lifecycle greenhouse gas emission impacts, of biofuels?

The environmental impacts and benefits of biofuels can go well beyond GHG emissions. At their best, biofuels could help us use water more efficiently, reduce water pollution, improve soil quality, and provide better protection for critical ecosystems than current agricultural and forestry land-uses. But without safeguards and performance based standards, biofuels carry grave risk to our lands, forests, wildlife, waters, soil and public health.

As noted above, the biomass safeguards established by EISA not only provide immediate amelioration of some of the greatest risks to our forests, grasslands, and important wildlife habitat, they also represent the foundation for future safeguards and incentives to address additional issues like water and soil conservation. Particularly considering the nexus between land-use change and GHG emissions, it is also important to emphasize the synergy between the biomass safeguards and the life-cycle GHG standards. The biomass provisions act as another safeguard against the clearing of native ecosystems like our imperiled grasslands, while also avoiding harm to our vulnerable wildlife, loss of old-growth forests, or the conversion of natural forests and degradation of our federal forests. It is critical that these safeguards are maintained and implemented aggressively and effectively.

Building on these safeguards, it is also imperative that global biofuels production move towards a credible and verifiable international sustainable certification standard. Already, significant progress toward such a standard has been made through the work of the Roundtable on Sustainable Biofuels. This effort, underway since 2007, is a multi-stakeholder effort - bringing together farmers, companies, non-governmental organizations, experts, governments, and inter-governmental agencies from around the world - to develop draft global standards for sustainable biofuels production and processing. After 12 months of consultation on its initial draft standard, the Roundtable has just released it next official draft for an additional six months of global consultation. This tool will assist consumers, policy-makers, companies, banks, and others identify biofuels that deliver on their promise of sustainability.

A third important step is to replace our other biofuels policies, like our current tax credits and tariffs, with a performance based, technology neutral incentive that will drive better environmental performance. One of the most critical areas to invest in is the identification, cultivation, and deployment of more sustainable feedstocks that do not induce direct or indirect GHG emissions, disrupt food supplies, and if produced properly have the potential to produce environmental co-benefits.

Finally, to achieve this potential, we cannot pursue biofuels in isolation. We need to increase the efficiency of our use of crop lands and forestry products and we need to encourage better environmental performance for all types of land-use. A critical set of tools across all types of land-use are better performance metrics and measurement tools. If we are going to require and incent better performance, we need to be able to define what that looks like on the ground and give farmers and foresters better tools to measure their performance. Then the market can develop

innovations and find the best way to meet societies (more efficient) demands with the minimum impacts.

The most urgent needs are in being able to measure or model accurately consumptive water use, fertilizer runoff and volatilization, and soil quality. Using our current conservation payments to pay for more quantifiably better performance across these metrics and reforming our current morass of biofuels tax credits to pay for better performance in these areas would result in tax payers getting a lot more for their money than they do today.

Senator CARPER. Thank you very much.

Every now and then, I like to ask the witnesses to comment on another witness's testimony. I am going to do that in this case. I am not going to ask Mr. Pierce and Mr. Faber to gang up on you, Mr. Greene, but is there anything that he said that you would especially like to comment on?

Mr. FABER. I would just like to say that, I am sure you know, Mr. Chairman, that until recently I worked for the Environmental Defense Fund for a number of years. I worked very closely with Tim Searchinger, author of the Science article on this subject on indirect land use issues.

I agree with much of what Nathanael said. I think one of the real stumbling blocks we face is that we don't yet have a common set of accounting principles for verification methods to know whether or not biofuels are going to significantly reduce or significantly increase greenhouse gas emissions. I think this is not so much a criticism of NRDC or other environmental groups or so much a criticism of the Congress for getting ahead of the science. It seems to me that in light of the fact that there is a great deal of new analysis, but also a recognition that we don't yet have the tools necessary to adequately assess all these indirect land use effects, that we ought to step back and slow down and live with a 10 billion gallon ethanol industry as opposed to rushing ahead and building a 15 billion or larger billion gallon ethanol industry.

Senator CARPER. Thank you.

Mr. Pierce.

Mr. PIERCE. Yes. I would just add a piece. I was trying to make the point that yield is a big deal. The more yield you have, the more sustainable any of your policies are going to be. The magical acre will go a long way.

Senator CARPER. What did you say in your testimony? I think you talked about going way back in time in terms of bushels of corn per acre. It seemed like it was 20 or 30 bushels?

Mr. PIERCE. That is right.

Senator CARPER. And we are looking now at?

Mr. PIERCE. We are average now 150 bushels. We are getting over 300 in high-yield cornfields. Soybeans are doing the same thing. These are phenomenal things that prevent hundreds and hundreds and hundreds of otherwise needed millions of acres that were otherwise meant to be planted, and technology is driving that even faster.

Senator CARPER. And prices are.

Mr. PIERCE. What is that?

Senator CARPER. And the price of oil as well.

Mr. PIERCE. I was just going to make one other point, and that is with respect to these indirect land use things, it is absolutely true that there are not sound mechanisms and algorithms to relate what you do mowing your front yard to what someone in Brazil does in their back yard. Absolutely true, and part of me thinks it will always be rather difficult making those connections because it is such a complex set of inputs.

I think that if we are going to address deforestation, we ought to do it with direct policies, and addressing it through the use of biofuels policies or cotton growth policies or soybean growth policies

or any other particular kind of thing is really kind of like trying to drive a car by driving a lug nut. I mean, it is just not going to work.

So really, deforestation is a big deal. It should be addressed with policies, but you recall some years ago, I recall some years ago when deforestation was a huge, huge issue being addressed with lots of policies, and biofuels wasn't even a whimper on the landscape. So direct policies for direct uses.

Senator CARPER. All right. Thanks.

Mr. Greene, do you want to make any comment in response? And then I have some other questions.

Mr. GREENE. Yes, sure. I think there is a real risk in assuming that we should just turn a blind eye, or just throw up our hands and say we can't do this. There is not an environmental issue that we don't face these days that hasn't been made worse by claims that because there is uncertainty around the science we should do nothing, or we should assume the value is zero.

I think trying to just hold the market steady, try to push back on competition, or deny the importance of indirect land use impacts, which I think is what we have heard suggested here, really runs that risk. Rather than trying to claim that it is all too complicated or too hard, we need to use the best tools we have, the best science, the best modeling, and start pushing on the market to go in the direction that we know it can.

Senator CARPER. All right. Thanks.

I mentioned earlier in one of my questions, I talked about this little biofuels company called Coskata. It is the firm in which GM has taken an equity position this year. They expect that they are going to be able to produce a biofuel for about $1 a gallon, use less than a gallon of water to produce a gallon of fuel, the energy it produces about seven times the amount of energy that goes into the production of the fuel, and greenhouse gas emissions are about 85 percent less than gasoline, and it can be created using plant waste, municipal waste, the old tires off our old cars, trucks and vans.

I hope that is going to happen. They are talking about being able to produce maybe 100 million gallons or so in the nest several years from a facility.

Another vision that I have is one in which you have a farmer, whether it is Delaware or some other place, who raises corn, going out into the field at harvest time, and on a single pass with their farm equipment being able to harvest not only the corn that is on the cob, but to also harvest corn holders, including the stalks and leaves, and to be smart enough to be able to leave something behind to fertilize the condition of the soil.

How much of a pipedream is that? Or is that something that is doable in the foreseeable future?

Mr. PIERCE. Senator, let me take a crack at that. As part of our cellulosic ethanol program focused on corn cob, the way to harvest is a very important thing. We have been working for some years with a number of universities and companies like John Deere that are precisely focused on things like that. With one pass through, farmers turn out not to want to take a second pass through their field, and so they want to do it with one pass.

Senator CARPER. Not with fuel prices what they are, that is for sure.

Mr. PIERCE. Well, even without fuel prices, what they want is one pass through the field. In fact, we have done a life-cycle assessment, and in fact have had someone from the NRDC on our life-cycle assessment board for this for the last 4 years. We have done county-by-county looks. It depends on the actual farm, but sometimes you can take maybe 50 percent or 75 percent of the cornstover and still have good soil health. Other times, you can only take maybe 25 percent. But on average, you can take about 40 percent to 50 percent of the cornstover, leaving the rest behind for soil health, as you say.

Senator CARPER. All right.

Mr. GREENE. I would just add, I think the Coskata example is a really exciting one. There has been just an incredible explosion of innovation in the area of conversion technologies. You heard the fellow from DOE talk about the level of private sector investment that has gone into that.

I think the real challenge at this point is helping farmers bring that same type of innovative thinking to the feedstocks, so we do want to find feedstocks like the cornstover you are talking about, that would allow us to produce food and more food per acre, which we know we need to do to feed ourselves and feed the world, but then also be able to get fuel off of those same acres.

Senator CARPER. It reminds me a little bit of what the Indians used to do with buffalo. They would find a way to use almost every part of the buffalo, so none of it would go to waste.

I would like to followup with Mr. Greene. I think you may be the only witness today who has mentioned cap-and-trade, although Senator Boxer and I had a brief discussion when she was here, about the role of cap-and-trade, adopting a cap-and-trade system, putting it in place, the kind of positive role that might have on addressing these issues. Do you want to take a shot at that?

Mr. GREENE. There are two parts of the cap-and-trade system obviously that are just absolutely critical here. One is starting to level the playing field in terms of the cost of emitting carbon, putting a real value on that in the system so that the oil and our fossil fuel technologies can't just keep polluting our environment while other cleaner technologies don't get any benefit for avoiding pollution that they provide us.

And then the second is obviously what you do with the revenues you create when you auction off the credits under the cap, and using that money smartly we can really drive all the sorts of innovation, create jobs, build whole new sectors, and dramatically expand the sectors that have been growing so rapidly recently in the clean-tech world. So really this is a beautiful two-step process, and we just need to get going as fast as possible if we want to revitalize our economy and protect our environment.

Obviously, the legislation that was debated here in the Senate also contemplated a low carbon fuel standard, which I think is a critical next step, building off of the renewable fuel standard, because the renewable fuel standard has minimum life-cycle greenhouse gas requirements. So those are the floor. Below that, you are not legal. You are not allowed to play in this mandated market.

But what we want is not people just to be just barely legal. We want them to be doing as good as they possibly can. That is what the low carbon fuel standard really encourages, but also acts as a defense against high carbon fuels such as tar sands or coal-to-liquids.

So the legislation that was debated here in the Senate and that type of approach, both a cap on carbon emissions and using the dollar wisely to invest in our economy, invest in new technologies, and then other types of policies that get packaged like the low carbon fuel standard, all absolutely critical.

Senator CARPER. Mr. Faber.

Mr. FABER. I would just add that the LCFS can actually help us address the——

Senator CARPER. LCFS?

Mr. FABER. The low carbon fuel standard. It could be a benefit or it could be a curse. Let me explain. I think if you set the LCFS right, it could actually require a significant reduction in greenhouse gas, life-cycle greenhouse gas emissions, and you got the accounting right, and you got the verification systems right, which are a lot of ifs, then that could actually act as a brake on ultimately the amount of food that is converted into fuel.

If you set the standard poorly, if the standard is too low, if corn ethanol is exempted or treated unfairly, then you could have the unintended consequence of effectively increasing the current mandate and diverting even more food into our fuel supply.

So regardless of whether or not we should have a low carbon fuel standard, the details will really make an extraordinary difference in whether or not a low carbon fuel standard increases food prices or ultimately helps act as a brake on the amount of food that is being diverted to our fuel supplies.

Senator CARPER. All right.

Mr. Pierce, DuPont is involved I am sure in a number of biofuels projects that I am not aware of. The ones that I am most aware of are working on cellulosic ethanol, in part fueled by a Department of Energy grant of some $18 million or $20 million. I am aware of the work that you all have done with respect to biobutanol.

Do you have a demonstration project going on in England with biobutanol, a partnership with BP that involves actually selling the product? What are you doing there? What are you learning from that endeavor?

Mr. PIERCE. Right. We are building a pilot facility in the UK on a BP site in northeastern United Kingdom. But perhaps the demonstration project you are thinking of is fleet testing biobutanol in a variety of cars.

Senator CARPER. I think that is it.

Mr. PIERCE. We have done a lot of fuel testing in cars in the United States, employees' cars and things like that looking for new effects. But now this is fleet testing, mixtures of biobutanol with gasoline in the UK with normal cars and normal gas stations and things like that. BP is a fuel company and they know all the types of things one needs to know when one is introducing new fuels, so we are taking those steps to understand how butanol is going to interact with that supply chain.

Senator CARPER. And when do you expect to have learned something from what you are doing over there?

Mr. PIERCE. Say that again please?

Senator CARPER. When do you expect to have learned?

Mr. PIERCE. Well, we have already learned a bunch of stuff, and so far it is good news. I mean, you keep moving the thing along and they start off with no effect, no effect, so getting a bunch of non-answers is a good thing. When we are done, if we never get a bad answer, we will consider it a resounding success. But this will keep going on until you are millions and millions and millions of gallons, and every time you go a little bit further, you keep your eye out and make sure that you are treading carefully.

Senator CARPER. All right.

Can any of you talk to us about biofuels work that is being done that involves algae?

Mr. GREENE. Sure. The promise of algae is really in its incredible potential for yield.

Senator CARPER. We have to worry about algae that forms on the inland base in southern Delaware and the DelMarVa Peninsula. It would be nice to——

Mr. GREENE. You know how prolific it is.

Senator CARPER. Yes.

[Laughter.]

Mr. GREENE. So just to give you a sense of why people are so excited about algae, with biodiesel you get roughly 60 gallons per acre if you are using soy-based biodiesel; corn ethanol, roughly 400 gallons. People talk about cellulosic, and its relatively early levels getting 800 to 1,000, and maybe in the future getting, if we are wildly successful, over 2,000 gallons per acre.

People talk about algae starting at about 10,000—6,000 to 10,000 gallons per acre, and going up as high as 100,000 gallons per acre. So that is why it is such an exciting and important technology to be working on. Obviously, there are real challenges. To get those really high yields, you end up basically building very infrastructure-intensive systems, maybe enclosed systems. So you basically have plastic or glass covering acres and acres of land, hundreds of acres of land.

There are important questions about water, both water use and water pollution concerns where the algae goes. So it is incredibly exciting technology, but one where there are lots of innovations and questions that we need to understand as the industry grows.

Senator CARPER. All right.

Anyone else want to comment on this?

Mr. FABER. I would just say that the law of unintended consequences is always in effect. That is certainly the case with all of these second-generation fuels. Let me just say, it is critically important that we get these advanced and cellulosic biofuels to commercial scale as quickly as possible, if only because the Congress has built this mature corn ethanol industry that has now made corn more valuable as an energy source than as a source of food.

So for those of us who are worried about the price of food and our ability to feed the poorest among us, getting these second-generation fuels to commercial scale is critically important. If it is not done carefully, it could have the same effect as corn ethanol. To

grow switchgrass or other grasses or even forest lands or plantations at a commercial scale for biofuels production, ultimately you could wind up displacing land that is now being used for food crops. If you squeeze the balloon, it is going to pop out somewhere else. That is why using these wastes—stover, rice straw, wheat straw—really hold the most potential to produce more fuel without pitting our energy needs against the needs of the hungry.

Senator CARPER. All right.

Another question, if I could, for you, Mr. Greene. EPA's life-cycle analysis of greenhouse gas emissions associated with biofuels will hinge on the assumptions that they make and really the criteria that they use. As you know, there has been a debate over whether to account for indirect emissions in life-cycle modeling.

My question is, does EPA have the authority to include international indirect emissions in its modeling? And a second half of that question would be, is it necessary to consider indirect emissions?

Mr. GREENE. Let me actually start with the second part of the question, which is that it is not only necessary, but it is absolutely critical. Most of the land use change that is happening in the agricultural sector is happening internationally, and a lot of that change is happening on biologically rich and carbon-rich landscapes like rain forests, like grasslands. So looking internationally and understanding the changes that happen internationally are just absolutely essential. Similarly, as John mentioned, some of the greatest potential for innovation is in international agriculture as well.

As to the authority, I think not only does EPA have the authority, I think it was clearly the intent, if I can be so bold to read into it, of the language that Congress adopted. Congress had the wisdom to talk about the full life-cycle impacts, all of the aggregate emissions, and many other sections of the bill talk specifically about domestic issues and international issues, and in this instance did not specifically call out domestic only impacts.

It is also important to understand that we are not talking about regulating land use internationally. We are just talking about understanding what is happening and including it in the calculus of fuels that are produced and how that changes the international landscape.

So I believe it is critically important that they do. I hope and read the language, the plain English language to direct them to include the international issues, and I believe legally it is clearly within their scope.

Mr. FABER. Yes, but the real challenge is—and John suggested this—applying sustainability standards to biofuels doesn't solve the problem if all you are doing is focusing on crops that are being used to produce fuels. This year we will use about 12 million acres of land that produces corn to produce corn ethanol in the U.S. Well, we are going to find another 12 million acres. It is not always a one-to-one relationship. But we are going to bring other land into cultivation to produce food that wouldn't be subject to these sustainability standards or these accounting principles or verification standards.

So we can pretend that these biofuels policies are not going to have ultimately the indirect effects that I think we all know they

will, if we just focus on land that is being brought into production for biofuel production. What will happen obviously is you will have two sets of books. These crops were produced on lands that were previously cultivated, therefore they ultimately don't create a problem; and these lands will produce food and feed and are not subject to the sustainability standards.

If we are going to have a set of sustainability standards—and that is I think an open question—it ought to apply across the board.

Mr. PIERCE. Or this crop is grown for biofuel, but this crop is grown for feed. The acreage use has exactly the same impact on whatever life-cycle analysis you may care to discuss. But if you have two different sets of books based on intended use, you run into a problem not only of keeping books, but having a rational calculation.

Mr. FABER. And it is very hard to figure out. We don't have the tools today to assess these indirect effects issues. The notion that Congress has gotten ahead of this without having all the available science resolved for us is troubling. We have seen the consequences. According to the United Nations, there are 50 million more people who are in poverty primarily because of increased food prices driven by biofuels.

Senator CARPER. I see Mr. Greene over here who is shaking his head. Do you want to say something else on this?

Mr. GREENE. Yes. Unfortunately, Scott has misunderstood the issue of indirect land use issues. Maybe he thinks he is talking about the renewable biomass definition, which is an important part of the renewable fuel standard. But the indirect land use issue is something you add onto any acre. So it doesn't matter whether you are saying you are using it for food or you are saying you are using it for fuel, if you use it, it is what that acre could have done otherwise. So it is an economic calculation about how the world changes when you make the change in the use of a given acre of land.

I think the argument that it is too complicated to certify sustainability on an acre or land, or that it is too complicated to bother calculating the indirect land use emissions again is an incredibly risky and poorly advised position. It argues that we can't ever differentiate in the markets between good practices and bad practices because maybe there is a shell game going on, or that because we don't know exactly how to calculate something, we should assume it is zero and therefore not address the impacts.

So Scott's colleagues at Environmental Defense I am sure would not apply to that position, because it is exactly what has led us down the global warming path. It is because people have argued for so long that the uncertainty around global warming is too great that we can't regulate it, that we now find ourselves in a crisis in global warming, where we don't have the luxury of waiting around to find the perfect solutions to global warming. We have to move aggressively to get the best solutions into the market as fast as possible.

Senator CARPER. Yes, maybe just a quick point, and then we will move on.

Mr. FABER. That is really a misrepresentation. I don't think anyone is suggesting that we shouldn't try to develop accounting prin-

ciples and verification systems. I am only making the point that we haven't yet been able to do that and we need to do that before we proceed further.

Mr. GREENE. That is what EPA is doing right now.

Mr. FABER. And while EPA is doing it, they are also simultaneously mandating that refiners blend nine million gallons of ethanol into our gasoline supplies this year.

Mr. PIERCE. Just a brief comment. There was discussion earlier about cap-and-trade and low carbon fuel standards, those are directly applicable, straightforwardly understandable, non-indirect measures that can be taken. The same type of non-indirect measures can and have dealt with things like deforestation and the like. We should allow a cotton farmer to choose to grow soybeans without having to do a recalculation about whether it is an appropriate use of the land, and that is within the United States, let alone what happens some thousands of kilometers away.

Senator CARPER. All right. We have come close to the end.

I think mostly on this panel, but even on the first panel, we talked a bit about the challenge of expanding global agricultural output, and that to the extent we can help our neighbors around the world do a better job there, we address our problems and we also address their problems. We hear almost on a weekly basis about the violence in countries in South America, like in Colombia for example, where it would be great if the farmers there would grow things other than drugs, the crops used to create drugs. And Afghanistan, a huge creator—I think they produce the vast majority of poppies used to create heroin.

I read an interview in the newspaper this past week with some farmers in Afghanistan where their crops are drying up. Their corn crops are basically, at least on these farmers' lands, pretty much worthless. And yet we have DuPont and other companies, your Pioneer subsidiary, are developing corn that can better face all kinds of pests and drought and so forth.

But it seems to me that there is a real opportunity here for us to help them feed themselves, to help them particularly in countries where they are creating crops that are used to feed drug addictions here and around the world, and the need to make sure that food prices don't continue to go up.

Any advice for us here in the Congress as to how we can help make that happen? This goes back to Thomas Edison talking about sometimes we miss out on an opportunity because it comes along wearing overalls and is disguised and looks a lot like work. There is real opportunity here.

Mr. FABER. Clearly, we have not invested nearly enough in global agricultural development. We have paid a price for that. Global agricultural development increased by about 2 percent annually from 1970 to 1990. It has now slowed to about 1.3 percent or 1.2 percent annually. So our ability to feed ourselves is gradually slowing.

At the same time, global demand, especially in places like Asia and India, especially for meat protein, is growing dramatically. So clearly, we need to invest a lot more in global agricultural development. Those investments won't yield benefits for many, many years. So I think that anybody who has looked at this objectively, including the U.N. FAO and others, would say that we need to

start making those investments, but we are going to see significant shortages or supply demand challenges in the next few years as more and more of our commodities are diverted for fuel production.

Mr. PIERCE. I do think that is something Congress can do via policy to enhance the type of agricultural aid and dissemination of current technologies throughout the world. I talked about going from 150 bushels an acre to 200 bushels an acre in the U.S., and that is pretty good. But you can go many factors in broad, broad swaths of the world using technology from just today, not even future technologies, not even GMO technology, just modern agricultural practices. So that is something that Congress could do.

Another thing that you might consider is we talk about all this cellulosic feedstock. There is a whole part of the cellulosic feedstock world that is about collection. You talked about the combine going through the field, and the like. A lot of these technology companies like Coskata, they are focused on what happens in the plant, right? There is a whole distribution infrastructure for grains, but it does not yet exist for cellulose. So some type of assistance in various States—Tennessee is doing it with switchgrass, there are some other small State efforts around—but putting that supply chain in place to go from the farm field to the facility would be something else that could be of assistance.

Senator CARPER. Good. Thanks.

Mr. Greene.

Mr. GREENE. Yes. I think this is a really critical point that you have touched on. You are absolutely right that there are head-on things that we can do about making sure the poorest and most vulnerable among us have access to food, and that all of us face food prices that are affordable.

I think the greatest risk in the position that Scott has put forward is the idea that the only thing, the only tool we have to address this critical and moral challenge is by tweaking the biofuels policies. In fact, if you look at the history of biofuels since the first RFS, where the industry has been consistently above the mandate, the argument that we could somehow change the mandate and that would magically solve the world hunger problem is just alarmingly dangerous, I would argue, because it distracts from the policies that are absolutely critical like the policies you are talking about here—agricultural trade policies, ways that we can help farmers around the world grow more, which not only addresses the near-term problems, but also goes to longer-term issues of how do we keep those farmers from going into forests, going into grasslands, while the population continues to grow.

Mr. FABER. Well, the World Bank says the increase in global——

Senator CARPER. Mr. Faber, I know you want to say this, and go ahead and say it, just be brief, because I have one more question.

Mr. FABER. I represent an industry.

Senator CARPER. I know you do. I want you to have a chance to say, but then I want us to be able to move on and then eventually to move out.

Mr. FABER. I couldn't agree more.

Senator CARPER. Go right ahead.

Mr. FABER. Well, again, a third party World Bank economist, disinterested party, the increase in global production and yields were

above trend and would have been more than adequate to accommodate demand growth and even add to global stocks without the large increase in biofuel use.

Clearly, there are a lot of factors driving food inflation, but according to the World Bank, the IMF, IFPRI, FAPRI, every independent agricultural expert who has looked at this issue, surging demand, especially between 2006 and 2008 for corn ethanol is a dominant factor in rising food prices. I don't think there is any escaping that. It is not the only solution, but clearly we should be looking hard at how much more ethanol we are going to produce while we are looking at other solutions such as increasing global agricultural development.

Senator CARPER. All right. Thank you.

Mr. Greene, one last question for you, and I think what I am going to ask the panel, all of you, is a final question. This is like the second-to-last question, but this is just directed at you, Mr. Greene, but the others can be thinking about my last question.

You bring different perspectives. Even Mr. Faber has put in some time at Environmental Defense, a fine outfit. I want to commend all of you for your work on the partnership that has been created on climate change. There is a lot of leadership at this table and we are grateful for that.

But I want to ask you all to tell us, where do you think you agree in terms of the path forward for our Country? Obviously, there are some areas where you disagree, but where do you agree? So just be thinking about that, and we will come back to that at the very end, which is almost upon us.

But Mr. Greene, as you are certainly aware, earlier this year a number of scientific studies were published analyzing greenhouse gas emissions associated with production, associated with transportation, associated with combustion of various types of biofuels. Some argue that it is difficult for virtually any type of biofuel to reduce carbon emissions when land use changes are taken into account, while others paint a more positive picture of biofuels' potential. What do these studies get right and what do they get wrong?

Mr. GREENE. Well, I think they point to a critically and undeniable true dynamic, which is that the laws of supply and demand work in agriculture and the fiber sector. So if you are taking supply out in one part, the market tries to reach equilibrium. There are really only three things the market can do. Prices can go up so people can consume less. We can bring new land into production. And we can intensify the production of the lands that we have. All three are going to play, so pointing out the critical importance of that dynamic, and when you do bring new lands into the system, how large those greenhouse gas impacts can be. That was really I think the fundamental information that woke up a lot of people that was particularly in some of the articles in Science early in February.

I think what they also both acknowledged, and all the articles I have seen have acknowledged, the potential to produce biofuels in ways that avoid these impacts, that there are feedstocks out there that we are aware of today—waste, construction demolition debris, agricultural residues, some forest residues if they are collected in sustainable and responsible ways—and the potential for new feed-

stocks to be developed and agricultural practices to be developed that avoid those impacts. All of that I think they get right.

I think the challenge at this point is how do we take that initial modeling, the initial estimates that came out of that—it is one point; it does not represent a scientific consensus—and use it, build on that modeling and develop new modeling and get the market moving in the right direction.

We are not going to come up with the right point estimate or point number at day one, but some method of sending a clear signal to the market to avoid those types of impacts, to minimize those types of impacts, and maximize the production of feedstocks and fuels that either avoid it, or even better, produce more food and fuel. There are options out there that we know already that are not in the marketplace, but switchgrass, for instance, has more protein in it per acre than soybeans, and that is the primary reason we grow soybeans is to feed livestock.

So if we could get more protein per acre, while getting the biomass residue that we want from switchgrass to make fuels, that is a solution that makes us all better off. I think that is what those articles pointed out is the direction we need to be heading.

Senator CARPER. Thank you.

One of the things I try to do around here in the Senate is to try to get people to work together. Senator Voinovich, who was unable to be with us today because of a number of other conflicts in his schedule, that is one of the things that he does. There are others on our Committee who certainly endeavor to try to find a way to pull together and develop consensus on difficult issues.

This is an issue on which we have developed a fair amount of consensus, but clearly we are going to need more going forward. We not only need to develop consensus, but to use common sense in developing that consensus.

In closing, just share with us your thoughts of where you agree in terms of a path forward for our Country, including us in Congress, but for our Country.

Mr. Pierce.

Mr. PIERCE. Yes, I will take a start at that. I have a sense from the discussion today that we all have a strong anticipation of the benefits of cellulosic technology and biofuels, as well as advanced biofuels; that policies like cap-and-trade and low carbon fuel standards properly applied can be very helpful in getting us to that.

We didn't talk at all really today about national security. We all talked about the environmental effects and this and that of course of other big parameters, but underlying a lot of this biofuels activity comes down to national security issues, too.

But all in all, while there were I think some specific disagreements in terms of specific approaches one might take, the overall view that biofuels have a very positive impact to make came across loud and clear all day long.

Senator CARPER. All right. Thank you.

Mr. Faber.

Mr. FABER. I would just agree. I think there is a broad agreement that we need to get second-generation fuels, advanced cellulosic biofuels to commercial scale as quickly as possible, to make

sure we have the right safeguards in place so that we are limiting the potential for unintended consequences.

I think there is probably agreement that we ought to be reforming the tax credit that goes to refiners to really help favor the commercialization of those second-generation fuels, and probably some agreement—or we could easily find agreement—that we ought to reduce or significantly modify the tariff. A lot of these second-generation fuels aren't going to be produced here. They are going to be produced in equatorial regions where you can get multiple harvests, and eliminating or significantly reducing our tariff, or even somehow linking it to greenhouse gas emissions would be a significant step forward.

Senator CARPER. Thank you.

Mr. Greene.

Mr. GREENE. I would echo what the other panelists have said, and particularly draw on that last point that Scott made, which is the tax credits and the import tariff today are very blunt tools that were appropriate when the industry was nascent. But today, we can and should get more for that money. It is a lot of money that is on the table. Even at 45 cents a gallon, when you put it in the context of the mandate, we should be getting more out of that money.

I think with the climate legislation coming down the pike, with climate being part of the renewable fuel standard, we shouldn't stop at climate when we look at those tax credits. We should try to look at other types of sustainability aspects—water use, water efficiency, water pollution, wildlife management, soil protection—the panoply of issues that make up sustainable agriculture, sustainable production of the feedstocks, and sustainable conversion. They should all be worked into those tax credits, but it seems a really ripe area for sending the industry to moving forward in an even better direction.

Senator CARPER. Well, gentlemen, we appreciate very much your taking the time out of your schedules, out of your lives, to be with us today, for your preparation for this hearing, and for your presentation, and for your willingness to respond to our questions.

We have a lot of hearings around here, as you might imagine. I serve on five full committees. I don't even know how many subcommittees I am on. I chair three. In the course of a month, I sit through some subcommittee hearings or some committee hearings that when they are over, they are over, and you basically turn the page and that was that. Today's hearing, this was an exceptional hearing. I really thank the panelists for helping to make it so.

I want to thank the members of our staff who worked very hard to prepare for this as well, and express our appreciation. It is important for our Country. We have to figure out how to get this right. To the extent that we do, I think we enhance our national security.

We certainly enhance our environmental security and our economic security. I think we provide some added economic opportunity here in this Country, but we could also do that around the world and maybe even take a small step toward eradicating illegal drugs. I like to say switchgrass is a grass that will save the world. I don't know if that would be the case, but we have the potential

here for doing a whole lot of good if we get this right. It is just important that we do that. So thank you for helping us to get it right.

With that having been said, this hearing is adjourned. Thank you.

[Whereupon, at 12:25 p.m. the subcommittee was adjourned.]

142

Rising food prices: Policy options and World Bank response

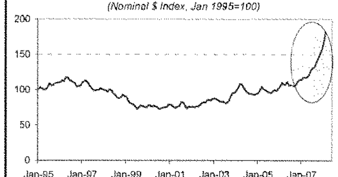
This note is being distributed for information as background to the discussion of recent market developments at the Development Committee meeting. It was prepared by PREM, ARD and DEC, drawing from work across the Bank. Questions/comments should be addressed to Ana Revenga, PRMPR (ext. 89850).

1. *Context*

1.1 Rising food prices: trends and determinants

The rising trend in international food prices continued, and even accelerated, in 2008. U.S. wheat export prices rose from $375/ton in January to $440/ton in March, and Thai rice export prices increased from $365/ton to $562/ton. This came on top of a 181 percent increase in global wheat prices over the 36 months leading up to February 2008, and a 83 percent increase in overall global food prices over the same period (see Figure 1).

Figure 1. Food prices
(Nominal $ Index, Jan 1995=100)



Source: DECPG

Increased bio-fuel production has contributed to the rise in food prices. Concerns over oil prices, energy security and climate change have prompted governments to take a more proactive stance towards encouraging production and use of bio-fuels.[1] This has led to increased demand for bio-fuel raw materials, such as wheat, soy, maize and palm oil, and increased competition for cropland. Almost all of the increase in global maize production from 2004 to 2007 (the period when grain prices rose sharply) went for bio-fuels production in the U.S., while existing stocks were depleted by an increase in global consumption for other uses.[2] Other developments, such as droughts in Australia and poor crops in the E.U. and Ukraine in 2006 and 2007, were largely offset by good crops and increased exports in other countries and would not, on their own, have had a significant impact on prices. Only a relatively small share of the increase in food production prices (around 15%) is due directly to higher energy and fertilizer costs.[3]

The observed increase in food prices is not a temporary phenomenon, but likely to persist in the medium term. Food crop prices are expected to remain high in 2008 and 2009 and then begin to decline as supply and demand respond to high prices; however, they are likely to remain well above the 2004 levels through 2015 for most food crops (Table 1). Forecasts of other major organizations (FAO, OECD, and USDA) that regularly monitor and project commodity prices are broadly consistent with these projections. Predictions of high food price in the medium run are further strengthened when we factor in the impact of policies aimed at achieving energy security and reduced carbon dioxide emissions, which may present strong trade-offs with food security objectives (see Section 3 below).

[1] Numerous countries have set standards or targets for use of bio-fuels. The E.U. has set a goal of 5.75 percent of motor fuel use from bio-fuels by 2010. The U.S. has mandated the use of 28.4 billion liters of bio-fuels for transportation by 2012. Brazil will require that all diesel oil contain 2 percent bio-diesel by 2008 and 5 percent by 2013, and Thailand will require 10 percent ethanol in all gasoline starting in 2007. India mandates a 5 percent ethanol blend in nine states, and China is requiring a 10 percent ethanol blend in five provinces.

[2] From 2004 to 2007, global maize production increased 51 million tons, biofuel use in the U.S. increased 50 million tons and global consumption for all other uses increased 33 million tons, which caused global stocks to decline by 30 million tons (Mitchell 2008).

[3] Mitchell (2008) 'A note on rising food prices' (mimeo)

Table 1. Index of projected real food crop prices, 2004=100.

	2007	2008	2009	2010	2015
Real Prices					
Maize	141	179	186	176	155
Wheat	157	219	211	204	157
Rice	132	201	207	213	192
Soybeans	121	156	150	144	127
Soybean oil	138	170	162	153	119
Sugar	135	169	180	190	185

Source: DECPG.

1.2 Impact on countries and households

Rising global food prices are contributing to high food inflation in many countries. The pass-through of rising global prices does not translate into an immediate and proportionate rise in domestic price levels, due to various factors such as a weakening dollar, domestic infrastructure and price stabilization policies. While the extent of global price transmission varies, over the past year there have been significant surges in domestic food price inflation in countries such as Sri Lanka (34%), Costa Rica (21%), and Egypt (13.5%). In many countries and regions, food price inflation is higher than aggregate inflation and contributing to underlying inflationary pressures. For example, in Europe and Central Asia overall inflation in 2007 averaged 10%, food inflation 15% and bread and cereals inflation 23%.[4] This compares to 6% overall inflation and 6.4% food inflation in 2006.

The terms-of-trade effects of these higher food prices have generally been mitigated by rising non-food commodity prices, although these averages mask significant balance of payments impacts for certain countries. When all primary commodity price changes are considered, the terms-of-trade impacts become large and positive for resource rich countries as exports of oil and other commodities more than compensate for higher food prices. Countries with the largest negative terms-of-trade impact include Lesotho, Eritrea and Gambia.

The distributional impacts of rising food prices can be serious even in countries where the balance of payments has not been adversely affected. While some households benefit from higher prices, others are hurt by them, depending on whether they are net producers or consumers of the food staple and the extent to which wages adjust to higher food price inflation. In general poor people, especially in urban areas, suffer due to rising food prices. Using a sample of household data for eight low income countries, a recent paper[5] analyzes the impacts of higher prices of key staple foods on poverty, taking into account direct impacts from changes in commodity prices, and impacts through changes in wage rates for unskilled labor. The results show that, in six of the eight countries considered, price increases for staple foods were associated with a significant rise in poverty. Averaging across these eight countries, the increase in food prices between 2005 and 2007 is estimated to have increased poverty by 3 percentage points. A recent assessment in Indonesia shows that over three-fourths of the poor are net rice buyers, and an increase in the relative rice price by 10 percent will result in an additional two million poor people (or 1% of the population). Analysis using an alternative price index weighted according to the consumption patterns of the poor in Latin America suggests that in most countries of the region, the effective inflation rate faced by the poor is higher than the official rate by 3 percentage points.[6]

---

[4] Alam, Kathuria and Vybornaia (2008) 'Rising Food Grains and Energy Prices in ECA: Some Economic and Poverty Implications, and Policy Responses' (mimeo).
[5] Ivanic and Martin (2008) 'Implications of Higher Global Food Prices for Poverty in Low-Income Countries.'
[6] 'Rising Global Food Prices – the World Bank's LAC region position paper' (2008).

For many countries and regions where progress in reducing poverty has been slow, the negative poverty impact of rising food prices risks undermining the poverty gains of the last 5 to 10 years, at least in the short term. For example, in the case of Yemen, estimates show that the doubling of wheat prices over the last year could reverse all gains in poverty reduction achieved between 1998 and 2005. Over the long term, the impact on poverty of higher food and other commodity prices is less clear and depends partly on how overall economic growth responds to increased wealth accumulation and investment by net food-selling rural households.

2. What can governments do?

Policy interventions can be divided into three broad classes: (i) interventions to ensure household food security by strengthening targeted safety nets; (ii) interventions to lower domestic food prices through short-run trade policy measures or administrative action, and (iii) interventions to enhance louger-term food supply. Within all three categories of policies there are 'first best' or preferred options that are more effective and equitable, and introduce fewer distortions. Annex I summarizes the main policy options and ranks them according to the extent to which they meet these and other desirable criteria.

2.1 Ensuring household food security via targeted safety nets

First best options to address food insecurity include targeted cash transfers to vulnerable groups. These support the purchasing power of the poor without distorting domestic incentives to produce more food, and without reducing the incomes of poor food sellers. Examples include cash or near-cash transfers[7] that are conditional upon meeting a requirement (such as low income, location or occupation) or engaging in a mandated behavior (such as sending children to school). The scale, targeting efficiency and value of such transfer programs tend to be directly related to overall levels of development, given the administrative complexities and fiscal costs entailed. They are not always a feasible option in low-income countries with weak administrative capacities. Various kinds of cash transfer programs are currently used in Brazil, China, Ethiopia, Egypt, Indonesia, Mexico, Mozambique, South Africa, Sri Lanka, and Tunisia. Several of these countries are adjusting current programs in response to the rise in food prices. For example, in Ethiopia, where food price inflation in February 2008 was 23 percent (year on year), the Government has raised the cash wage rate of the largest cash-for-work program by 33%.

A number of countries, including Bangladesh, Madagascar, Cambodia, and India, are using **self-targeted[8] food-for-work programs,** while others, iucluding Afghanistan and Angola, use **emergency food aid distribution** to ensure food security for vulnerable groups. The food-for-work program in Bangladesh has been expanded recently due to both natural disasters and the rise in food prices. While self-targeting reduces the costs involved in administrative targeting, the physical transfer of food is itself costly and can lead to leakages. Food aid can also have growing disincentive effects on local production if it becomes entrenched beyond the initial emergency or is not tied to a work requirement.

Still other countries, including Bnrkina Faso, Brazil, China, Kenya, Honduras, Mexico and Mozambique, make effective use of **school feeding programs** to improve the food intake of school-age children and their families. South Africa is expanding allocations to its school nutrition program to keep pace with the rate of food inflation.

---

[7] Food stamps are the most frequently used form of near-cash transfer.

[8] Self-targeted programs are designed to minimize the incentives the non-poor may have in taking part in the program. This is typically achieved through a mix of rationing benefits (e.g. limiting quantities of food), physical requirements (e.g. manual work for food), and queuing.

On the downside, school-based programs do not typically address child malnutrition at its most critical point – when children are in their infancy.

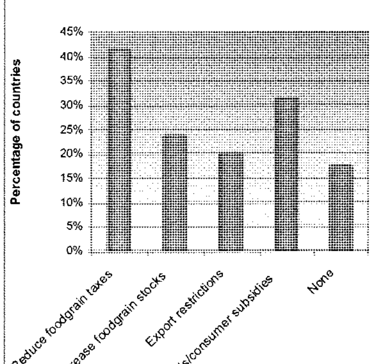
Rising food prices also risk derailing recent gains in **reducing malnutrition**. Between 1990 and 2005, the share of children under five with moderate and severe stunting fell from 33.5 percent worldwide to 24.1%.[9] While food prices are not the main driver of malnutrition, they do affect nutritional outcomes through their impact on real incomes and household purchasing behavior. In compensating for rising food prices, vulnerable households may substitute towards less food, or cheaper, but less nutritious, substitutes for current diets.

2.2 Ensuring household food security by lowering domestic food prices

First best options to lower domestic prices include reducing tariffs and other taxes on key staples. Many countries impose tariffs on food imports, both to encourage domestic production and boost domestic revenue. In times of sharply increasing prices, reductions in tariffs and taxes can provide some relief to consumers, albeit at a fiscal cost. The revenue loss from reducing tariffs can be significant and the fiscal implications of combining this with additional social protection expenditures may well require cutbacks in lower priority areas. Some twenty-four of fifty-eight countries sampled have recently reduced import duties and VAT in the wake of rising food inflation (see Figure 2). Others, such as the Philippines, continue to maintain high tariffs to protect domestic producers in– yet these high tariffs adversely affect the large majority of the poor, who are net consumers.

Several countries (mainly in the Middle East-North Africa region) have a long history of using **bread or grain subsidies specifically targeted to the poor** to cope with household food insecurity. Others have introduced consumer subsidies for staples following the recent rise in food prices. For example, the Government of Yemen is supplying wheat in select markets at subsidized rates following a sharp rise in food prices. In early 2008 the Government of Pakistan announced that it was reviving a ration card system to distribute subsidized wheat. The risk with such measures is that they can become entrenched, incurring high fiscal costs. Moreover, if consumer subsidies are met by measures to keep producer prices low, this can create disincentives for domestic food producers, and end up being counterproductive. The one exception is when price controls are explicitly introduced as a temporary measure and are widely felt to be justifiable in terms of a higher social goal. In such cases, the risks of entrenchment will be minimized, as observed in recent interventions to limit price increases for staples during Ramadan in Morocco.

Figure 2. Food Price Policies (% of 58 countries)



Source: Data based on responses from 58 country teams

For countries that are grain exporters, there may be political pressures to **ban or tax grain exports** in high price years. Unfortunately, several countries have now implemented these types of measures. These policies tend to have a limited impact on domestic price levels and a significant negative effect on earnings for domestic producers and exporters. They can also lead to sharp price

[9] World Bank (2008) 'Global Monitoring Report: MDGs and the Environment – An Agenda for Inclusive and Sustainable Development.'

fluctuations in countries that depend on imports, proving harmful to the global system.

In the 1970s and 1980s, many countries implemented a **grain buffer stock** policy to physically carry over grain surpluses (domestic or imported) from low price years to high price years. In practice, this policy tended to entail high fiscal costs with difficult management and governance issues, while the benefits it yielded for household food security were unclear. Furthermore, world markets could be relied on to provide a steady supply of relatively cheap grain imports when needed. More recently, however, the stock-holding policies of several large producers—such as the U.S., E.U. and China—have changed, contributing to the present situation of very low global grain stocks and increased global price volatility. As a consequence, a number of developing countries, such as Indonesia, are considering reverting to this form of price management, particularly after experiencing the impact of export bans in key export countries.

2.3 Measures to stimulate a medium-term food grain supply response

While higher grain prices are clearly a burden to poor net purchasers of food, they also present an opportunity to stimulate foodgrain production and enhance the contribution of agriculture to medium-run growth. For example, higher prices weaken the rationale for costly floor prices or import tariffs for grain, and may facilitate the implementation of politically difficult trade reforms. Higher grain prices can also help to reverse a generally declining trend in government, private sector and donor investment in the agricultural sector. Agricultural producers such as Brazil, Malaysia and Thailand have made significant progress in agricultural commercialization in recent years, and have increasingly undertaken investments in research and extension necessary to promote increased agricultural productivity and reduced agricultural risk.

However, some of the short-run policy options discussed above may limit the scope for longer-term solutions. For example, policy responses that seek to control markets through mandated grain prices, export restrictions, forcible procurement, or direct government involvement in marketing activities are likely to lower the food supply response over the medium term. In contrast, alternative measures such as the piloting of market-based risk management tools in Malawi, and the improvement of publicly accessible market information systems in India and Mali, are all likely to mobilize significant new resources in the private sector to cut marketing costs and improve efficiency of grain markets over the medium term.

For many low-income countries, transport and logistics costs are a key component of food prices and are generally far higher than OECD benchmarks of around 9 percent. While countries can do little to reduce ocean shipping costs (which for high volume, relatively low value goods such as grains and edible oils represent a significant part of the final price), they can act to lower the overall cost of domestic distribution. The importance of strengthening inland transport links in mitigating price spikes was recently underscored in Congo Republic. Improvements in transport capacity stemmed the rise in food price inflation that was experienced in 2006, and further investments in transport links with Brazzaville are expected to be an important part of controlling price spikes. Investments in basic transport infrastructure have a proven record in reducing prices, particularly in remote locations in countries such as Nepal. Moreover, improvements in customs facilitation, logistics performance, and efficient grain storage can also have significant benefits for consumers, while generating a favorable supply response.

2.4 Measures to handle the 'spillover' effects of the above-mentioned policy responses

Many of the policy responses discussed in the previous two sections have significant fiscal implications. In the case of Ethiopia, for example, the total additional costs of combined measures to raise the wage on the cash-for-work program, lift the VAT on food grains, and distribute wheat to the urban poor at a subsidized price, are likely to exceed 1% of GDP. The macroeconomic consequences of higher spending depend largely on how

they will be financed. Where additional budgetary costs are financed via higher domestic borrowing, this may lead to higher overall inflation. An alternative is to transfer costs to non-poor taxpayers, which may or may not be feasible depending on country-specific revenue-raising capacities and political economy considerations. Diverting resources from other social sector spending or from other core public investments to finance short-term responses may have medium and long-run opportunity costs. On the other hand, addressing food security priorities may provide an opportunity to reduce lower priority expenditures and reallocate these resources. Given the potentially important economic and political costs of not addressing food security, a temporary increase in budget deficits may be warranted.

Not all countries have the same capacity to accommodate and execute additional safety net and food policy spending. Using comparable data from the World Bank's Country Policy and Institutional Assessment indicators, developing countries can be classified into four categories, depending on the extent of fiscal and balance of payments imbalances: (1) those in which initially weak public finances and fiscal management capacity has been further undermined by adverse terms-of-trade shocks (e.g. Burundi, Eritrea, Grenada, Haiti, Jamaica, and Nepal); (2) those in which somewhat stronger initial positions have been weakened by the terms-of-trade shocks (e.g. Burkina Faso, Ethiopia, and Honduras) and/or compounded by political crises (e.g. Kenya and Pakistan); (3) those in which there is weak fiscal capacity to effectively execute the additional food policy spending even in the face of favorable terms-of-trade movements (e.g. Mongolia and Zambia); and (4) those with stronger initial fiscal and balance of payment indicators, in which there is greater scope for mitigating the adverse impact of rising food prices (e.g. Indonesia, Mexico, and Tunisia).

The design of public policies to address rising food prices is conditioned by political economy factors. The strength of different interest groups is a critical factor in influencing policy choices and determining what solutions are feasible. Even in cases where countries are net suppliers of food to world markets, governments may face strong incentives to put in place protective measures. Sound policy choices will seek to implement those solutions which are economically most efficient, yet reflective of political economy considerations and in line with the country's fiscal space and institutional capacity. In some cases, first or even second best policies may not be feasible or may involve difficult political choices. In general, government policy choices are likely to be better accepted and understood if accompanied by a transparent and **effective communications strategy** on the causes of high food prices and accompanying policy measures.

3. How can the World Bank and donors help?

The Bank is well-positioned to help countries identify the appropriate mix and sequencing of short and medium-term policies needed to support vulnerable groups, while allowing for broader adjustments to the structural increases in food prices. Core elements of the Bank's response will include policy advice, financial support and global leadership.

3.1 Support for rapid policy responses

At present, the greatest demand for Bank engagement is to help countries evaluate the economic and social implications of rising food prices, as well as the available policy responses. Since many governments are faced with political economy pressures to implement sub-optimal, and even counterproductive, policies, the Bank can provide analytical inputs to highlight the least distortionary courses of action and help countries forge an effective, integrated response. Increased financial support may also be appropriate in a number of country contexts.

Just-in-time policy advice to address immediate concerns. There is strong demand for Bank advice on the design and expansion of safety net programs and food market interventions to help protect vulnerable groups. In Indonesia, the World Bank's work has played a significant role in informing discussion of the impact of rice prices on poverty and on the usefulness of various policy instruments, for example cash transfers.[10] In Egypt, the Bank helped bring together Mexican officials with experience of conditional cash transfer programs to share with Government officials. In Ethiopia, wage rate analysis carried out by the Bank was the basis of adjusting the cash transfer element of the country's largest safety net program.

There has also been demand for advice on market interventions to smooth supply and lower food prices. An intensified dialogue on food stocks (which addresses optimal stock amounts, fiscal trade-offs, and implementation challenges) is being held in several countries, including Indonesia and Burkina Faso. In the Philippines, the Bank is advising the Government on the best strategy for reducing rice import tariffs. A high level forum is being organized in Morocco to discuss various reform options of the fuel and food subsidy programs.

Several countries have sought policy advice from the Bank to cope with the macroeconomic implications of rising food prices. Several policy notes have been prepared for partner countries on the causes of high food price inflation (e.g. Bangladesh and China) and options to manage rising inflation rates (e.g. Morocco). At the request of a number of Latin American Central Banks, the World Bank is organizing a workshop in Peru in May 2008 to discuss the use of inflation targeting. Several governments are asking for information on global trends and prospects to better understand the structural nature of the rise in food prices, as well as for information on responses adopted by other countries. Bank staff will be meeting with the Ministers of Finance of Central American countries to share Bank knowledge on food price trends and policies.

Meeting short-run financing needs. The immediate fiscal impacts of rising food prices vary across countries, as many food importers have been compensated by rising commodity export prices. It is still too early to assess the extent to which countries will turn to the Bank to contribute to emerging financing gaps. However, a few countries are actively considering increasing the size of forthcoming Development Policy Loans (e.g. Burkina Faso's PRSC 7).

In the short run, the World Bank could scale up financing in existing programs and ongoing investment projects for safety net and agricultural programs. In Latin America, where many countries have comprehensive safety nets providing support to vulnerable groups, the Bank stands ready to scale up financial support to many of these programs. Additional Bank support can help expand and improve existing programs by providing: technical assistance to improve targeting and coverage, programmatic financing for strengthening social protection systems, and contingent financing for budgetary flexibility in the face of large-scale shocks.[11] In Jamaica, the Bank is currently preparing a social protection project, which could be expanded to increase its coverage (Box 1). In other cases, existing lending programs are being modified to improve the efficiency of safety net programs. For instance, in the Middle East-North Africa region, a number of DPLs are supporting the reform of food subsidies.

While most of its agricultural projects are geared towards medium-term policy and institutional reforms to increase productivity, the Bank also designs interventions to boost short-term food staple production, storage and distribution. For instance, an additional $15 million supplemental credit for an existing agricultural project is being prepared in Burundi in order to finance the distribution of crop inputs for the forthcoming agricultural season.

[10] 'Recent developments in food policy in Indonesia' (February 2008) East Asia and Pacific Region mimeo.
[11] 'Rising Global Food Prices: The World Bank's LAC Region Position Paper' (2008).

Box 1: Potential scaling up of the World Bank's social protection support in Jamaica

Jamaica has a range of safety net programs to protect the vulnerable, including self-targeted public works, school feeding, conditional cash transfers and programs targeting the elderly, poor and disabled. Of these various programs, the Program for Advancement Through Health and Education (PATH), a **conditional cash transfer program**, presents the most promising opportunities for scaling up, given its strong institutional capacity and robust targeting mechanisms.

At the beginning of 2008, the Government approved a 9 percent increase in the PATH's benefit level, to help offset the impacts of inflation. To respond to the food price shock, the PATH could deliver additional cash transfers to poor households to offset the risk of worsening nutrition outcomes, reduced health take-up, and elevated school dropout rates. The additional transfer should be temporary and clearly separated from the core CCT program.

The Bank is in the final stages of preparing a social protection project which will provide performance-based financial support to the PATH. This project could be expanded to increase the number of poor households covered if the Government so requests.

Source: Rising Global Food Prices: Latin America and Caribbean Country Action Plans

In helping countries meet short-term financing needs, the Bank is collaborating closely with the IMF, and other donors, including the World Food Program (WFP), which has significant expertise in food availability assessments and responding to short-term crisis needs. Close collaboration with the WFP, the EU, bilaterals and other development partners is particularly important in countries where lead donors are not able to expand support or are cutting back food distribution programs (e.g. Mozambique).

3.2 Support for medium-term agenda

An important role for the Bank is to help governments interpret and contextualize the medium-term implications of rising food prices for their national development strategy and investment programs. In doing so, the Bank needs to work closely with other donors to build a shared dialogue and coordinated financial response. While it may be premature for countries to have a clear roadmap, analytical work to better understand the economic, poverty and social implications of rising food prices can contribute to the design of flexible, country-specific strategies. This implies expanding Bank diagnostics and support in critical areas, including: agricultural constraints; distributional analysis of food price increases and safety net programs; rural investment climate assessments; and public expenditure reviews. Flexibility will be crucial, since the Bank may need to adjust its CAS programs, including the lending pipeline and possible front-loading of lending programs.

In general, a balanced medium-term response to the structural increase in food prices calls for expanded investments in agriculture, as well as improved instruments for risk management, involving social safety nets and other risk management instruments. Expanded investments in agriculture should focus on raising agricultural productivity and not only on food self-sufficiency or food security. The latter is best achieved through international trade, efficient domestic markets, and well designed safety nets. Key issues for the Bank in these two areas are briefly outlined below.

Making agriculture a priority. In 1980, 30 percent of annual World Bank lending went to agricultural projects, but this declined to 12 percent in 2007. The overall proportion of all Official Development Assistance going to agriculture is currently only 4 percent. Falling and stable world real cereal prices in the 1980s and 1990s contributed to a sense of complacency with respect to agricultural issues in developing countries from the late

1970s until recently. Rising food prices, as well as a heightened concern to accelerate growth among the many agriculture-dependent Sub-Saharan African countries, has led to renewed attention on this sector. The Bank has recently committed itself to doubling lending for agriculture in Africa, from an average of $450 million per year, during the IDA 14 period, to US$800 million per year in FY10.

The recent WDR on Agriculture identified four key elements for a comprehensive approach to agricultural growth, which will guide the Bank's renewed focus on this sector. They include: (i) improving producer incentives (including the removal of subsidies which benefit richer farmers more); (ii) providing quality core public goods – science, infrastructure and human capital; and (iii) stronger institutions to support an attractive rural investment climate for men and women, including more access to rural financial institutions and risk management instruments, improved property rights, and greater opportunities for collective action by farmers; and (iv) ensuring sustainable use of natural resources.

Expanding and improving access to safety nets and risk management instruments. Improving the quality of and access to safety nets will be a priority for protecting vulnerable households in the face of continued uncertainties in global food markets – at least for the foreseeable future. The Bank can help countries build stronger and more flexible safety nets to cope with shocks, with clear targeting and programmatic frameworks that can be quickly scaled up to protect vulnerable households. In addition, expanding programs to ensure basic nutrition, particularly for infants, and improved access to health and education systems will also help minimize the likelihood that income shocks reduce demand and damage human capital accumulation. Finally, the Bank is also investing to help develop modern risk management systems such as crops and disaster insurance.

3.3 Support for an international agenda

The impacts of the recent surge in food prices are reverberating across key dimensions of the development agenda, including poverty alleviation, macroeconomic stability, investment incentives and energy security/climate change policies. Because it is capable of weaving together the economic, poverty, social, agricultural and environmental perspectives, the Bank is well-placed to catalyze global action and influence the international agenda. Three such issues where the Bank can seek to improve global outcomes are discussed below, many of which are of direct consequence for middle-income countries.

First, the Bank is working closely with countries and other donors to minimize the adoption of policies with negative spillover effects for others. High levels of trade tariffs and subsidies create major negative externalities. Agricultural tariffs and subsidies in developed countries cost developing countries annually the equivalent of about five times the current levels of overseas development assistance to agriculture.[12] Export bans also bring about negative externalities, particularly for countries that are heavily dependent upon imports. They can create price spikes in importing countries and political pressure for domestic food self-sufficiency.

Second, the Bank's climate change agenda seeks to inform the global debate on bio-fuels through analysis, monitoring and balancing of competing needs for energy and food security. Concerns over increasing energy use, climate change, and carbon dioxide emissions from fossil fuels make switching to low-carbon fuels a high policy priority at both the global and country levels. Bio-fuels are a potential low-carbon energy source, although whether bio-fuels offer carbon savings depends on how they are produced.[13] Second-generation bio-fuels produced from waste products, in particular, can avoid land use change and some of the emissions associated with current bio-fuel programs, and may hence offer significant environmental and social

[12] World Bank (2008) 'World Development Report: Agriculture for Development.'

[13] Converting rainforests, peatlands, savannas, or grasslands to produce food-based bio-fuels in Brazil, Southeast Asia, and the United States creates a 'bio-fuel carbon debt' by releasing 17 to 420 times more (CO_2) than the annual greenhouse gas (GHG) reductions these bio-fuels provide by displacing fossil fuels.

benefits. These benefits, however, have to be weighed against the potential costs of rising food prices. According to a recent IFPRI study, most scenarios of increased use of bio-fuels imply substantial trade-offs with food prices.[14] These trade-offs are dampened, although not eliminated, when technological advances in bio-fuel and crop production are considered. Trade-offs between energy security, climate change and food security objectives need to be carefully monitored and integrated into both food and bio-fuel policy actions.

Third, the increase in food prices creates an opportunity for the global community to refocus on investments in agriculture and social protection. The structural shift in food prices creates an opportunity for the Bank and other donors to work with partner countries to build the political coalitions and mobilize the necessary financial support to reverse a perennial problem of under-investment in agriculture and to build better safety nets to help the poor cope with their endemic high levels of risk.

[14] IFPRI, IMPACT results (2006).

ANNEX I

POLICY EFFECTIVENESS SUMMARY

	TARGETED TO VULNERABLE GROUPS	PRESERVES INCENTIVES (E.G. LABOR / PRODUCTION)	COSTS LIMITED WITHIN NATIONAL BORDERS	EASY TO IMPLEMENT / INTRODUCE	LIMITED MANAGEMENT / GOVERNANCE CONCERNS
SAFETY NET PROGRAMS					
Cash transfers (targeted / conditional)	√	√	√		√
Food for work	√	√	√		
Food aid	√		√	√	
Feeding / nutrition programs		√	√		
POLICIES TO REDUCE DOMESTIC FOOD PRICES					
Reducing import tariffs and VAT		√	√	√	√
Targeted consumer subsidies / rations	√	√	√		
Using buffer stocks to increase supply		√		√	
Generalized consumer subsidies			√	√	
Export bans / restrictions				√	
Producer price controls					

USDA
United States Department of Agriculture

WRS-0801
May 2008

Outlook

A Report from the Economic Research Service

www.ers.usda.gov

Global Agricultural Supply and Demand: Factors Contributing to the Recent Increase in Food Commodity Prices

Ronald Trostle

Abstract

World market prices for major food commodities such as grains and vegetable oils have risen sharply to historic highs of more than 60 percent above levels just 2 years ago. Many factors have contributed to the runup in food commodity prices. Some factors reflect trends of slower growth in production and more rapid growth in demand that have contributed to a tightening of world balances of grains and oilseeds over the last decade. Recent factors that have further tightened world markets include increased global demand for biofuels feedstocks and adverse weather conditions in 2006 and 2007 in some major grain- and oilseed-producing areas. Other factors that have added to global food commodity price inflation include the declining value of the U.S. dollar, rising energy prices, increasing agricultural costs of production, growing foreign exchange holdings by major food-importing countries, and policies adopted recently by some exporting and importing countries to mitigate their own food price inflation. This report discusses these factors and illustrates how they have contributed to food commodity price increases.

Keywords: Agricultural prices, food prices, prices, supply, demand, global supply, global demand, food inflation, energy prices

Acknowledgments

The report was improved by comments, questions, and suggestions, from Mike Dwyer of the Foreign Agricultural Service, Carol Goodloe of the Office of the Chief Economists, Dave Stallings of the World Agricultural Outlook Board, and Joy Harwood of the Farm Service Agency. Special thanks go to Paul Westcott and Janet Perry of the Economic Research Service for numerous substantive contributions and for helping incorporate reviewers' comments on a compressed schedule. Cynthia Ray produced the final report on a much shortened schedule.

Contents

Approved by USDA's World Agricultural Outlook Board

Introduction

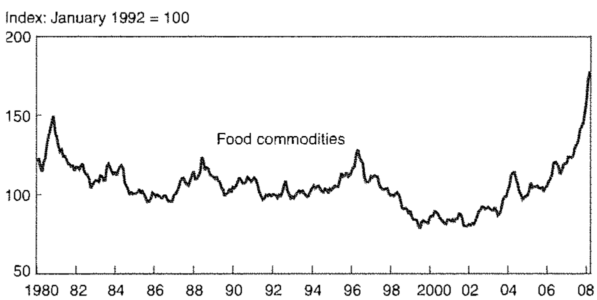
World market prices for major food commodities such as grains and vegetable oils have risen sharply to historic highs—more than 60 percent above levels just 2 years ago. Retail food prices in many countries have also risen in the last 2 years, raising concerns around the world.

No one factor has been the cause of the price runup in food commodity prices. Some factors reflect underlying trends in supply and demand for agricultural commodities that began more than a decade ago. Other developments that have contributed to the price increase have occurred more recently. Some factors reflect significant structural changes in supply and demand relationships; others can be interpreted as short-term shocks to global supply and demand for agricultural products.

Figure 1 shows an index of monthly prices for food commodities, e.g., grains, vegetable oils, meats, seafood, sugar, bananas, and various other commodities that are the basis for human consumption of staple foods. Although prices, measured in nominal dollars, trended slightly downward between 1980 and 2002, there were several short periods (1980, 1983, 1988, and 1996) when prices did rise from the previous year. After 2001, prices began to rise slowly and by 2004 reached the level that they had been in the mid-1980s. In early 2006, commodity food prices began to rise more quickly. During the last 2 years, prices of these commodities rose sharply to a new high, more than 60 percent above what they were 2 years ago.

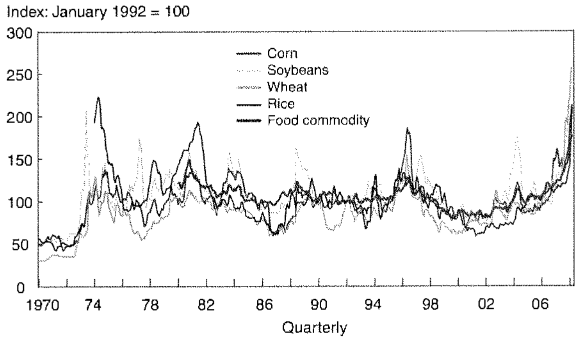
Figure 2 puts the evolution of the food commodity price index into broader perspective. Monthly price indices for wheat, rice, corn, and soybeans back to 1970 have been added to the index for food commodity prices. Wheat and rice account for much of the world food consumption of grains. Corn is used for both food and animal feed. Soybeans provide vegetable oil for human

Figure 1
Food commodity prices rose more than 60 percent in the last 2 years



Source: International Monetary Fund: International Financial Statistics.

Figure 2
Food commodity price spikes since 1970



Source: International Monetary Fund: International Financial Statistics.

consumption and protein feed for animals. Combined, the four crops account for a large share of the staple foods that are consumed globally.

Two general patterns are especially significant in figure 2. First, the index of average food commodity prices (data only available back to January of 1980) closely tracks the prices of the four major crops (wheat, rice, corn, and soybeans), although in a somewhat dampened manner. Second, there have been periodic spikes in the prices of the four crops during the last 38 years. Although some of the price spikes focused on only one of the crops, in general the prices of all four crops rise and recede in a similar pattern. This occurs because buyers can substitute among these or other commodities, whether for food use or animal feed use, and purchase whichever is cheaper. With the exception of the early 1970s, each period of rapidly rising prices was followed by a retreat back to their pre-spike level.

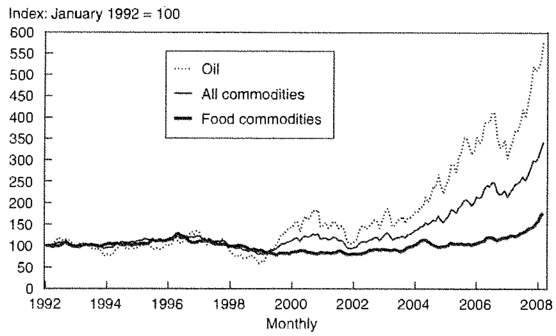
The question on the minds of many consumers around the world is, "Will food prices drop again this time?" Or, stated another way, "Is the current price spike any different from those of the past, and if so, why?"

Before we begin to explore the factors contributing to the most recent rise in food commodity prices, two more additions to the graph provide an even broader perspective on the current increase in food commodity prices.

Figure 3 charts the price index for food commodities along with an index for the average of all commodities and an index for crude oil. Although the food commodity index has risen more than 60 percent in the last 2 years, the index for all commodities has also risen 60 percent and the index for crude oil has risen even more.

Since mid-1999, when all three indices were at about the same level (and were about where they had been 10 years earlier), food commodity prices have risen 98 percent (as of March 2008); the index for all commodities has

Figure 3
Prices of many commodities rose



Source: International Monetary Fund: International Financial Statistics.

risen 286 percent; and the index for crude oil has risen 547 percent. In this perspective, the recent rise in food commodity prices might not seem so severe after all. However, because an increase in the price of food--a basic necessity--causes hardships for many lower income consumers around the world, food-price inflation is socially and politically sensitive. That is why much of the world's attention is now focused on the increase in food prices more so than on the more rapid increase in prices of other commodities.

A number of long-term, slowly evolving trends have affected the global supply and demand for food commodities. The impact of these trends has been to slow growth in production and to strengthen demand. The resulting tightening of the global supply and demand balance has gradually put upward pressure on agricultural prices. Many of these long-term trends have been exacerbated by the more recent developments that have put additional upward pressure on world prices by further reducing supplies and increasing demand.

The annual growth rate in the production of aggregate grains and oilseeds has been slowing. Between 1970 and 1990, production rose an average 2.2 percent per year. Since 1990, the growth rate has declined to about 1.3 percent. USDA's 10-year agricultural projections for U.S. and world agriculture see the rate declining to 1.2 percent per year between 2009 and 2017.[1]

Growth in productivity, measured in terms of average aggregate yield, has contributed much more to the growth in production globally than has expansion in the area planted to grains and oilseeds. Global aggregate yield growth averaged 2.0 percent per year between 1970-1990, but declined to 1.1 percent between 1990 and 2007. Yield growth is projected to continue declining over the next 10 years to less than 1.0 percent per year.

The growth rate for area harvested has averaged only about 0.15 percent per year during the last 38 years. In USDA's agricultural projections, crop prices do not decline much over the next decade. The continued higher prices

[1]USDA's 10-year agricultural projections are a Departmental consensus on a longrun scenario for the agricultural sector. The projections are not a USDA forecast of what the future will be, but instead are a description of what would be expected to happen with a continuation of current farm legislation and under very specific assumptions regarding the macroeconomy, trade policies, weather, and international developments. The projections provide a neutral backdrop, reference scenario that provides a point of departure for discussion of alternative farm sector outcomes that could result under different domestic or international assumptions. The projections referred to in this report were prepared in October through December 2007 and reflect a composite of model results and judgment-based analyses. See the documentation of the baseline process at http://www.ers.usda.gov/Briefing/Baseline/ .

provide the incentive for producers to respond by increasing the area allocated to crops during the coming decade. Some of this expanded area planted will come from land converted to cropland from non-cropland uses, such as pasture and forest. Area harvested will also increase as a result of more intensive use of existing cropland, generally from double-cropping and reduced fallow area.

Long-Term Trends

Reduced agricultural research and development by governmental and international institutions may have contributed to the slowing growth in crop yields. Stable food prices during the last two decades have led to some complacency about global food concerns and to a reduction in R&D funding levels. Although private sector funding of research has grown, private sector research has generally focused on innovations that private companies could sell to producers. These have often been cost-reducing rather than yield-enhancing technological developments. Publicly-funded research might be more likely to focus on innovations that would increase yields and production, particularly in parts of the world where farmers are unable to pay royalties for new varieties of seeds.

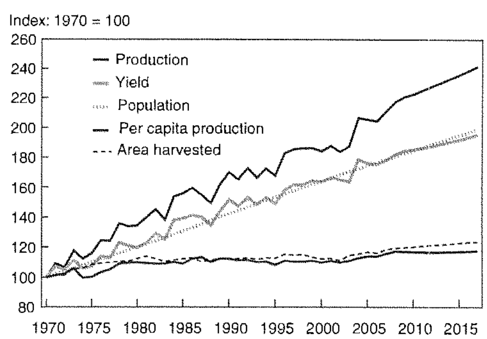
Other trends show an even longer history of gradually slowing production growth.

- For decades, each year a small percentage of the world's agricultural land has been converted to nonagricultural uses.
- The ability to obtain more water for agricultural uses has gradually become more difficult, either because gravity-flow irrigation systems are more difficult and expensive to develop, or because irrigation wells have to be dug deeper as water tables decline.
- Climate change has increasingly become a concern, although its impact on crop production is unclear.

Those factors are changing slowly and likely played a negligible role in the recent increase in world prices.

Figure 4
Total world grain & oilseeds[1]
Production, yield, area harvested, population & per capita production

Exponential trend growth rates:	1970-90	90-07	2008-17
Production	2.2	1.3	1.2
Yields	2.0	1.1	0.8
Area	0.15	0.14	0.39
Population	1.7	1.4	1.1
Per capita production	0.56	0.11	0.02



[1]Total oilseeds = soybeans + rapeseed + sunflowers.
Source: USDA Agricultural Projections to 2017.

The demand for agricultural commodities has also been affected by some long-term trends. Over the last decade, strong global growth in average income combined with rising population to increase the demand for food, particularly in developing countries. As per capita incomes rose, consumers in developing countries not only increased per capita consumption of staple foods, they also diversified their diets to include more meat, dairy products, and vegetable oils, which in turn, amplified the demand for grains and oilseeds.

Global economic growth has been strong since the late 1990s (fig.5). For developing countries, growth has been quite strong since the early 1990s. Growth in Asia has been exceptionally strong for more than a decade. Unusually rapid economic growth in China and India, with nearly 40 percent of the world's population, has provided a powerful and sustained stimulus to the demand for agricultural products.

Rapid economic growth in developing countries has also resulted in very rapid growth in the demand for energy for electricity and industrial uses, as well as for transportation fuel. The associated increase in petroleum use in developing countries has contributed to rapidly rising oil prices since 1999. The oil imports of China alone grew 20 percent per year from 166 million barrels in 1996 to 1.06 billion barrels in 2006.

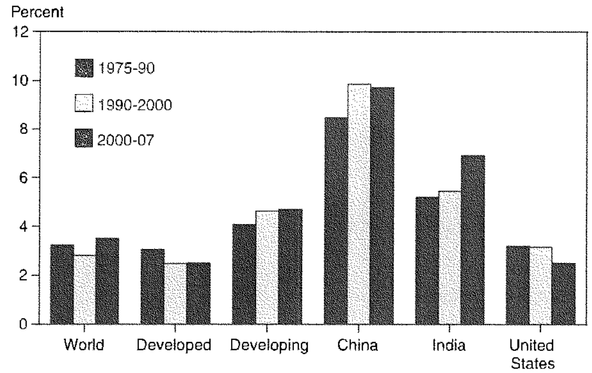
The world's population growth rate has been trending down since before the 1970s (fig. 6). This declining trend applies to nearly all countries and regions of the world. However, the number of people on earth is still rising by about 75 million (1.1 percent) per year. This rising population adds to the global demand for agricultural products and energy. The impact on demand is amplified because the most rapid population growth rates tend to be in developing countries. Many of these have rapidly rising incomes, again particularly important for agricultural demand due to diet-diversification.

Figures 7-12 illustrate how the rapid increase in global demand for agricultural products is facilitated by growth in imports. Note that much of the demand growth comes from developing countries.

Figure 5

Strong economic growth

Average real GDP growth rates

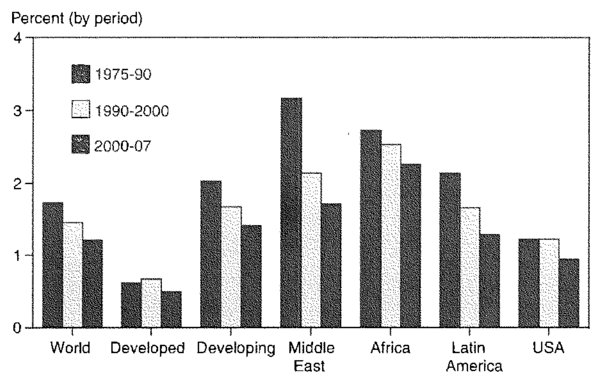


Source: USDA Agricultural Projections to 2017.

Figure 6

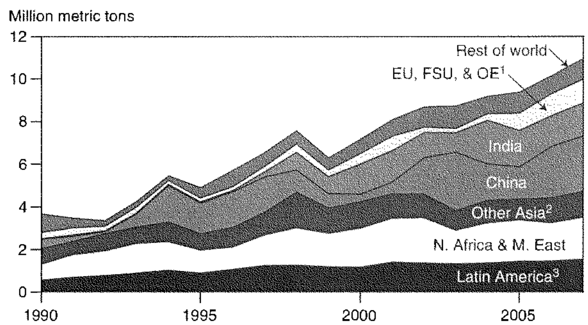
Population growth rates decline

But still high in developing countries



Source: USDA Agricultural Projections to 2017.

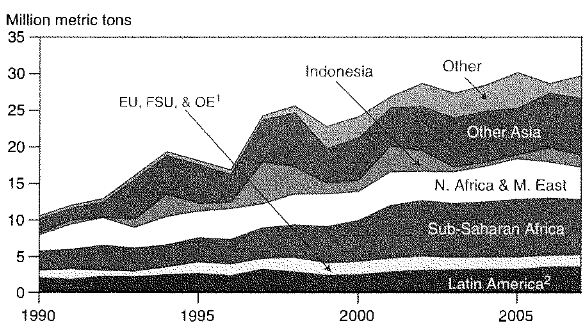
Figure 7
Global soybean oil imports



[1]European Union, former Soviet Union, and other Europe.
[2]Asia excluding India and China.
[3]Includes Mexico.

Source: USDA Agricultural Projections to 2017.

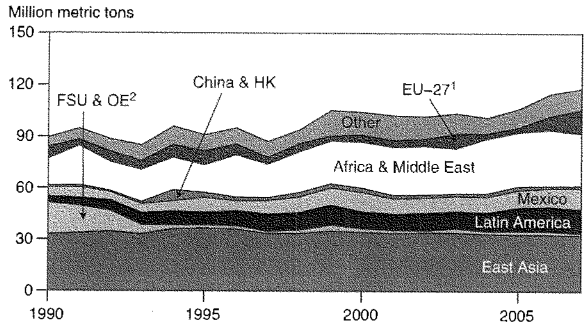
Figure 8
Global rice imports



[1]European Union, former Soviet Union, and other Europe.
[2]Includes Mexico.

Source: USDA Agricultural Projections to 2017.

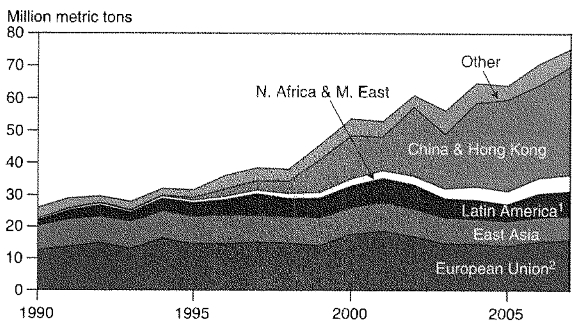
Figure 9
Global coarse grain imports



[1]EU-27 excludes intra-trade after 2002, EU-15 intra-trade before 2003, Slovenia before 1992.
[2]Former Soviet Union and other Europe; prior to 1999, includes Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia.

Source: USDA Agricultural Projections to 2017.

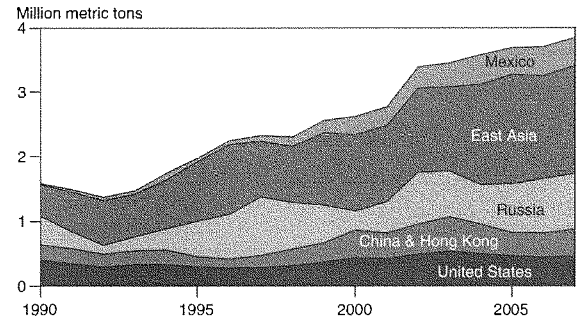
Figure 10
Global soybean imports



[1]Includes Mexico.
[2]EU-27 excludes intra-trade after 2002, EU-15 intra-trade before 2003, Slovenia before 1992.

Source: USDA Agricultural Projections to 2017.

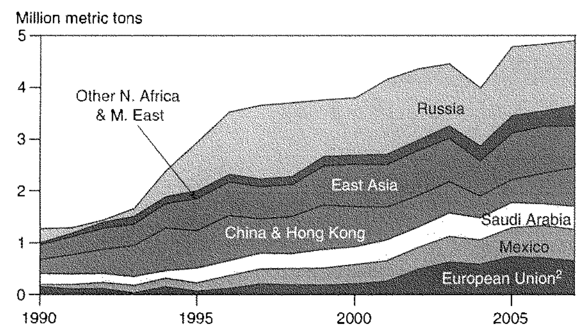
Figure 11
Pork imports[1]



[1]Selected importers.

Source: USDA Agricultural Projections to 2017.

Figure 12
Poultry imports[1]



[1]Selected importers.
[2]EU-27 excludes intra-trade after 2002, EU-15 intra-trade before 2003, Slovenia before 1992.
Source: USDA Agricultural Projections to 2017.

Increased Meat Consumption Means Increased Demand for Grain and Protein Feeds

Global consumption of meat has been growing much more rapidly than consumption of grains and oilseeds. Between 1985 and 1990, production of meat (beef, pork, chicken, and turkey) rose more than 3 percent per year. Since this was well above the world's population growth rate of 1.7 percent per year, per capita consumption was able to climb by 1.4 percent per year. Although the average growth rates in production and per capita consumption of meat have declined somewhat since 1990, they are still well above the growth rates for aggregate use of grains and oilseeds.

As the demand for meat rises, the demand for grain and protein feeds used to produce the meat grows proportionally more quickly. Feed-to-meat conversion rates vary widely depending on the class of animal and the production practices used to produce the meat. The feed-to-product conversion factors below show an upper bound of how much the demand for feed increases for every 1-pound increase in meat consumed using the typical U.S. production system.

Feed-to-meat conversion rates

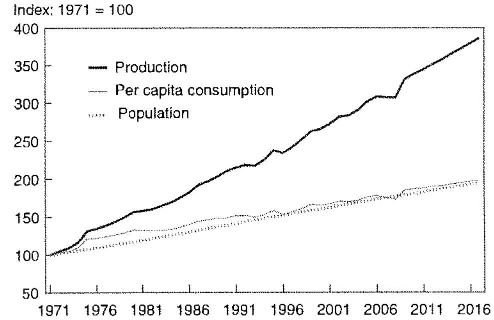
Class of animal	Pounds of feed needed to produce 1 pound of meat
Chicken	2.6
Pork	6.5
Beef	7.0

Source: Ephraim Leibtag, "Corn Prices Near Record High, But What About Food Costs?" In *Amber Waves*, February 2008.
http://www.ers.usda.gov/AmberWaves/February08/Features/CornPrices.htm

Figure 13
Global meat[1]
Production, per capita consumption, and population

Exponential trend growth rates

	1985-90	90-07	2008-17
Production	[illegible]	2.5	2.1
Population	1.7	1.4	1.1
Per capita cons.	1.4	1.1	1.0



[1]Total meat = beef + pork + chickens & turkeys.

Source: USDA Agricultural Projections to 2017.

Developments Since 2000

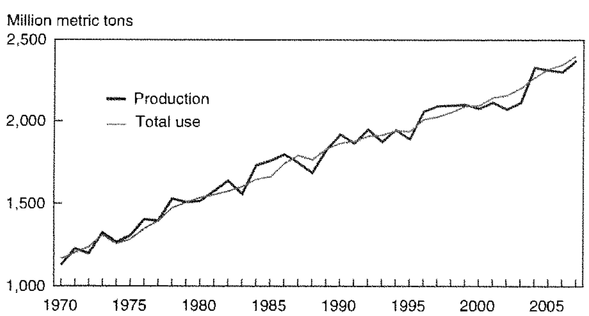
As the new century began, the trends discussed above resulted in slowing growth in production and increasing growth in demand. At the same time, policy decisions in China led to a reduction of its grain stocks. And elsewhere, there were incentives for governments and the private sector to reduce stocks. Government-held buffer stocks were deemed to be less important after nearly two decades of low and stable food prices. For the private sector, the cost of holding stocks, use of "just-in-time" inventory management, and years of readily available global supplies provided incentives to reduce stock holding. Over the last decade, the shift toward more liberalized trade reduced trade barriers and facilitated trade, which in turn reduced the need for individual countries to hold stocks.

As a result of these factors, global consumption of aggregate grains and oilseeds exceeded production in 7 of the 8 years since 2000 (fig. 14). And since 1999, the global stocks-to-use ratio for the aggregate of grains and oilseeds declined from about 30 percent to less than 15 percent currently—the lowest level on record since 1970 (fig. 15). The resulting low level of world stocks in 2007 has caused importing countries to become anxious about being able to obtain their future food needs.

In 2000, the price of crude oil began to rise—slowly at first (see fig. 3). The underlying trends of rapid economic growth and demand for energy led to rapidly rising use of crude oil in developing countries.

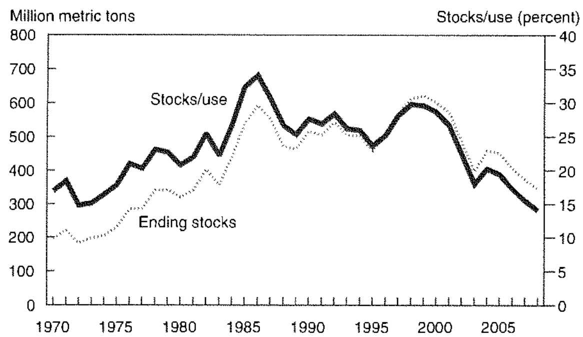
Beginning in 2002, the U.S. dollar began to depreciate, first against OECD country currencies, and later against many developing countries' currencies. As the dollar lost value relative to the currency of an importing country, it reduced that country's cost of importing. Since the United States is a major source of many agricultural commodities, foreign countries' imports of commodities from the United States began to rise. This put upward pressure

Figure 14
Total world grain & oilseeds
Production and total use



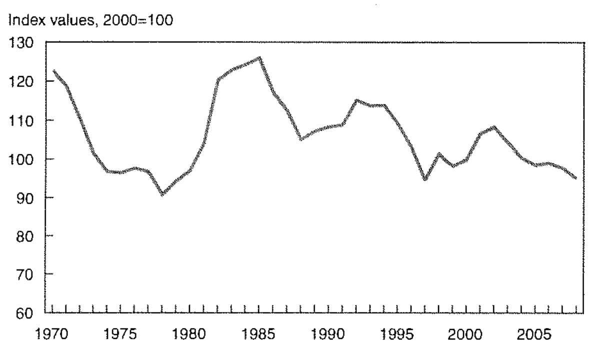
Source: USDA PS&D Database.

Figure 15
Total world grain & oilseeds
Stocks and stocks-to-use ratio



Source: USDA PS&D Database.

Figure 16
Value of U.S. dollar declines after 2002[1]



[1]Real U.S. agricultural trade-weighted dollar exchange rate, using U.S. agricultural export weights, based on 192 countries.
Source: ERS International Macroeconomics Dataset.

on U.S. prices for those commodities. Further, since the world price of major crops are typically denominated in U.S. dollars, the depreciation of the dollar also raises prices (measured in dollars).

Crude oil is also denominated in U.S. dollars, and the declining value of the dollar enabled importing countries to increase their oil imports. This increase in global demand for oil (in addition to the underlying trend resulting from rapid economic growth in developing countries) put additional upward pressure on the world price of crude oil, and in 2004 oil prices began to rise more rapidly than in prior years.

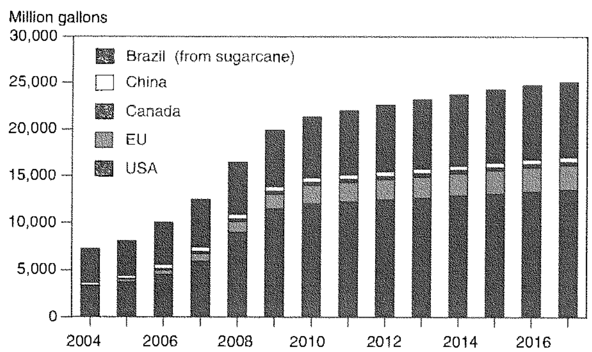
The Role of Biofuels

Biofuels have been produced and used in small amounts in several countries in recent decades. Production generally grew slowly until after the turn of the century. U.S. ethanol production began to rise more rapidly in 2003; EU biodiesel production began to increase more rapidly in 2005.

Brazil and the United States account for most of the world's ethanol production. Brazil uses sugarcane as a feedstock, while the United States uses nearly all corn. A number of other countries have policy initiatives designed to increase ethanol production, but so far the total augmentation in production capacity has been small relative to the combined capacity of Brazil and the United States. In 2007, China reversed its decision to invest in facilities to produce more ethanol from grain. Given its food policies, China is now focusing on using cassava and sweet potatoes as feedstocks for future increases in ethanol production.

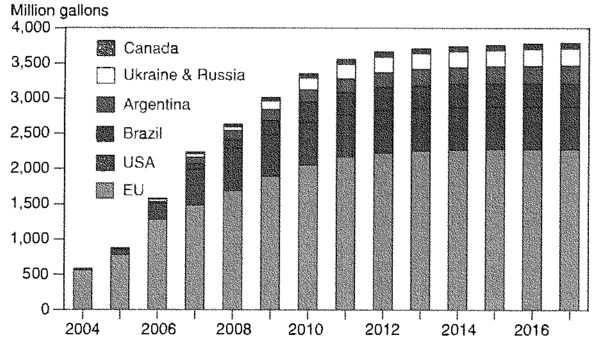
The European Union is the largest biodiesel producer, and rapeseed oil is its main feedstock. The EU has mandated that biofuels account for 10 percent of transportation fuel use by 2020. The EU cannot produce sufficient rapeseed to fill the mandate and will have to import either some feedstocks for producing biodiesel, or some biodiesel. Russia and the Ukraine are increasing rapeseed production destined for export to the EU as rapeseed, rapeseed oil, and perhaps as biodiesel. Brazil and Argentina are using soybean oil as a feedstock to expand biodiesel production. Brazil's biodiesel will mostly be produced in the Center West part of the country and will replace petrol-diesel traditionally trucked in from the coast. Most of Argentina's biodiesel production is destined for the export market. Canada is expanding biodiesel production in the Prairie Provinces using rapeseed as the feedstock.

Figure 17
Ethanol production
Mostly from grain feedstocks except for Brazil



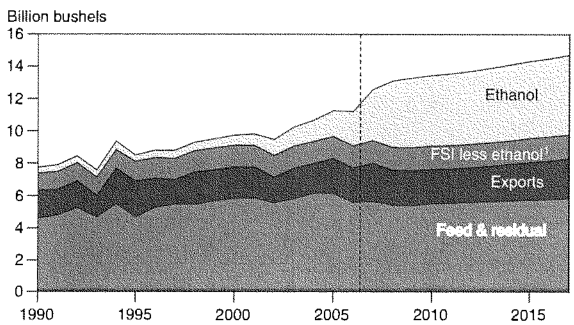
Source: USDA Agricultural Projections to 2017.

Figure 18
Biodiesel production



Source: USDA Agricultural Projections to 2017.

Figure 19
U.S. corn use



[1]Food, seed, and industrial less ethanol.

Source: USDA Agricultural Projections to 2017.

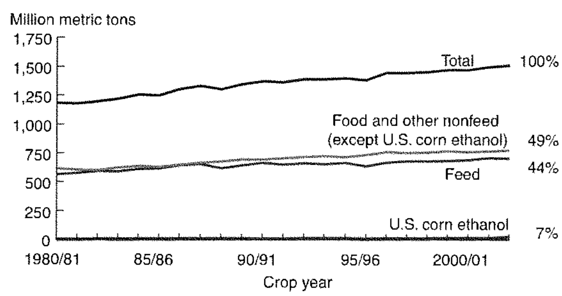
U.S. ethanol production began to expand rapidly in 2002. There were several incentives for expanding ethanol production: the increasing price of petroleum; concerns about the reliability of some traditional exporters; concerns about the polution effects of methyl tertiary butyl ether (MTBE) and initial switching from MTBE to ethanol; and an environmental objective to increase the use of cleaner burning fuels. Without the concerns about petroleum, the increase in U.S. and world biofuels production would not have been nearly as great.

Corn used for ethanol rose from about 1 billion bushels in 2002/03 to a projected 3.1 billion bushels in the current (2007/08) crop year. With this increase, corn used for ethanol production now accounts for about 24 percent

of total U.S. corn disappearance, up from 10 percent in 2002/03. This increase was facilitated because U.S. corn production rose in response to increased demand and prices, and, in general, other uses of U.S. corn (food, feed, non-ethanol industrial uses, and exports) did not decline.

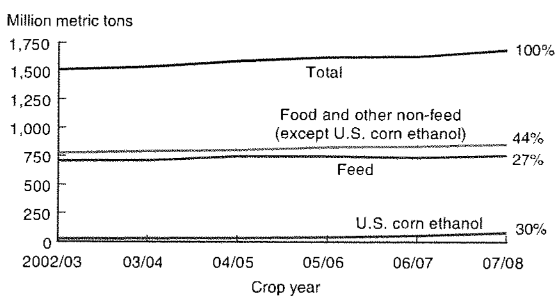
Figures 20 and 21 provide perspectives about the importance of grain used to produce ethanol relative to the total demand for grain used for all purposes over 1980-2002 and over the most recent 5 years. For both charts, average contributions to the markets, as well as marginal contributions to recent growth are discussed.

Figure 20
Global wheat and coarse grains use, 1980/81– 2002/03
U.S. ethanol accounted for 7 percent of historical global growth



Note: Category's share of the change in total use from 1980/81to 2002/03 shown at the right.
Source: USDA PS&D Database.

Figure 21
Global wheat and coarse grains use, 2002/03 – 2007/08
U.S. ethanol has accounted for 30 percent of recent global growth



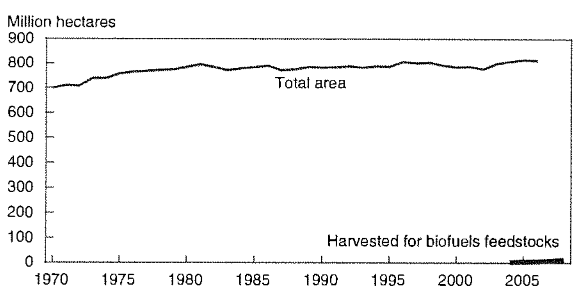
Note: Category's share of the change in total use from 2002/03 to 2007/08 shown at the right.
Source: USDA PS&D Database.

Historically, the amount of grain used to produce ethanol has been a small percentage of the global total used for all purposes. Furthermore, during the 1980s and 1990s, the increase in grain used to produce ethanol accounted for a small percentage of the total increase in demand. Between 1980 and 2002 (before the more rapid growth in ethanol production in the United States began), the amount of corn used to produce ethanol in the United States rose by 24 million metric tons. During the same period, global feed use of wheat and coarse grains increased 144 million metric tons, and food and other non-feed uses (besides U.S. corn for ethanol) increased by 160 million tons. Of the total increase in the demand for wheat and coarse grains (corn, barley, sorghum, rye and oats), ethanol accounted for 7 percent, feed use for 44, and food and other non-feed use, except for U.S. ethanol, for 49 percent. During this period, the strong growth in global demand for food and feed far surpassed the demand for industrial uses of grain. Biofuels was only one of several rising industrial uses of grain (fig. 22).

Ethanol output increased rapidly after 2002, and from the perspective of global market changes from 2002 onward, provides a somewhat different picture. Between 2002 and 2007, the quantity of U.S. corn used to produce ethanol rose by 53 million metric tons. This accounted for 30 percent of the global growth in wheat and feed grains use. Feed use grew by 48 million tons and accounted for 27 percent of the increase in total use. Food and other non-feed uses climbed 79 million tons and accounted for 44 percent of the global increase in wheat and coarse grains use.

The data suggest that while U.S. corn used for ethanol production had only a small effect on global markets in the 1980s and 1990s, the increase in U.S. ethanol production over the past 5 years and the related significant changes in the structure of the U.S. corn market have had a more pronounced impact on the world's supply and demand balance for total coarse grains recently. Importantly, since the United States is the world's largest corn exporter, some of the higher prices resulting from increased U.S. demand has spilled over onto world markets.

Figure 22
Global area harvested
Including for biofuels feedstocks[1]



[1]Crops include: Wheat, rice, corn, barley, sorghum, other cereals, soybeans, rapeseed, sunseed, and cotton.

Source: USDA Agricultural Projections to 2017.

Most feedstocks used to produce biofuels come from annual crop production. (Palm oil and previously used vegetable oils and fats that are feedstocks for biodiesel are the primary exceptions.) Use of those annual crops for biofuel diverts cropland away from producing crops used for food, feed, and non-biofuel industrial uses. However, since total area harvested has risen, a 1-acre increase in land used to produce biofuels feedstocks has meant less than a 1-acre reduction in used for traditional uses.

A rough estimate suggests that about 21 million acres were used world wide to produce feedstocks for biofuel production in 2007. This would account for about 1.3 percent of all cropland used to produce grains, annual oilseeds, and cotton. (Notice the line for biofuels in the lower, right-hand corner of the graph.) However, at the margin, the 11-million acre increase in the area of biofuels feed-stocks harvested between 2004 and 2007 accounted for about 24 percent of the 45 million acre increase in total area harvested during the same period.

Further Developments

Developments in 2004

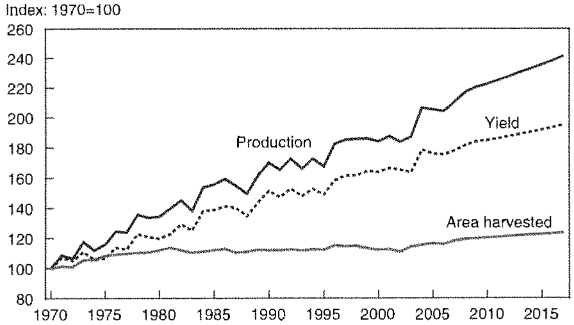
In 2004, agricultural production costs began to rise, especially for energy-related inputs such as fertilizer, fuel, and pesticides. Although there was a lag between the increase in petroleum prices and when farmers began to pay more for fertilizer, fertilizer prices have risen sharply. In the long run, farmers must cover their costs of production. Farm output prices will increase because of reductions in output, until production again becomes profitable, or because of offsetting price increases due to demand strength.

Developments in 2005/06

In early 2006, food commodity prices began to rise more rapidly than in previous years. This increase reflected many diverse and not necessarily related factors.

During 2006, hedge funds, index funds, and sovereign wealth funds became more involved in agricultural commodity markets. The investors in these funds were not so much interested in agricultural commodities as they were in using commodities to diversify their financial portfolios. The funds held an increasingly large percentage of open interest in the futures market for agricultural commodities, as well as of nonagricultural commodities such as metals and energy. These investors only had a financial interest in the markets and did not intend to take delivery of the agricultural commodities. Indeed, it is likely that in general, neither the investors nor the financial managers that directed the funds' investments knew much about the fundamentals of agricultural commodity markets. It is unclear to what extent the effect these new investor interests had on prices and the underlying supply and demand relationships for agricultural products. However, computerized

Figure 23
Total world grain and oilseeds[1]
Production, yield, and area harvested



[1]Total oilseeds = soybeans + rapeseed + sunflowers.
Source: USDA Agricultural Projections to 2017.

trend-following trading practices employed by many of these funds may have increased the short-term volatility of agricultural prices

The U.S. Energy Policy Act of 2005 mandated that renewable fuel use in gasoline reach 7.5 billion gallons by calendar year 2012. Additionally, the legislation did not provide liability protection for effects of methyl tertiary butyl ether (MTBE), an oxygenating gasoline additive that has been found to contaminate drinking water. As a result, blenders sharply reduced use of MTBE by May 2006 and switched to ethanol as a fuel additive.[2]

[2]Paul Westcott, "U.S. Ethanol Expansion Driving Changes Throughout the Agricultural Sector," *Amber Waves*, U.S. Department of Agriculture, Economic Research Service, September, 2007.

Adverse weather reduced crop production in some countries in 2006. Russia and Ukraine had yield losses due to drought. Australia was in the second year of a severe drought. South Africa also experienced drought. These droughts resulted in lower world production of grains and oilseeds, contributed to a further decline in the global stock-to-use ratio for aggregate grains and oilseeds, and contributed to rising prices. In September 2006, corn prices began a significant rise to a new high.

Developments in 2007

In 2007, a number of adverse weather events affected yields across the globe, including:

- Northern Europe had a dry spring and harvest-time floods.
- Southeast Europe experienced a drought.
- Ukraine and Russia experienced a second year of drought.
- A large area of the U.S. hard red winter wheat area had a late, hard, multi-day freeze that killed some of the crop and reduced yields over large areas.
- Canada's summer growing season was hot and dry, resulting in lower yields for wheat, barley, and rapeseed.
- Northwest Africa experienced a drought in some of its major wheat- and barley-growing areas.
- Turkey had a drought that reduced yields in its nonirrigated production areas.
- Australia was in the third year of the worst multiyear drought in a century. Grain yields were very low and exports plummeted.
- Argentina had a late freeze followed by drought that reduced corn and barley yields.

The result of adverse weather in 2007 was a second consecutive drop in global average yields for grains and oilseeds. In historical perspective, two sequential years of lower global yields occurred only three other times in the last 37 years. The lower production caused yet another decline in the global stocks-to-use ratio and created a world market environment characterized by concern among importers about the future availability of supplies.

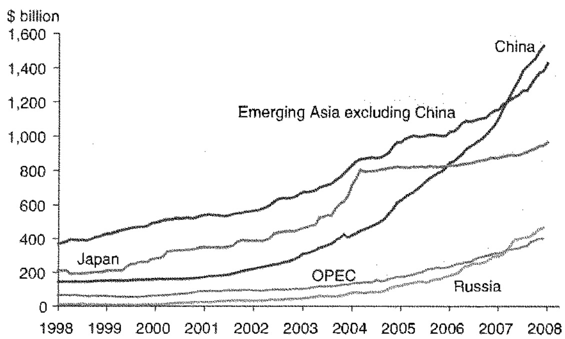
In May of 2007, soybean prices began a rapid upward trend. Corn prices were already at record highs.

By late summer 2007, some importers were aggressively contracting for imports of grains and oilseeds. Even though prices were at record highs, importers were buying larger volumes, not less. Some countries that usually imported sufficient quantities of grain to meet their needs for the following 3-4 months began to contract for imports to meet their needs for the following 5-10 months.

Large foreign exchange reserves held by some major importing countries enabled them to contract for their import needs regardless of how high the world price rose. There have been very large accumulations of foreign exchange reserves held by oil-exporting countries (OPEC, Russia, and Ukraine) and by countries with large non-oil trade surpluses (China, Japan, and other Asian countries). Countries holding these large foreign exchange reserves are able to import large volumes of food commodities in order to meet their consumption needs and allay their domestic food price inflation. In essence, they can bid supplies away from other traditional importers that do not hold significant foreign exchange reserves.

In August 2007, world wheat prices began a sharp upward trend. Rice prices jumped sharply later in the fall.

Figure 24
Foreign exchange reserves



Source: Oxford Economics / Haver Analytics

Policy Responses to Rising Food Prices

The rapidly increasing world prices for food grains, feed grains, oilseeds, and vegetable oils caused domestic food prices at the consumer level to rise in many countries. In response to rising food prices, some countries began to take protective policy measures designed to reduce the impact of rising world food commodity prices on their own consumers. However, such measures typically force greater adjustments and higher prices onto global markets.

In the fall of 2007, some exporting countries made policy changes designed to discourage exports so as to keep domestic production within the country. The objective was to increase domestic food supplies and restrain increases in food prices. A partial list of these policy changes follows:

Eliminated export subsidies:

- China eliminated rebates on value-added taxes on exported grains and grain products. The rebate was effectively an export subsidy that was eliminated.

Export taxes:

- China, with food prices still rising after eliminating the value-added tax rebate, imposed an export tax on a similar list of grains and products.
- Argentina raised export taxes on wheat, corn, soybeans, soybean meal, and soybean oil.
- Russia and Kazakhstan raised export taxes on wheat.
- Malaysia imposed export taxes on palm oil.

Export quantitative restrictions:

- Argentina restricted the volume of wheat that could be exported even before raising export taxes on grains.
- Ukraine established quantitative restrictions on wheat exports.
- India and Vietnam put quantitative restrictions on rice exports.

Export bans:

- Ukraine, Serbia, and India banned wheat exports.
- Egypt, Cambodia, Vietnam, and Indonesia banned rice exports. India, the world's third largest rice exporter, banned exports of rice other than basmati, significantly reducing global exportable supplies.
- Kazakhstan banned exports of oilseeds and vegetable oils.

Early in 2008, importing countries also began to take protective policy measures to combat rising food prices. Their objective was to make high-cost imports available to consumers at lower prices. A partial list of policy changes follows:

The following countries reduced import tariffs:

- India (wheat flour)

- Indonesia (soybeans and wheat; streamlined the process for importing wheat flour)
- Serbia (wheat)
- Thailand (pork)
- EU (grains)
- Korea and Mongolia (various food commodities)

Subsidizing consumers:

- Some countries, including Morocco and Venezuela, buy food commodities at high world prices and subsidize their distribution to consumers.

Other decisions by importers:

- Iran imported corn from the United States, something that has occurred rarely—only when they could not procure corn elsewhere at reasonable prices.

The policies adopted by importing countries also changed price relationships in world markets. Their policy changes increased the global demand for food commodities even when world prices were already rapidly escalating.

The policies adopted by exporting countries to reduce food price inflation within their own countries resulted in lower supplies available to the rest of the world. Importers who want to buy food commodities now have fewer sources. This heightened concerns among importing countries, stimulating them to buy additional supplies, even at record high prices. The combination of reduced supplies and increased demand meant that world market adjustments had to be made by the smaller number of countries trading in the world market that had not changed their trade policies.

The combination of reduced supplies from traditional exporters and increased demand from importers, at a time when the global stocks-to-use ratio was unusually low, increased importers' concerns about future availabilities to meet consumption needs. This boosted world market prices even more. These contributions to higher world prices in April 2008 exacerbated an already tight supply and demand situation.

Implications for Food Security

Rising food commodity prices tend to negatively affect lower income consumers more than higher income consumers. First, lower income consumers spend a larger share of their income on food. Second, staple food commodities such as corn, wheat, rice, and soybeans account for a larger share of food expenditures in low-income families. Third, consumers in low-income, food-deficit countries are vulnerable because they must rely on imported supplies, usually purchased at higher world prices. Fourth, countries receiving food aid donations based on fixed budgets receive smaller quantities of food aid.

A number of factors affect how much of an increase in world food commodity prices passes through to consumers' budgets: the percentage of income spent on food, the percentage of retail food expenditures spent on staple foods, government trade and domestic food policies. A simplified comparison of the impact of higher food commodity prices on consumers in high-income countries and on consumers in low-income, food-deficit countries illustrates these differences.

Impact of Higher Food Commodity Prices On Consumers' Food Budgets*

	High-income countries	Low-income food-deficit countries
I. Base scenario		
Income	$40,000	$800
Food expenditure	$4,000	$400
Food costs as % of income	**10.0%**	**50%**
Disaggregate retail food spending (staples vs. non-staples)		
Staples as % of total food spending	20%	70%
Expenditures on staples	$800	$280
Expenditures on non-staples	$3,200	$120
II. Scenario: 50% price increase in staples, partial pass through on staples		
Assumed % pass through	60%	60%
Increase in cost of staples	$240	$84
New cost of staples	$1040	$364
New total food costs	$4,240	$484
Food costs as % of income	**10.6%**	**60.5%**

*These are illustrative food budgets that characterize the situations for consumers in high- and low-income countries.

Source: As compiled by ERS.

This illustrative comparison shows that for a consumer in a high-income country, a 50-percent increase in staple food prices causes retail food expenditures to rise 6 percent ($240). This results in the percentage of income spent on food rising from 10 to 10.6 percent—less than 1 percentage point. For a consumer in a typical low-income food-deficit country, food expenditures increase only $84, but that is a 21-percent increase in total food expenditures. Furthermore, this $84 increase means that the percentage of income spent on food climbs from 50 to more than 60 percent.

For highly import-dependent or highly food-insecure countries, any decline in import capacity stemming from rising food prices can have challenging food security implications. Foreign food aid donations have provided supplemental assistance to lower income consumers in many low-income, food-deficit countries. However, food aid donations have stagnated during the last two decades, and food aid's share has declined relative to total food imports of low-income countries.[3] Higher food commodity prices negatively affect the ability to provide food aid donations. Most food-aid donors budget a fixed annual amount to fund procurement of food aid commodities. When prices rise, their fixed budget buys less food to donate. Additionally, higher petroleum prices have been a major factor in the sharp increase in ocean freight rates. This further increases the cost of getting food aid donations to the recipient countries.

[3]Stacey Rosen and Shahla Shapouri, "Rising Food Prices Intensify Food Insecurity in Developing Countries," *Amber Waves*, U.S. Department of Agriculture: Economic Research Service, February 2008.

Food Price Inflation Impact on Social Unrest

The recent price spike has led to social unrest in a number of countries.[4] Peaceful protests have been held in Malaysia (millers & bakers), Indonesia (markets selling soybeans and meats), and Pakistan (wheat marketers). Peruvian farmers blocked rail lines to protest rising fertilizer costs. In South Africa, members of the National Labor Federation demonstrated against higher food and electricity prices.

Less peaceful demonstrations of consumers' anger and fear over higher food prices (generally referred to in the news media as riots) have occurred in a variety of countries including:

Guinea	Mauritania	Morocco	Senegal
Cameroon	Mexico	Uzbekistan	Yemen
Niger	Burkina Faso	Egypt	Haiti
Ethiopia	Philippines	Thailand	Mozambique
Ivory Coast	Bangladesh	Indonesia	

Most of these incidents have occurred in low-income, food-deficit countries.

[4]Incidents gleaned from news media reports.

Summary of Factors Contributing to Higher Food Prices

Food prices, and particularly the prices for basic food commodities, have risen sharply during the last 2 years. Many factors contributed to these price increases. Long-term trends that led to slower growth in production and rapid growth in demand contributed to a sharp downward trend in world aggregate stocks of grains and oilseeds that began in 1999. Recent factors that have further tightened world markets include increased global demand for biofuels feedstocks and adverse weather conditions in 2006 and 2007 in some major grain- and oilseed-producing areas.

Additional recent developments that have put upward pressure on food commodity prices by further restricting available supplies or increasing demand for food commodities include the devaluation of the U.S. dollar, rising energy prices, increases in agricultural costs of production, growth in foreign exchange holdings by major food-importing countries, and protective policies adopted by some exporting and importing countries.

As a result of these market factors, stocks of grains and oilseeds in the world have fallen to levels that make the global aggregate stock-to-use ratio for grains and annual oilseeds the lowest since 1970. Stocks in major exporting countries are particularly low. All of these factors have contributed to higher world prices for food commodities.

Prospects for the Future

In assessing prospects for the future, there are a number of uncertainties and concerns:

Global economic growth: If rapid growth continues, particularly in developing countries, it will continue to put upward pressure on food commodity prices through increases in food demand.

Energy prices: If petroleum prices continue to rise, costs of agricultural production will rise, as will the cost of processing, and the cost of transporting products to markets both within a country and exporting to other countries. Continued high petroleum prices will also sustain the global incentives to produce more biofuels.

Biofuels production: In USDA's 10-year agricultural projections, global growth in biofuels production begins to slow in the next several years and production from grains and oilseeds flattens out in the next half decade. World food commodity prices are not projected to retreat to past levels. However, several years into the future, the underlying long-term trend in rapidly increasing global demand is expected once again to be the primary contributor to future upward pressure on food commodity prices.

Supply response capacity of the global agricultural prodnction system:

- *Cost of inputs:* Continued increases in production costs, especially in energy-related costs, will restrain the world's production response. Higher costs for fertilizer, fuel, and seeds could cause farmers without access to credit to plant less than they otherwise would have, or to shift to crops requiring fewer inputs.
- *Additional cropland (quantity and quality):* What will be the longrun impact of higher world food commodity prices on the amount of land used to produce the crops? What is the productivity of the land that will be used to increase production?
- *Water shortages:* How quickly will constraints on the amount of water available for agricultural production become more widespread?
- *New seed varieties and use of biotechnology:* Will higher food prices encourage some countries to adopt the use of biotechnology, especially genetically modified seed for crops? Will future research focus more on yield-enhancing varieties rather than cost-reducing innovations?
- *Biophysical response to climate change:* How will climate change affect agricultural production? How will it change temperatures, precipitation, the length of growing seasons, and variability of yields? How, and under what circumstances, will climate change increase and/or reduce production? In affected regions, how difficult will it be for producers to shift to different crops, to adopt new cropping patterns, and to adjust production practices to the new environment?

With such low world stocks of food commodities, food prices are vulnerable to a production shortfall in one or more major production areas. If a significant shortfall occurs this year due to weather or disease, food prices might continue to rise sharply from the current high level. Although trade flows can mitigate some of these effects, new or existing trade restrictions or barriers can exacerbate price impacts. However, if good crop production conditions exist in the Northern Hemisphere during the next 6 months, food commodity prices could retreat significantly from their current highs.

HLC/08/INF/1 **E**

April 2008

منظمة الأغذية
والزراعة
للأمم المتحدة

联合国
粮食及
农业组织

Food and Agriculture Organization of the United Nations

Organisation des Nations Unies pour l'alimentation et l'agriculture

Organización de las Naciones Unidas para la Agricultura y la Alimentación

HIGH-LEVEL CONFERENCE ON WORLD FOOD SECURITY: THE CHALLENGES OF CLIMATE CHANGE AND BIOENERGY

Rome, 3 - 5 June 2008

SOARING FOOD PRICES: FACTS, PERSPECTIVES, IMPACTS AND ACTIONS REQUIRED

Table of Contents

W0000

SOARING FOOD PRICES:

FACTS, PERSPECTIVES, IMPACTS AND ACTIONS REQUIRED

I. INTRODUCTION

1. The world is experiencing a dramatic increase in food prices. During the first three months of 2008, international nominal prices of all major food commodities reached their highest levels in nearly 50 years while prices in real terms were the highest in nearly 30 years. Although the food market situation differs from country to country and future evolution remains highly uncertain, best projections suggest that food prices are likely to remain high in the next few years and high prices are expected to affect most developing country markets.

2. Rising food prices are causing severe hardship and suffering. For many of the 800 million people who are already affected by chronic hunger, higher food prices can be devastating. Already their ranks are being swelled by many other millions of poor people who now find themselves unable to buy the food that their families need for a healthy life. It is not surprising that this is provoking social unrest across the developing world. It is also prompting short-term policy responses from governments in both exporting and importing countries that risk exacerbating instability in world markets. In the short run, those food buyers in the cities and in the rural areas (including the poorest rural households that are predominantly net food buyers) who spend a large share of their income on food will be the most adversely affected. In some countries, urgent action is required to maintain and, in some cases, enhance emergency safety nets. On the other hand, high prices will stimulate a supply side response where the market signals are transmitted to food producers who have capacity to increase production and, where existing transport and market infrastructure allow, to supply the market. This may represent an important opportunity for promoting agricultural and rural development in many low-income countries, provided an enabling policy environment and supportive measures are established quickly.

3. The general purpose of this technical background document is to discuss the causes and consequences of the recent increases in food prices. The paper starts from a broad, global perspective, proceeds to national level impacts, and then to household level effects. The concluding section discusses possible actions to deal with rising prices.

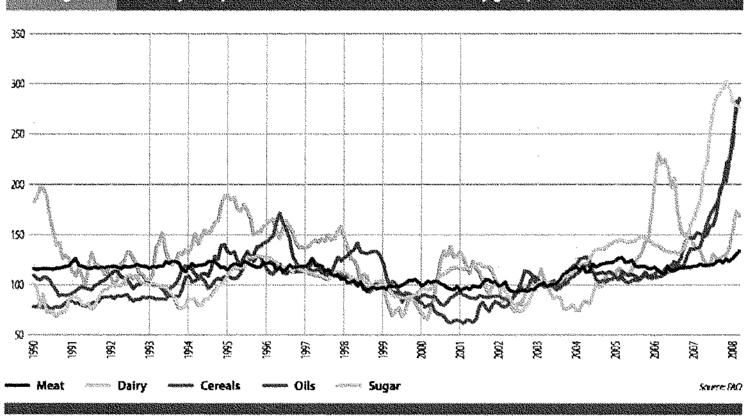
4. The first part of the paper provides an assessment of recent global trends in food prices, a description of the factors underlying the current state of world markets, and finally, a brief look into the future of these markets. The second part of the paper discusses country level macroeconomic impacts in terms of effects on food import bills, current account deficits, the transmission of international prices to domestic prices, and effects on consumer price indices and per capita cereal consumption. The third part of the paper discusses household level impacts, with a special focus on the poorest members of society.

5. The final section of the paper provides some short- and long-term policy options at both national and international levels to help mitigate the negative impacts and take advantage of the emerging opportunities through investment in agriculture with the hope of stimulating discussions at the High-Level Conference.

II. BRIEF ASSESSMENT OF RECENT DEVELOPMENTS

6. Agricultural commodity prices rose sharply in 2006 and 2007 and continued to rise even more sharply in the first three months of 2008. While the FAO food price index rose, on average, 8 percent in 2006 compared with the previous year, it increased by 24 percent in 2007 compared to 2006.[1] Currently, the increase in the average of the index for the first three months of 2008 compared to the same three months in 2007 stands at 53 percent. The continuing surge in prices is led by vegetable oils, which on average increased by more than 97 percent during the same period, followed by grains with 87 percent, dairy products with 58 percent and rice with 46 percent. Sugar and meat product prices also rose, but not to the same extent. Recent large increases in some commodity prices point also to increased volatility and uncertainty in the current market environment.

Figure 1 Monthly FAO price indices for basic food commodity groups (1998-2000=100)



7. High-price events, like low price events, are not rare occurrences in agricultural markets, although often high prices tend to be short lived compared with low prices, which persist for longer periods.[2] What distinguishes the current state of agricultural markets is the

---

[1] The FAO food price index is a trade-weighted Laspeyres index of international quotations expressed in US dollar prices for 55 food commodities (see http://www.fao.org/worldfoodsituation/FoodPricesIndex).

[2] If a price spike is identified as an annual percentage change that is above two standard deviations of the five years preceding the year that the percentage change is calculated from, it is possible to identify the years in which high price events for basic food commodities (using FAO food price index) occurred during the 1961-2008 period. Checking each year's percentage change against twice the standard deviation calculated as:

$$\sigma_t^2 = \frac{\sum_{i=t-6}^{t-2} (x_i - \bar{x})^2}{5},$$

four distinct periods can be identified when prices exhibited significant increases: 1972-74, 1988, 1995, and the current period. The only price events in consecutive years are those that occurred in the first and the last period, but three years in a row in the first, 1972, 1973 and 1974 and two years at the moment, 2007 and 2008. When the same methodology is employed to the prices expressed in real terms, however, only four appear to have been significant price event years: 1973 and 1974 and 2007 and 2008.

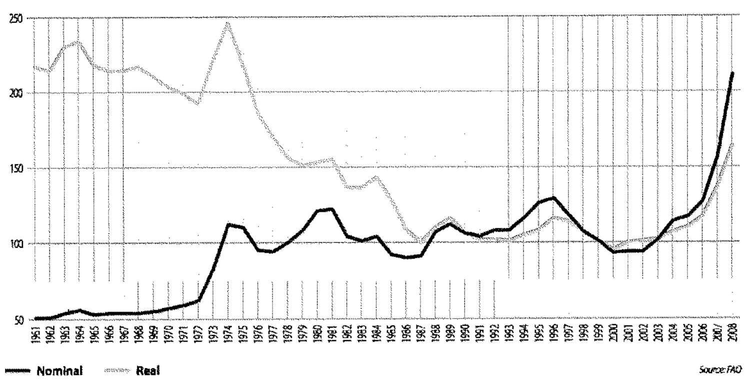
occurrence of the hike in world prices of not just a selected few but, as noted above, of nearly all major food and feed commodities (Figure 1) and the possibility that the prices may continue to remain high after the effects of short-term shocks dissipate. As will be discussed below, many factors have contributed to these events, though it is difficult to quantify their contributions. Among the most important factors it is possible to list are the strengthening of linkages among different agricultural commodity markets (i.e. grains, oilseeds and livestock products) as a result of rapid economic and population growth in many emerging countries; the strengthening of linkages among agricultural commodity markets and others, such as those of fossil fuels; biofuels and financial instruments that influence not only the costs of production of agricultural commodities but also the demand for them; and the depreciation of the US dollar against many currencies. The price boom has also been accompanied by much higher price volatility than in the past, especially in the cereals and oilseeds sectors, highlighting the prevalence of greater uncertainty in the markets. Yet the current situation differs from the past in that the price volatility has lasted longer, a feature that is as much a result of supply tightness as it is a reflection of changes in the nature of the relationships among agricultural markets of individual commodities, as well as their relationships with others as noted above.

8. These differences compared to the previous periods of agricultural price hikes suggest that the observed long-term decline in real prices could come to a halt, signalling a structural change in agricultural commodity markets. Deflating the extended FAO food price index[3] with the index of unit value of global exports of manufactured goods (MUV)[4] indicates that the downward trend in fact was halted in the late 1980s. There was an important peak in the mid 1990s, an historical low near 1999, followed by a gradual recovery beginning in 2000, and then the sharp increase commencing in 2006. The average growth rate over the 2000-2005 period of 1.3 percent per year jumped to 15 percent since 2006 (see Figure 2).

[3] The FAO food price index has been extended on an annual basis from 1961-1989 by splicing it to the index of unit value of imports of the same group of commodities.

[4] The choice of deflator may be important in examining real commodity price movements. Alternatives such as the CPI, the GDP deflator or the personal consumption deflator will yield different estimates. The MUV estimates are from:
http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTDECPROSPECTS/0,,contentMDK:20587651~pagePK:64165401~piPK:64165026~theSitePK:476883,00.html

Figure 2 Extended Annual FAO Food Price Index 1998-2000=100



9. The next section discusses in more detail the changes in the fundamentals underpinning the developments observed over the past two seasons. Almost all commentators agree on the list of these fundamentals, but there are different opinions as regards to which one has dominated the increases. Some recent reports attempt to assign proportionate blame to various causes, both on the demand and supply side. For example, a recent report by Mitchell (2008) of the World Bank has concluded that 65 percent of the rise in prices is due to biofuels and factors related to their rapid increase in demand for feedstocks[5]. IMF assessments have also concluded that rising biofuel production, largely due to biofuel policies, is responsible for a significant part of the jump in commodity prices[6]. Such an assignment of determining factors is not undertaken here, as the situation is very complex and evolving. Rather discussion focuses on the nature of causes and their impacts, attempting to differentiate transitory and permanent factors, and to identify the countries and people who are most affected.

Factors underlying the current state of the food markets

10. It appears that a confluence of different forces has created the unique developments that have been observed over the past two seasons. These can be summarized as follows.

On the supply side

11. *Weather-related production shortfalls:* A critical trigger for the price hikes has been the decline in the production of cereals in major exporting countries, which beginning in 2005[7]

[5] D. Mitchell (2008)

[6] S. Johnston (2007)

[7] Although rice prices, as measured by the FAO rice price index, rose 25 percent in 2004 over 2003 in recovery from very low levels in 2000-2003, the ensuing increases were much subdued until 2007, when it increased by 17 percent. However, in the first few months of 2008 the index rose sharply, by 38 percent compared to the average of 2007, mainly as a short-term reaction to policies applied in some countries that reduced export availabilities. This reaction is expected to subside with the onset of new harvests in 2008.

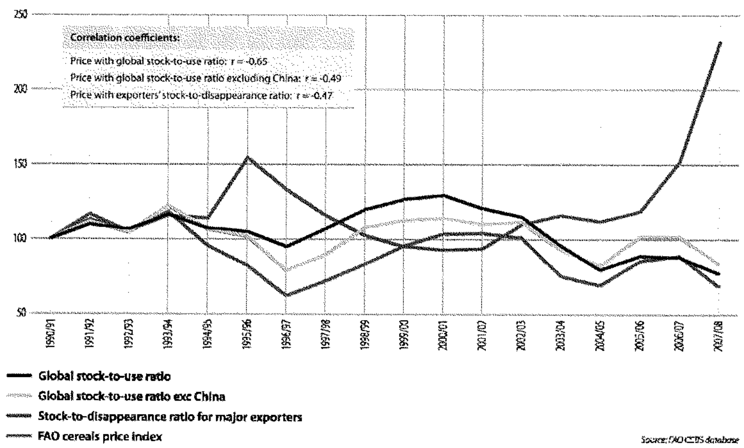
and continuing in 2006, declined annually by 4 and 7 percent respectively. Yields in Australia and Canada fell by about one fifth in aggregate, and yields were at or below trend in many countries. There was a significant increase in cereal output in 2007,[8] especially in maize in the US, in response to higher prices. On the other hand, production of all the other major food commodity groups by major exporting countries was not affected in a similar way during the same period. The quick supply response for cereals in 2007 came at the expense of reducing productive resources allocated to oilseeds in some countries (especially soybeans in the United States), resulting in an important decline in oilseed production.

12. *Stock levels:* The gradual reduction in the level of stocks, mainly of cereals, since the mid-1990s is another supply side factor that has had a significant impact on markets recently. Indeed, since the previous high-price event in 1995, global stock levels have declined, on average, by 3.4 percent per year as demand growth has outstripped supply. Production shocks at recent low stock levels helped set the stage for rapid price hikes.

13. A number of changes in the policy environment since the Uruguay Round Agreements have been instrumental in reducing stock levels in major exporting countries, namely: the size of reserves held by public institutions; the high cost of storing perishable products; the development of other less costly instruments of risk management; increases in the number of countries able to export; and improvements in information and transportation technologies. When production shortages occur in consecutive years in major exporting countries under such circumstances, international markets tend to become tighter and price volatility and the magnitude of price changes become magnified when unexpected events occur. Indeed, there is a statistically significant negative relationship between the stocks to use ratio (the ratio of stocks at the beginning of the season to utilization during the season) and the average cereal prices during the same season. This means that tight markets at the global level at the beginning of the season tend to put upward pressure on prices (see Figure 3). As stocks reach very low levels, the absence of buffer supplies means that prices may rise precipitously under either a demand or supply shock.

[8] Current estimates suggest that the production of cereals will increase by nearly 5 percent, reaching a record high.

Figure 3 Relationships between cereal stocks ratios and prices



14. This is one of the important reasons that international cereal prices spiked so sharply in 2006 and are expected to remain at high levels for some time. By the close of the 2008 seasons, world cereal stocks are expected to decline a further 5 percent from their already reduced level at the start of the season, reaching their lowest levels in 25 years. The ratio of world cereal stocks to utilization ratio is expected to fall to 18.8 percent, down 6 percent from the previous low in 2006/07.

15. The stock situation for oils/fats and meals/cakes began to deteriorate in mid-2007 because of spillover effects from developments in the cereals markets, especially of wheat and coarse grains, with the stock-to-utilization ratio expected to fall from 13 to 11 percent for oils/fats and from 17 to 11 percent for meals/cakes by the end of the 2007/08 season.

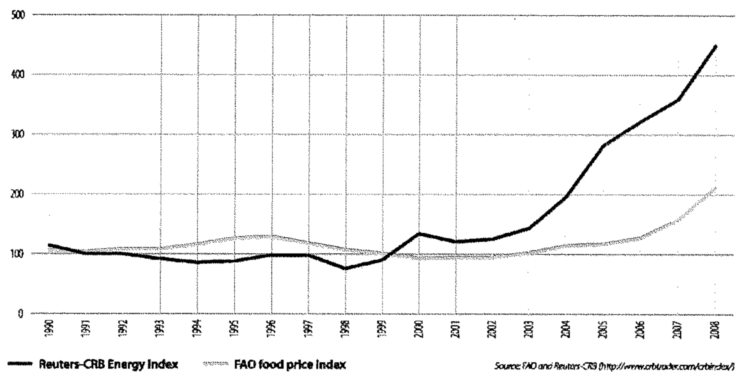
16. *Increasing fuel costs:* The increases in fuel prices have also raised the costs of producing agricultural commodities with, for example, the US dollar prices of some fertilizers (e.g. triple superphosphate and muriate of potash) increasing by more than 160 percent in the first two months of 2008, compared to the same period in 2007. Indeed, the increase in energy prices has been very rapid and steep, with the Reuters-CRB energy price index more than tripling since 2003[9] (see Figure 4). With freight rates doubling within a one-year period beginning in February 2006,[10] the cost of transporting food to importing countries also has been affected.

---

[9] Energy prices began increasing in 2003 (up 15 percent compared to 2002). A large spike occurred in 2004 (37 percent), about two years before the hike in grains prices (20 percent in 2006 compared to 2005, and 43 and 60 percent in the following two years).

[10] For both IGC Grain Freight and Baltic Dry indices: see International Grains Council, as quoted in FAO (2007, *ibid.* p. 45).

Figure 4 Reuters-CRB Energy and FAO Food Price Indices 1998-2000=100



On the demand side

17. *Biofuels and agricultural commodities:* The emerging biofuels market is a new and significant source of demand for some agricultural commodities such as sugar, maize, cassava, oilseeds and palm oil. The increase in demand for these commodities has been one of the leading factors behind the increase in their prices in world markets which, in turn, has led to higher food prices.

18. These commodities, which have predominantly been used as food and/or feed, are now being grown as raw material (feedstock) for producing biofuels. Significant increases in the price of crude oil allow them to become viable substitutes in certain important countries that have the capacity to use them.[11] For example, ethanol from various feedstocks and farming production systems becomes competitive with gasoline (petrol) at different crude oil and commodity prices. Brazilian sugar cane is competitive at much lower crude oil prices than other feedstocks and production locations. Schmidhuber (2006) estimated that US maize ethanol was competitive at crude oil prices of around US$58 per barrel, but it is important to note that this breakeven point reflects maize prices as of a fixed point in time and would change along with feedstock prices. Indeed, maize prices have risen sharply since this analysis was conducted, partly due to demand for biofuels. Tyner and Taheripour (2008) estimate that with oil priced at US$100 per barrel, maize would need to cost less than US$4.14 per bushel for US maize-based ethanol to be profitable without ethanol subsidies, or less than US$5.74

[11] Since the relative contribution of the bioenergy sector to total global energy supplies is small, feedstock prices can be considered as largely endogenous to changes in fossil-fuel prices, with minimal feedback effects. Consequently, shocks from energy markets can be carried into the food markets. On the supply side, when the marginal value product in the biofuel market (net of crop feedstock costs, including by-product revenues) exceeds that in the food market, the crop will be diverted to the production of the biofuel. When larger quantities of the feedstock are absorbed by the energy sector, price determination will tend to mirror that in the energy sector and an 'energy floor price' effect will be created. As energy crops compete for other agricultural resources, greater cultivation intensity of energy crops can lead to reduced supplies of other competing crops, thus pushing up their prices. On the demand side, the degree of substitutability by which biofuels can be blended in large proportions with their fossil-fuel counterparts (e.g. flex-fuel vehicles) determines how much biofuel and petroleum prices may depart from one another. If this substitutability is high, with biofuel competitive at the pump and large quantities of feedstock subsumed by the energy sector, consumers ensure equilibrium between prices of petroleum and biofuel, and producers between prices of biofuel and the feedstock (Schmidhuber, 2007). The implications for price determination in agriculture are considerable.

with subsidies (Table 1). They include in their calculation of subsidies the combined value of US renewable fuel mandates, tax credits and tariff barriers, representing a total value of about US$1.60 per bushel for maize used in ethanol production.

Table 1. Crude oil – maize price breakeven points for US ethanol production (2007)

Crude oil price (US$/barrel)	Break-even price for maize without subsidies (US$/bushel)	Break-even price for maize with subsidies (US$/bushel)
20	<0	1.50
40	0.96	2.56
60	2.01	3.62
80	3.08	4.68
100	4.14	5.74
120	5.20	6.81

Source: Tyner and Taheripour 2008.

19. This possibility, coupled with expectations that these developments can encourage rural development while reducing dependency has increasingly led to the implementation of public policies in support of the biofuels sector, which further encourages the demand for these feedstocks. The support for bioethanol and biodiesel in selected OECD countries totalled US$11-12 billion in 2006 (Table 2). The Total Support Estimates (TSE) represents the total value of all government support to the biofuels industry. This includes the total value of consumption mandates, tax credits, import barriers, investment subsidies and general support to the sector such as public research investment. It does not include support to agricultural feedstock production. US processors and growers received support worth about US$6.7 billion in 2006, and those in the European Union received about US$4.7 billion. The table also indicates that the majority of support varies with the level of production, which suggests that OECD biofuel subsidies are likely to become much larger as mandated consumption increases.

Table 2 - Total support estimates for biofuels in selected OECD countries in 2006

	Ethanol		Biodiesel		Total liquid biofuels	
	TSE (billion US$)	Variable share (percent)	TSE (billion US$)	Variable share (percent)	TSE (billion US$)	Variable share (percent)
United States	5.4-6.6	60-65	0.5-0.6	85	5.9-7.2	65
EU	1.6	98	3.1	90	4.7	93
Canada	0.15	70	0.013	55	0.11	65
Australia	0.035	70	0.021	70	0.05	70
Switzerland	<0.001	94	0.009	99	0.01	98
Total	7.2-8.4		3.6-3.7		10.8-12.1	

Source: Steenblik 2007.

20. To provide some perspective on the relative importance of these biofuel subsidies, Table 3 shows them on a per litre basis. Ethanol subsidies range from about US$0.30 to US$1.00 per litre, while the range of biodiesel subsidies is somewhat wider. This table reveals that although some countries' total support expenditures are relatively modest, they can be substantial on a per litre basis. Again, the variable portion of support provides an indication of the scope for growth in expenditures with output, although some subsidies are budget limited, especially at the state or provincial level.

Table 3: Approximate average and variable rates of support per litre of biofuels in selected OECD countries (US$/litre)

	Ethanol		Biodiesel		Comment
	Average	Variable	Average	Variable	
United States	0.29-0.36	0.15-0.26	0.54-0.67	0.26-0.52	Includes federal and state supports. Varies by state.
EU	1.00	1.00	0.70	0.70	Includes EU and Member State supports. Varies by Member State.
Canada	0.40	0.00-0.20	0.20	0.00-0.40	Includes federal and provincial supports. Varies by province.
Australia	0.40	0.30	0.40	0.30	
Switzerland	0.60	0.60	1.00	0.60-2.00	

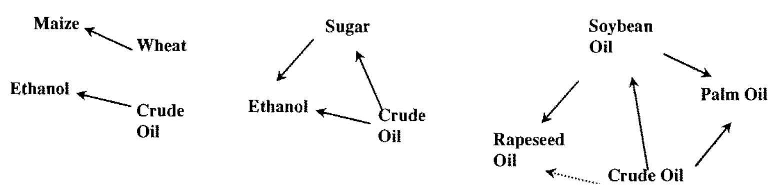
Source: Steenblik 2007

21. Among all major food and feed commodities, the additional demand for maize (a feedstock for the production of ethanol) and rapeseed (a feedstock for the production of biodiesel) has had the potential for the strongest impacts on prices. For example, out of the nearly 40 million tonne increase in global maize utilization in 2007, almost 30 million tonnes were absorbed by ethanol plants alone, mostly in the US which is the world's largest producer and exporter of maize. Over 30 percent of that country's 2008 maize harvest is forecast to be diverted to ethanol distilleries, which amounts to over 12 percent of global maize production. In the EU, the biodiesel sector is estimated to have absorbed about 60 percent of member states' 2007 rapeseed oil output, which amounts to about 25 percent of global production and 70 percent of the 2007 global trade in the commodity.

22. The issue is not limited to how much of each crop may be used for biofuels instead of food and feed, but how much planting area could be diverted from producing other crops to those used as feedstock for production of biofuels. To illustrate, high maize prices since mid-2006 encouraged farmers in the US to plant more maize in 2007. Maize plantings increased by nearly 18 percent in 2007. This increase was only possible because of reductions in soybeans and, to a lesser extent, in wheat areas. The expansion in maize plantings combined with favourable weather resulted in a bumper harvest in 2007 which made it possible for the US to meet domestic demand, including that from its growing ethanol sector, as well as exports. However, this apparent success in maize masked another important development – reduced wheat and soybean plantings and therefore their decreased production was one reason for their sharp price increases. This chain reaction may be repeated in 2008, but this time in reverse order. Farmers in the US are reported to be cutting back their maize plantings in favour of soybeans and wheat because of their higher relative prices. However, the demand for maize by the ethanol sector is expected to continue to rise and if production of maize declines in 2008, it is difficult to expect that the United States will be able to meet all demand (food, feed, fuel and exports) without a significant drawdown on its own maize stocks. Such an eventuality will

be watched closely because, in these periods of tight markets, they could result in firmer prices for maize again next year. In future years, in view of the new US Energy Independence and Security Act (EISA), feedstock demand for maize is almost assured to grow considerably under mandates.

Price discovery in biofuel markets



*Solid line refers to significance at the 5 percent level, dashed line refers to significance at the 10 percent level. The arrow signifies the direction of causality.

23. Analyses of the links between weekly prices of gasoline, ethanol, maize and sugar, and between crude oil and important vegetable oils such as palm, soybean and rapeseed,[12] suggest that there are statistically significant inter-linkages among the relevant markets. The above schematic summarizes those relationships and contains information about the empirical paths of influence revealed by the analysis. Crude oil prices were found to determine the long-run equilibria of both sugar and ethanol prices in Brazil, as well as to constitute an important driver in EU vegetable oil markets, with soybean oil prices also influencing palm and rapeseed oil markets.

24. The "independence" of maize prices in the US energy nexus is a somewhat surprising result, in that energy prices do not appear to feature in the equilibrium between grain markets and the price of maize does not affect the determination of ethanol prices, despite the price of the feedstock being the dominant component in ethanol's cost schedule. The evidence suggests that over the period, other "fundamentals", including policies and policy changes in grain and biofuel markets in the country, were more important in the evolution of the grain prices. It should be noted that short term deviations can be expected between biofuel and crop feedstock prices which result from adjustments to rapidly evolving situations, both in the energy and crop markets. In the future, as production capacity grows, and as the degree of substitutability between biofuel and fossil fuel grows on the demand side, price relationships can be expected to become tighter.

25. *Changing structure of demand:* It is widely accepted that economic development and income growth in developing and emerging countries, as well as population growth and urbanization, have been gradually changing the structure of demand for food commodities. Diversifying diet patterns are moving away from starchy foods towards more meat and dairy

---

[12] The analyses were conducted using price data for US grain-ethanol-crude oil, Brazil sugar-ethanol-crude oil and EU vegetable oil-crude oil. A sufficiently long series of biodiesel prices was not available, but it is expected that the crude oil price itself would be a reasonable proxy in capturing energy market impacts. The choice of commodities was governed by their importance in international trade and thus for the prospect of price shocks originating from them to be passed on to importing countries and also for the potential for shocks to be transmitted to other related commodities.

products, which is intensifying demand for feed grains and strengthening the linkages among different food commodities.[13] However, these changes were not really the main cause of the sudden spike that began in 2006.[14] This is not to downplay the role that changing consumption patterns might have played in reducing stock levels in cereal and oilseed markets over the past decade and, hence, on the observed price hikes, nor the role they are likely to play in the future.[15] This said, it is noteworthy that food and feed consumption continues to show strength despite dramatic price increases, indicating that either demand is incredibly inelastic to price hikes, has shifted to a higher level, or that prices have not been transmitted to domestic levels. It would appear that a combination of these factors is in play.

Other relevant factors

26. *Operations on financial markets:* Market-oriented policies are gradually making agricultural markets more transparent. Derivatives markets based on agricultural markets offer an expanding range of financial instruments to increase portfolio diversification and reduce risk exposure. The abundance of liquidity in certain parts of the world that reflect favourable economic performances (notably among emerging economies), coupled with low interest rates and high petroleum prices, make such derivative markets a magnet for speculators looking to spread their risk and pursue more lucrative returns. This influx of liquidity, particularly prior to the global credit crunch, and the turmoil it caused in the financial markets, seems to have influenced the underlying spot markets to the extent that they affected the decisions of farmers, traders and processors of agricultural commodities.

27. A recent IMF study analysed the nature of the relationship between this type of financial flow into the futures markets and cash/spot prices of five commodities, including those of sugar, coffee and cotton. The empirical tests employed indicated that the short-run causality ran, in general, from spot prices to this type of financial flows, implying that higher spot prices are the "cause" rather than the "effect" of increased investor participation (IMF 2006, Box 5.1). The same type of empirical causality was also found where there were long-

---

[13] Von Braun 2007 notes that real GDP in developing Asia "increased by 9 percent per annum between 2004 and 2006. Sub-Saharan Africa also experienced rapid economic growth of about 6 percent in the same period." He also notes that the "world's urban population has grown more than the rural population; within the next three decades, 61 percent of the world's populace is expected to live in urban areas".

[14] China and India have usually been cited as the main contributors to this sudden change because of the size of their populations and the high rates of economic growth they have achieved. However, since 1980, the imports of cereals in these two countries have been trending down, on average by 4 percent per year, from an average of 14.4 million tonnes in the early 1980s to 6.3 million tonnes over the past three years. Moreover, mainland China has been a net exporter of cereals since the late-1990s, with one exception in the 2004-2005 season. Similarly, India has been a net importer of these commodities only once, in the 2006-07 season, since the beginning of the twenty-first century.

However, the situation for oil crops is different, in that there has been a significant increase in the imports of oilseed, meals and oils of these two countries since 1996. In fact, on average, annual increase in total utilization of oilseeds for these two countries for the period 1996-2008 has been nearly 5 percent, with that for imports more than 17 percent for meals (including the meal equivalent of seeds imported) and 12 percent for oils (including the oil equivalent of seeds imported). Despite this, there is no evidence that there has been a sudden increase in the imports from this source to indicate that they have contributed to the price hike for oilseeds, meals or oils, which began in mid-2007, after the spike in the prices of grains a year earlier.

[15] Indeed a recent study notes: "New government policies will slow, but not avert, the coming end of China's grain self-suffiency" (Trusted Sources).

term equilibrium relationships among the variables concerned.[16] A more recent OECD study (OECD 2008, p. 10) notes that "there have been problems achieving convergence in the corn, wheat and soybeans futures markets at times in recent years, i.e. the link between cash and futures prices may have been broken down occasionally. This could be due to a number of technical issues, such as available storage capacity in the delivery area and the incentives to engage in arbitrage." In particular, the study stated, "Conceivably, it could also be due to the 'inflation' of futures prices being caused by increasingly large long position placed by institutional investors. Could the strong upward pressure on futures prices be putting such stress on cash-futures price link that it breaks from time to time?"

28. The same study also notes that the more or less predictable seasonal differences between cash and futures prices are weakening and adds if "the large long positions of the institutional investors are boosting the futures prices higher than warranted by cash market supply and demand fundamentals, as these investors' growing shares of long side of the market suggest, this could be a cause of the weak basis and the resulting difficulties in pricing the cash corn, wheat and soybeans" (OECD 2008 *ibid.*).

29. *Short-term policy actions and exchange rate swings:* After the start of price hikes, some of the measures to reduce the impact of higher prices on vulnerable consumers, such as export bans and increased export taxes, exacerbated the short-run volatility of international prices. This happened recently in the rice markets, when important exporting countries introduced export bans to protect their own consumers. The section on 'Policies for addressing high food prices" provides further details on these types of policies.

30. Most agricultural commodity prices are quoted in US dollars and the significant decline in its value against many currencies over the recent years has had critical effects on certain developments in the agricultural markets. For those countries that experienced appreciation of their currencies against the US dollar, commodity imports from the United States have become cheaper, thereby boosting demand for products that are exported from the US, and altering trade patterns. Figure 5 provides two examples where the FAO food price index has been adjusted to reflect the changes in the exchange rates between the US dollar and the CFA Franc[17] and International Monetary Fund's (IMF's) special drawing rights (SDRs).[18] Although the adjusted indices are lower than the FAO food price index (expressed in US dollars) since the early 1980s, all three exhibit the recent upward trend. The level to which changes in the international US dollar prices of the individual commodities get transmitted to the domestic markets and the reasons for the extent of the transmission are discussed in more detail in the section on "Impact (pass through) of world price changes on domestic markets".

---

[16] The study concludes: "These findings are consistent with the hypothesis that speculators play a role in providing liquidity to the markets and may benefit from price movements but do not have a systematic causal influence on prices" (IMF *ibid.* p. 18).

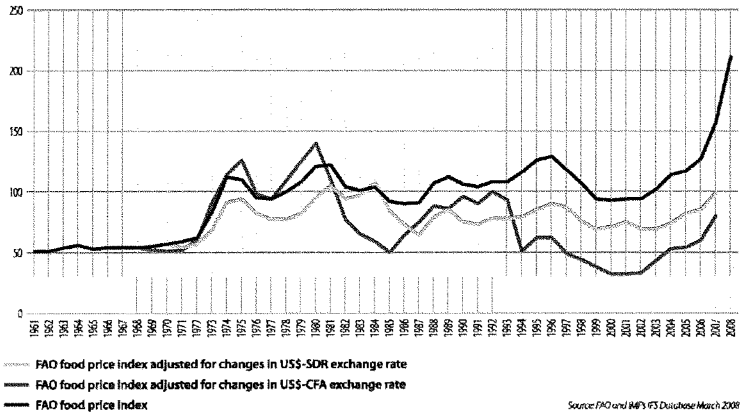
[17] CFA Francs are used in 14 Western and Central African countries: Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Sénégal and Togo in Western Africa; and Cameroon, Central African Republic, Chad, Republic of the Congo, Equatorial Guinea and Gabon in Central Africa. Although the West African CFA franc and Central African CFA franc have the same fixed exchange rate against the euro, one currency cannot be used in the countries using the other.

[18] IMF SDRs are international reserve assets created in 1969 to supplement the existing official reserves of member countries. The US dollar value of the SDR is calculated as the weighted sum of four currencies valued in US dollars – the euro, yen, pound sterling and US dollar. The weights of the currencies used in the calculation are revised every five years according to changes in the relative importance of these currencies in the world trading and financial systems.

197

The actual impact of exchange rate variation for given country also depends on its trading patterns including origin and destination of its exports and imports, and the bilateral exchange rates with its trading partners.

Figure 5 FAO Food Price Index adjusted for changes in the exchange rates between US dollar and SDR and CFA



Source: FAO and IMF's IFS Database March 2008

III. WHAT NEXT?

31. The market developments observed since 2006, and briefly described above, seem to have been the result of short-term imbalances in some commodity markets that spilled over to markets with which they had close linkages, as well as of some factors that may continue to influence the markets for longer periods. The fact that the markets can adjust rather rapidly has already been demonstrated by the supply response observed in the maize and sugar markets, where increases in production at the global level led to tempering the price increases in the former and to decreasing the prices in the latter in 2007. Indeed, the early indications are that the world cereal production will increase by 2.6 percent in 2008, reaching a record level of 2 164 million tonnes. With many agricultural commodity markets continuing to be tight despite the positive expectations for some, and with low stock levels that are not likely to be replenished quickly, the possibility of further sharp price hikes and continued volatility as a result of unforeseen events seems to be likely for the next few seasons. As opposed to other instances of sharp increases in agricultural commodity prices that have rapidly dissipated, we could be facing higher prices for some time. Of significance in this respect is the possibility of the persistence of demand for biofuels, which would depend on a number of factors, including:

- whether the price of crude oil continues to increase and policies supporting the biofuels sector are maintained;
- whether the rate at which second generation feedstocks – lignocellulosics that do not compete with agricultural products for land resources – are developed and commercialized speeds up sufficiently to replace first generation feedstocks.

Other important factors that will be influential over the longer term are:

- population and income growth, as well as intensifying urbanization;
- climate change impact on agricultural yields in different parts of the globe;
- land and water resource constraints; and
- the ability to increase yields of agricultural products through more effective use of existing technologies[19] and/or adoption of new technologies.

IV. LIKELY IMPACTS OF RISING FOOD PRICES

32. Substantial increases in food and fuel prices have important implications for countries and people. The most visible consequences of economic impact are the social unrest and food riots that have taken place on most continents recently, primarily in urban areas where people have felt the brunt of the impact of soaring food prices and rising fuel costs. Long queues at subsidized food stores and higher price tags on almost all food items, not only on staple foods, are an everyday occurrence. Several importing countries are involved in what has been reported as "panic buying" in their efforts to secure adequate supplies and build domestic stocks of major cereals. At the same time, major exporters' efforts to keep domestic cereal prices "in check", and block or impose serious impediments to exports, have further exacerbated the tightness in world markets. Least developed countries with high levels of poverty and food insecurity and large population groups that spend 70-80 percent of their household income on food are particularly vulnerable.

33. Far less visible, but not less important, are the difficult choices that households, especially the poorest ones, have to make because of their rapidly declining purchasing power. The risk of increased food insecurity and malnutrition is high among these population groups, as households have to give up more expensive sources of protein and other nutrient-rich foods and depend on low-cost high-energy foods to maintain a minimum level of productivity. Poor households find themselves having to compromise on health care, education and other non-food household expenditures. At the same time, higher prices present a unique opportunity to re-launch agricultural investment and increase agricultural productivity in the developing countries.

34. Urgent policy measures and practical action need to be taken by governments and development partners around the globe to enhance the positive and alleviate the negative effects of high food prices. FAO recommends the immediate adoption of a twin-track approach aimed at (i) alleviating the impacts of high food and fuel prices on the weakest population groups through direct transfers and safety nets, while (ii) implementing policies and programmes to promote agricultural and rural development both in the short and long run.

---

[19] As an illustrative example to indicate that a great deal can be done to increase yields using known technologies in developing countries, the Government of India notes that the actual yields of wheat, rice and sugar cane in selected states are on average 23, 26 and 31 percent, respectively, below the yields obtained by applying the best practices of farmers in those states and 80, 205 and 117 percent, respectively, below the yields obtained by applying improved practices. This indicates that developing countries have potential to increase production, without expanding area planted or using new technologies. Of course, what it would take to achieve this cannot really be disentangled from the difficulties that hinder the process of agricultural development in those countries. It would have already been done, had it been a simple process.

A. COUNTRY-LEVEL IMPACTS

35. Large increases in food and fuel prices threaten macroeconomic stability and overall growth, especially of low-income, net-importing countries. Table 4 lists 22 developing countries that are especially vulnerable due to a combination of high levels of chronic hunger (more than 30 percent undernourishment), while being highly dependent on imports of petroleum products (100 percent in most countries) and, in many cases, on imports of major grains (rice, wheat and maize) for domestic consumption. Countries such as Eritrea, Niger, Comoros, Botswana, Haiti and Liberia are especially vulnerable due to a very high level of all three risk factors.

Table 4: Net importers of petroleum products and major grains as a percent of domestic apparent consumption - ranked by prevalence of undernourishment

Countries	Petroleum % imported[1]	Major grains % imported[2]	% under-nourishment[3]
Eritrea	100	88	75
Burundi	100	12	66
Comoros	100	80	60
Tajikistan	99	43	56
Sierra Leone	100	53	51
Liberia	100	62	50
Zimbabwe	100	2	47
Ethiopia	100	22	46
Haiti	100	72	46
Zambia	100	4	46
Central African Republic	100	25	44
Mozambique	100	20	44
Tanzania	100	14	44
Guinea-Bissau	100	55	39
Madagascar	100	14	38
Malawi	100	7	35
Cambodia	100	5	33
Korea, DPR	98	45	33
Rwanda	100	29	33
Botswana	100	76	32
Niger	100	82	32
Kenya	100	20	31

[1]**Source**: Energy Information Administration *International Energy Annual 2005*, Washington DC ., US. Covers crude and refined petroleum products.

[2]**Source**: FAOSTAT, *Archives Commodity Balance Sheets*. Average 2001-03 for wheat, rice and maize.

[3]**Source**: FAOSTAT, Food Security Statistics, Prevalence of undernourishment in total population (2002-2004 preliminary): www.fao.org/es/ess/faostat/foodsecurity

Impact on food import bills

36. Substantial increases in the global cost of imported foodstuffs have already occurred, with the total import bill estimated at US$812 billion in 2007 (Table 5), 29 percent more than the previous year and the highest level on record. Developing countries as a whole could face an increase of 33 percent in aggregate food import bills, coming on the heels of a 13 percent increase the year before. Similar increases have occurred for the Least Developed Countries (LDCs) and LIFDCs. The sustained rise in imported food expenditures for both of these vulnerable country groups is alarming. Today, their annual food import basket could cost well over twice what it did in 2000. Because cereal prices surged even more in the second half of

2007, the results are more striking when the comparison is done on a marketing year basis. On that basis, the cereal import bill in LIFDCs is expected to increase by as much as 56 percent from 2006/07 to 2007/08.

Table 5: Forecast import bills of total food and major food commodities ***(US$ million)***

	World		Developing		LDC[1]		LIFDC[2]	
	2006	2007	2006	2007	2006	2007	2006	2007
Total Food	630 135	812 743	190 975	253 626	13 822	17 699	88 577	119 207
Cereals	186 794	268 300	74 615	100 441	6 101	8 031	31 363	41 709
Vegetable Oils	70 822	114 077	34 831	55 658	1 948	3 188	22 919	38 330
Dairy	45 572	86 393	13 593	25 691	824	1 516	5 079	9 586
Meat	78 704	89 712	17 064	20 119	872	1 079	6 295	8 241
Sugar	33 024	22 993	13 892	11 904	1 755	1 320	7 598	4 782

[1]Least developed countries

[2]Low-income food deficit countries

37. Based on the current forecasts, the global share of cereal imports by countries in Africa is about 22 percent, while its share in exports is roughly 3 percent. In spite of the rise in world prices of cereals, imports to Africa in 2007/08 are expected to increase by 2.5 million tonnes to a total of 55 million tonnes, reflecting higher wheat and maize imports, especially in Morocco and Nigeria, which had much smaller harvests in 2007. While this level of imports is higher than in 2006/07, it is below the peaks reached in 2004/05 and 2005/06 when cereal imports exceeded 56 million tonnes. Total wheat imports in Africa are forecast at 29 million tonnes, up 1.2 million tonnes from the previous season. Total imports of coarse grains (comprising mostly maize and barley) are forecast at 16.6 million tonnes, up 1 million tonnes from 2006/07. Rice imports are forecast at 9.6 million tonnes, marginally above the previous season. Africa's total cereal import bill in 2007/08 is forecast at US$2.7 billion, up 23 percent from 2006/07.

Food price increases and current account deficits

38. In some poor countries, increased food import bills might lead to substantial widening of the current account deficit, which in turn could impact other macroeconomic variables such as the exchange rate, the reserve position of the national bank or increased indebtedness.

39. Table 6 shows that, for seven out of a sample of 86 low- and lower-middle-income countries, the predicted *increase* in the cereals import bill in 2007/08 with respect to 2006/07 as a share of their 2007 GDP is greater than 3 percent.[20] This would imply a widening of the current account deficit of those countries as a share of GDP by more than three percentage

[20] The sample includes all low and lower middle income countries with populations in excess of 1 million for which the FAO has predictions on cereal imports. Of the 86, 67 are LIFDCs as classified by the FAO.

points.[21] For another seven countries, the anticipated increase is between 2 and 3 percent while, for the remaining 72 countries, the anticipated increase in the food import bill is less than 2 percent of GDP.

Table 6. Distribution of Low-Income and Lower-Middle-Income Countries according to their Current Account Position and the Predicted Increase in Cereals Import Bill

	Current account balance (% of GDP) Averages (2004-2007)				
Estimated Change in Cereals Import Bill(% of GDP):	Very Large deficit >10%	Large deficit 5-10%	Moderate Deficit 0-5%	Surplus	Total Number of Countries
	Number of Countries				
<1%	5	6	20	22	53
1-2%	4	8	3	4	19
2-3%	2	1	2	2	7
>3%	2	2	3	0	7
Total Countries	13	17	28	28	86
Average Change in the Cereals Import Bill (% of GDP):	1.5%	2.2%	1.1%	0.4%	1.1%

Sources: GDP in current dollars and current account from IMF (International Financial Statistics and World Economic Outlook estimates). Cereal Bills from FAO estimates for 2006/07 and 2007/08. The table entries can be interpreted as per the following example: The first entry (5) means that in 5 countries where the pre-existing ratio of current account deficit to GDP was larger than 10%, the additional cost of the 2007-2008 cereal imports added less than one percentage point to that ratio.

40. The vulnerable countries from a macroeconomic perspective are counted in the lower-left corner of Table 6. These are the countries that already are experiencing high current account deficits and are predicted to have higher relative increases in their cereals import bill. The table shows that 19 countries already have large deficits (>5 percent of GDP) and will experience a growth of their cereal import bill of more than 1 percent. Of these 19 countries, seven (The Gambia, Jordan, Liberia, Republic of Moldova, Mauritania, Niger, and Zimbabwe) are in the most vulnerable positions, with very high current account deficits and predicted increases of their cereal import bill of more than 2 percent. They could experience severe balance of payments problems as a result of higher food prices. Macroeconomic vulnerability also correlates with food insecurity. Of the 19 countries with large deficits and predicted cereals import bill growth greater than 1 percent, 11 have undernourishment rates greater than 20 percent, meaning that more than one out of every five persons does not consume the

---

[21] This is a rough indicator of the change in the current account. It assumes that the dollar denominated value of exports remains constant, and that the rest of import bill also does not change.

minimum caloric requirements necessary to maintain good health under light activity. From a macroeconomic perspective, of the seven most vulnerable countries, four have undernourishment rates of 29 percent or higher.

Impact (pass through) of world price changes on domestic markets

41. The impact of higher prices on the domestic economies of exporters and importers will depend, *inter alia,* on the extent to which changes in world market prices of cereal crops have been transmitted to domestic economies in recent years. Government policies designed to avoid large domestic price shocks[22] and the depreciation of the US dollar against many currencies (e.g. the euro and the CFA franc) tend to reduce transmission of world market prices to domestic markets. Table 7 shows that real exchange rate appreciation in recent years has been quite widespread across different types of countries (categorized according to World Bank income class). Below, price transmission from world to domestic markets is analysed along with the factors that affect transmission.

Table 7: Average real exchange rate appreciation of domestic currencies versus the US dollar, 2003 to 2007, by World Bank income classification.

Income class	(%)
Low income	16
Lower middle income	14
Upper middle income	19
High income	12

Source of raw data: USDA (2008). Calculation is a simple average of all countries in a given income class for which data were available.

Rice in Asia[23]

42. A specific analysis of price transmission for rice in seven large Asian countries is revealing. In Table 8, column (1) shows the cumulative price increase in real US dollars from the fourth quarter of 2003 to the fourth quarter of 2007, while column (2) shows the increase in world prices in real domestic currency terms during the same period of time. A comparison of columns (1) and (2) shows that changes in column (2) are substantially lower than column (1) for most countries, although the change is positive for all countries.

43. Column (3) shows cumulative changes in real domestic prices at the consumer level. For several countries, it can be seen that these changes are lower than the changes in column (2). These countries have used various commodity-based policies to insulate the domestic economy from price increases on international markets. For example, India and the Philippines use government storage, procurement and distribution as well as restrictions on

[22] For more details see last section of this report.

[23] The analysis in this section is based on Dawe (2008).

international trade. Bangladesh uses variable rice tariffs to stabilize domestic prices. Viet Nam uses export restrictions of various sorts.

44. Other countries, such as Thailand and China, have been content to allow most of the changes in world prices (after taking account of currency appreciation) to pass through to domestic markets.[24] In yet other countries, there have been domestic price increases unrelated to events on world markets. In Indonesia, for example, domestic prices surged 23 percent due to import restrictions from October 2005 to May 2007, a period when world prices declined by 20 percent in real rupiah terms.

45. A key conclusion that emerges from Table 8 (shown in column 4) is that, for all countries in the sample except China, the percentage change in column (3) is less than 60 percent of that in column (1). The average across these seven countries shows that about one-third of the increase in real US dollar prices has been passed through to domestic markets. This conclusion is consistent with Sharma (2002), who found that during the 1995-96 price spike, transmission elasticities in Asian countries were typically low, especially for rice.

46. However, world rice prices surged further in the first quarter of 2008, from an average of US$378 per tonne in December to more than US$700 per tonne by the end of March in nominal terms and have led to substantial price increases in many domestic markets. In Bangladesh, wholesale prices rose by 38 percent from December 2007 to March 2008, and in the Philippines they increased by more than 30 percent from October 2007 to April 2008. Average retail prices in India increased by 18 percent from October 2007 to March 2008.

[24] Thailand has some government intervention in terms of procurement and storage, but has largely followed a policy of free trade in rice. China, despite restrictions on private traders, was allowing changes in international prices to be reflected more or less fully in domestic prices, at least through the end of 2007.

BOX 1

Defying the resource curse: agricultural commodity price booms can lead to sustainable growth

The current commodity (agricultural and non-agricultural) price boom brings opportunities for increased government revenue and private sector income in exporting countries. At the same time, it presents a challenge as to how governments can best allocate windfall gains between consumption and investment. Thus, decisions made during the price boom are decisive for economic growth during periods of low prices.

Several research efforts have identified a "resource curse", meaning natural resource-abundant countries tend to grow more slowly than resource-scarce countries. However recent research points out that the impact on long-term growth varies with the type of export commodity (Collier and Goderis, 2007; Collier, 2007). Specifically for the African context, the resource curse relates primarily to oil and non-agricultural commodity price booms, while booming prices on agricultural commodities may, in fact, lead to higher economic growth both in the short and long run.

Where the public sector derives a large share of its revenue through taxation of price-volatile non-agricultural commodities, research has shown that such revenues are allocated in an unbalanced way that favours short-term consumption or relatively unproductive investment rather than savings and sound investments that will protect the economy during periods of lower prices. As a result, short-term growth is reversed when prices decline in the long run.

On the other hand, agricultural export commodities compete for land and other input factors with other crops, thus limiting opportunities for rent seeking. Additionally, farmers make expenditure and investment decisions for additional income generated by an agricultural commodity boom that consider long-term consumption paths, investment opportunities, etc. This tends to lead to both short-term economic growth and longer-term economic growth.

The policy implication is that the present agricultural commodity price boom provides an important opportunity for stimulating both short- and long-term growth if it is not, imprudently, taxed away and if the public sector provides the necessary resources in the form of public goods which will increase agricultural productivity.

Table 8: Cumulative percentage changes in real rice prices, Q4 2003 to Q4 2007

Country	(1) World price (US$)	(2) World price (DC)	(3) Domestic price (DC)	(4) Pass through (%) = (3)/(1)
Bangladesh	56	55	24	43
China	48	34	30	64
India	56	25	5	9
Indonesia	56	36	23	41
Philippines	56	10	3	6
Thailand	56	30	30	53
Viet Nam	39	25	3	11

Notes: Data for China compare 2003 and 2007 (annual). Data for Viet Nam compare 2003 and 2006 (annual). DC stands for " Domestic Currency".

47. Table 9 shows that the percentage changes in consumer and producer prices are remarkably similar in all cases for the Asian countries analysed, suggesting that markets are well integrated and that price changes at one level of the marketing system are passed through to other levels.

Table 9: Percentage change in real domestic producer and consumer prices

Q4 2003 to Q4 2007

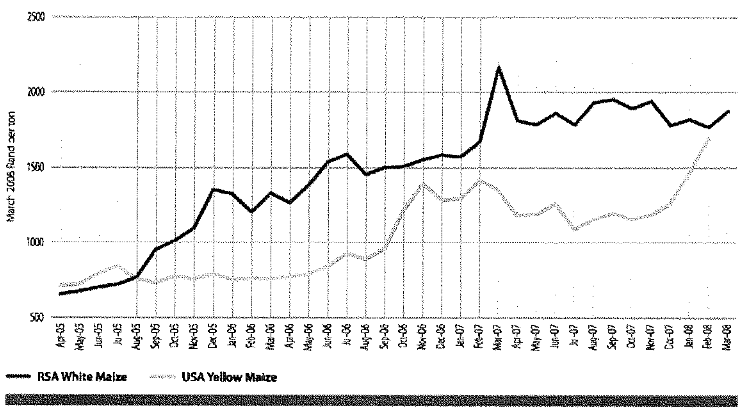
Country	Commodity	Producer	Consumer
Bangladesh	Rice	8	2
Bangladesh	Wheat	42	39
China	Rice	28	30
Indonesia	Rice	28	32
Philippines	Maize	9	5
Philippines	Rice	7	3

Notes: Data for Indonesia compare Q1 2003 and Q1 2007. Data for Bangladesh compare Q4 2003 and Q4 2006. Data for China compare 2003 and 2007 (annual).

White maize in Southern Africa[25]

48. As with rice in Asia, there also has been less than perfect transmission from international yellow maize markets to national or regional white maize markets in southern Africa. At one level, this is not surprising, as white maize is typically used for human consumption while yellow maize is used for animal feed or ethanol. On the other hand, the two commodities are potentially substitutes in production (as happened in Mexico when US maize prices increased) and in consumption (for feed purposes). A graph of yellow maize export prices in the United States (in real Republic of South Africa rand) does not seem to track the changes in South Africa white maize prices well (see Figure 7). There are two possible reasons for this – first, the commodities are different and, second, white maize prices are strongly dependent on supply shocks in South Africa and other countries in the region. For example, from April 2005 to April 2006, white maize prices nearly doubled in South Africa (primarily due to a drought that reduced the maize harvest by some 40 percent), while for US yellow maize, the price increases were very mild. More recently, US maize prices surged from November 2007 to February 2008, partly due to strong demand from the biofuel industry, yet South African maize prices held steady during this time.

Figure 7 Republic of South Africa wholesale white maize and USA yellow maize export prices (real Republic of South Africa rand per ton), January 2003 to March 2008



49. Interestingly, white maize prices in the smaller economies of the region (Malawi, Mozambique and Zambia) do not seem to correlate well with prices in South Africa. Further, a close examination of the data seems to indicate that a recent maize price surge in Malawi and Mozambique began just before a similar, but smaller, increase in US prices. Of course, maize markets in southern Africa cannot remain completely disconnected from world markets over the long term but, in the short term, national trade policies, public procurement and distribution of maize and poor infrastructure seem to play an important role in determining domestic prices. Countries with large maize imports relative to their domestic requirements,

[25] The analysis in this section is based on Gunjal and Dawe (2008).

such as Lesotho, Swaziland, Botswana and Zimbabwe, have experienced much stronger price transmission from South African prices, the region's main exporter.

Wheat in Latin America

50. Argentina and Chile present contrasting cases. Both are upper middle-income countries and have relatively good infrastructure. The exchange rate in both countries has appreciated against the US dollar during the past few years. Chile, however, imports a large share of its wheat consumption requirements, while Argentina is a major world wheat exporter. More important for price transmission, Chile pursues a very open trade policy, while Argentina is much more interventionist.

51. Due to exchange rate appreciation, world price equivalents in real domestic currency terms have increased more slowly in both Chile and Argentina than on world markets. Comparing Q4 2007 with Q4 2003, world wheat prices increased by 91 percent in real US dollars. However, in real Chilean pesos, the increase was just 50 percent, while in real Argentine pesos, the increase was 68 percent.

52. Domestic wheat prices in Chile follow international prices quite closely, as can be seen in Figure 8, while Argentina places export taxes on wheat to keep domestic prices lower and also uses export registrations to influence trade. Thus, Figure 9 shows that domestic wheat prices are consistently lower than benchmark international prices. Further, as international wheat prices have climbed, Argentina has increased its use of such instruments to control trade, with the result that the gap between domestic prices and the world price has increased during the past few years.

Figure 8 Chile domestic wholesale and world wheat prices (real Chilean pesos per kg), January 2003 to February 2008

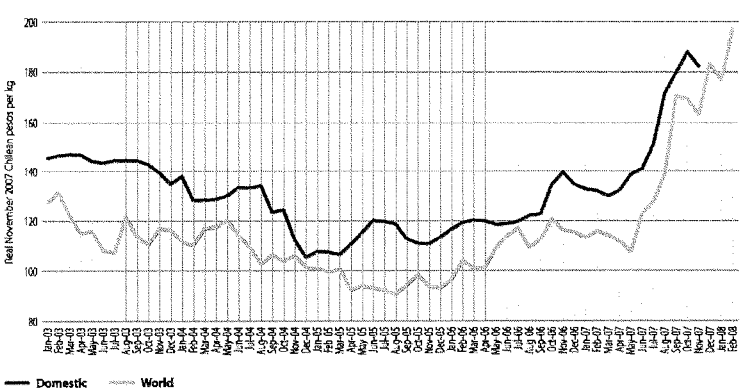
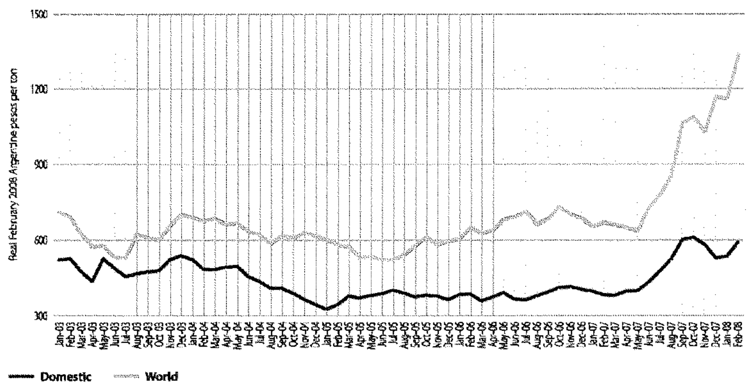


Figure 9 Argentina domestic wholesale and world wheat prices (real Argentine pesos per ton), January 2003 to February 2008



Impact of rising food prices on consumer price indices

53. One way to measure the price changes that have occurred on domestic markets is to examine data on food price inflation. One disadvantage of this approach is that the food basket consumed by the poor can be quite different from the food basket used in the calculation of the consumer price index (CPI). Nevertheless, data from the CPI can be used to estimate the aggregate impact of price increases for a wide range of food commodities, and they are available for a number of countries on a timely basis. This approach is helpful because prices have increased for a very large number of different commodities (see Table 10).

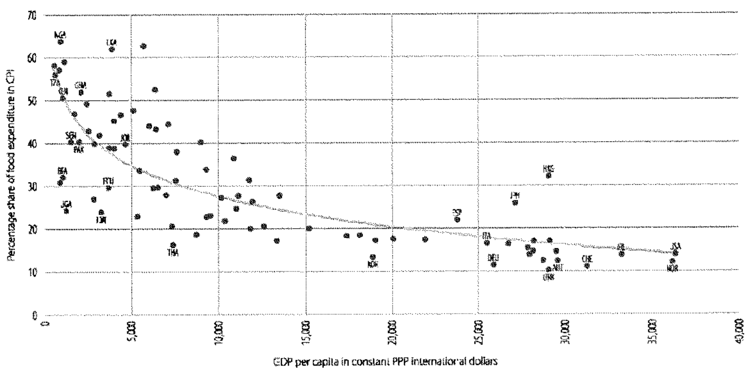
Table 10: Summary of changes in domestic prices of main basic food commodities observed in 45 developing countries

Commodities	Percentage of consumer price quotations from 45 reporting countries indicating *increases* of 0-75%			Percentage of consumer price quotations from 45 countries indicating *decreases*		
	01/2006 to 01/2007	01/2007 to 01/2008	01/2008 to 03/2008	01/2006 to 01/2007	01/2007 to 01/2008	01/2008 to 03/2008
Rice	67	72	65	27	15	29
Wheat	57	69	57	36	18	40
Maize	60	71	52	26	16	37
Root crops	43	65	52	39	28	42
Vegetable oils	72	75	63	23	2	24
Pulses	67	59	70	20	32	23
Milk	70	90	49	26	3	46
Meat	69	76	49	29	17	46
Eggs	58	70	49	33	25	43
Fish	62	62	43	26	28	51

Source: Survey of countries where FAO has a representative

54. Figure 10 highlights the importance of food expenditures for poor countries. It plots GDP per capita expressed in purchasing power parity (PPP) international dollars of 86 countries for which data are available, against the weight of food expenditures in the calculation of consumer price indices (CPIs) in each. For example, at the lower end, the average weight of food expenditures in total CPI is around 45 percent for the 20 countries with the lowest per capita income (i.e. less than PPP dollars 3 700), while the share of the richest top 20 countries (i.e. greater than PPP dollars 22 000) averages only 16 percent.

Figure 10 Share of food expenditure in consumer price index and consumer price index and GDP per capita for selected countries



55. Table 11 presents the percentage changes in the CPI, as well as the changes in its food component as a result of the changes in food prices in selected countries or group of countries from 2007 to 2008 for the months of January and February. As can be seen, in all cases for both months, the changes in the food component of the CPI have been larger than the changes in the value of the index itself, though there have been differences in the magnitude of changes, reflecting many of the factors described in the previous section. The average increase in the food component for the developing countries was about 12 percent in January, rising to 13.5 percent in February. For the developed countries/regions it was 5.4 percent for both months. The larger increases for the developing countries are probably due to the fact that foods consumed in those countries undergo less processing relative to that in developed countries. Thus, increases in the price of the basic food contribute relatively more to price increases for the final product in developing countries.

56. While the average figure for developing countries of 13.5 percent inflation in food prices is certainly cause for concern, especially for the poor, this increase is much less than what one might expect based on a reading of press reports. Further, some of this increase is just general inflation due to growth of the money supply. Nevertheless, the overall average may also hide many very serious increases in staple food prices, which are the most important for the poor. For example, as noted earlier, from October 2007 to March 2008, rice prices increased by 38 percent in Bangladesh, 18 percent in India, and more than 30 percent in the Philippines.[26] This is a very large increase for poor people who depend on a single staple food for the bulk of their caloric intake, and typically spend 20 to 40 percent of their income on this one commodity alone.

Trends in per capita consumption

57. One would expect that higher cereal prices would reduce cereal consumption, and countries with high levels of undernourishment that are highly dependent on cereals for their daily caloric intake would be of particular concern (see the top two panels of Table 12). However, in spite of the soaring prices in global commodity markets documented above, in particular of tradable cereals such as wheat, rice and maize, the most recent data on the food

---

[26] For the Philippines, the calculation refers to October 2007 to April 2008.

use of these key cereals have not shown a decline on a per capita basis. This trend is the same for most low- income countries, including those with high levels of undernourishment (see Figure 11). While this may change with the persistence of high cereal prices in the future, current trends suggest that given the importance of cereals as a major source of energy in the household diet, cereal consumption is highly inelastic to price changes.

58. These trends must be interpreted cautiously, however. First, the data on consumption are estimated using the supply-disposition method, and do not come from consumption surveys. There are major sources of uncertainty in the data used to make these calculations. Second, the average trends for a country obscure the fact that poor consumers respond more to price changes than do wealthy consumers; thus, average consumption may change little for the country in total, but for the poorest the changes could be quite substantial. Third, even if cereal consumption of the poor does not change, this does not imply that there are no important welfare effects. The poor may defend their intake of cereals, but only at the expense of reduced consumption of more nutritious foods and reduced expenditures on education and health (see the section on "Household level impact of high food prices").

Table 11: Monthly percent changes in the CPI and share of food expenditures in CPI for selected countries/groups

	Jan 2007 to Jan 2008		Feb 2007 to Feb 2008	
	%change		%change	
Country	**Total CPI**	**FOOD**	**Total CPI**	**FOOD**
Guatemala	7.7	18.3	8.0	11.6
Sri Lanka	4.6	5.8	19.4	25.5
Malawi	6.8	11.4		
Botswana	10.6	18.2	7.7	18.3
India[1]	8.6	13.6	4.6	5.8
Indonesia	5.4	9.1	6.8	11.4
Pakistan[1]	4.0	6.4	10.6	18.2
South Africa	5.8	10.9	8.6	13.6
Jordan	9.5	13.5	5.4	9.1
Peru	9.9	11.8	4.0	6.4
Senegal	3.6	7.3	5.8	10.9
Egypt	15.4	24.6	9.5	13.5
Haiti	10.3	14.2	9.9	11.8
UEMOA[2]	6.9	14.6	3.6	7.3
Kenya	4.6	12.6	15.4	24.6
Bangladesh	3.4	5.1	10.3	14.2
Chile	4.1	5.8	6.9	14.6
China	6.6	18.2	8.0	23.3
OECD	3.4	5.1	3.4	5.1
USA	4.1	5.8	4.1	5.8

[1] Food beverages and tobacco

[2] Includes: Benin, Burkina Faso, Cote d'Ivoire, Guinee-Bissau, Mali, Niger, Senegal, Togo

Figure 11 Per capita consumption of all cereals

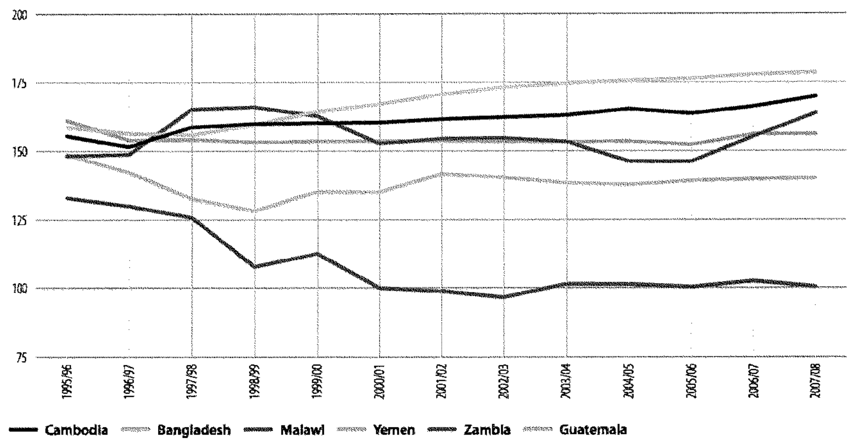


Table 12: Countries with high levels of undernourishment (>20%); high and low shares of Dietary Energy Supply (DES) from rice, wheat, maize

Country	Undernourishment Prevalence 2001-03 %	Undernourishment Number of People 2001-03 millions	% DES from rice, wheat, maize	2001-03 daily DES (kcal)
>55 % DES from tradable cereals				
Bangladesh	30	43	81	2200
Cambodia	33	5	77	2060
Zambia	47	5	63	1930
Korea, DPR	35	8	62	2470
Malawi	34	4	59	2140
Yemen	37	7	59	2020
50-55 % DES from tradable cereals				
Zimbabwe	45	6	54	2010
Sri Lanka	22	4	54	2390
Madagascar	38	7	53	2040
Guatemala	23	3	53	2210
India	20	212	53	2440
Sierra Leone	50	2	52	1930
<20 % DES from tradable cereals				
Dem. Republic of Congo (DRC)	72	37	18	1610
Central African Republic	45	2	17	1940
Burundi	67	5	15	1640
Chad	33	3	11	2160
Sudan	27	9	11	2260
Rwanda	36	3	9	2070
Niger	32	4	9	2160

Impact of high food prices at country level: some concluding remarks

59. There are several conclusions that can be derived from the analysis of the country-level impacts of high food prices. First, from the point of view of country-level impacts, assessment must be done on a case-by-case basis, because different countries have experienced differeut exchange rate movements and employ different commodity policies. International price movements are not fully reflected in domestic prices and changes in domestic prices are not necessarily due to events on international markets. Nevertheless, it should be emphasized that many countries have experienced sharp increases in domestic prices, even if these increases are less than price changes on world markets. Furthermore, even if these prices subsequently decline, it still remains difficult for the poor to cope with such changes, because it is not possible to forego staple food consumption for several months waiting for prices to fall.

60. These increases will be more easily tolerated if wages are increasing at sufficiently rapid rates, but the limited evidence available suggests that there is a lag of several years before wage increases are adequate to compensate the poor (Ravallion 1990; Rashid 2002).

61. Second, in the short run, most countries seem to have managed to maintain a non-declining per capita cereal consumption. The data on apparent consumption show no dramatic changes in the historical patterns. Again, however, these national average data hide changes that may be occurring in poor households, and they also ignore changes in consumption of

more nutritious food such as meat and dairy products, and changes in expenditures on health care and education. Large import bills have had large macroeconomic effects only in a limited number of countries, but these effects could be severe in many cases, especially if world prices remain high or continue to increase. If high prices remain in place for an extended period of time, some of the government interventions that have so far helped to moderate price increases will not be fiscally sustainable.

62. Most importantly, "moderating" the impact of movements in world prices on domestic prices does not mean that the food security impacts are negligible: increases in domestic prices even by moderate rates (10 or 20 percent) may be disastrous for very poor households that spend a large part of their income on food staples. For example, Senauer and Sur (2001) estimated that if there is a 20% increase in food prices in 2025 relative to the baseline, the number of under-nourished people in the world would increase by 440 million people. These considerations point to the importance of household-level food security analysis, which is discussed in the next section.

B. HOUSEHOLD-LEVEL IMPACTS OF HIGH FOOD PRICES

63. It is clear from media reports that soaring food prices have had a wide and substantial impact on the food security situations of households and individuals around the globe. While empirical data are limited, the following sections review the heterogeneous nature of this impact across households and individuals depending on existing consumption patterns and household market position as net buyers or net sellers of food.

64. Urban populations are more exposed to rising food prices for two reasons. First, urban populations are more likely to consume staple foods derived from tradable commodities (wheat, rice), while rural populations (particularly in Africa and Latin America) tend to consume more traditional staples, such as roots and tubers. Second, urban populations are less likely to produce a significant share of their own food or produce for sale.

65. In the very short term, the impact of soaring food prices on households depends crucially on their position in agricultural output food markets as producers and consumers. Low-income households that spend a large proportion of their income on tradable staples whose prices increase substantially are likely to be the ones whose overall welfare is worst affected. Households that derive a large proportion of their income from the production and sale of those goods will, on the contrary, be positively affected if producer prices are remunerative relative to production costs some of which, such as fuels, seeds and fertilizers, have also increased substantially. The effect on households that are both producers and consumers of different commodities is ambiguous and will depend on their net position in the specific markets and the relative price changes for different commodities.

66. Clearly these effects can be mitigated by the extent to which consumers are able to shift consumption towards less expensive food. In the medium term, production patterns will also reflect the movement in relative prices with households shifting to more profitable crops. If this supply side response is large enough, some households may move from being net buyers to net sellers, but that will depend on the movement in relative prices and the access to land and other resources needed to effect that response.

67. A reasonable picture of the likely short-term impact of high food prices on different types of households can be obtained by looking at the evidence from existing survey data on the production and consumption patterns of both urban and rural households. While price

changes affect all income groups, the focus of the analysis will be on households in the poorest strata of the population, which are those households that development policy is (or should be) most concerned with.

68. The first step is to identify the proportion of net seller or net buyer households and their characteristics. Table 13 reports on the share of net seller households in a sample of countries from the three main developing regions. The upper part of the table is based on RIGA[27] data, and defines net food sellers as those households with a value of production of a given country's main food staple larger than the value of their consumption of the same staple. The lower part uses results from Aksoy and Isik-Dikmelik (2008), which is based on two to three staples per country.

[27] The Rural Income Generating Activities (RIGA) programme is a joint effort by FAO, the World Bank and American University. More information may be found at http://www.fao.org/es/ESA/riga/index_en.htm.

Table 13: Share of Net Staple Food Seller Households [a] (percent)

	Share of Households [b]		
	Urban	Rural	All
Bangladesh, 2000	3.3	18.9	15.7
Pakistan 2001	2.8	27.5	20.3
Viet Nam, 1998	7.1	50.6	40.1
Guatemala, 2000	3.5	15.2	10.1
Ghana, 1998	13.8	43.5	32.6
Malawi, 2004	7.8	12.4	11.8
Madagascar, 1993	14.4	59.2	50.8
Ethiopia, 2000 [c]	6.3	27.3	23.1
Zambia, 1998 [c]	2.8	29.6	19.1
Cambodia, 1999 [c]	15.1	43.8	39.6
Bolivia, 2002 [c]	1.2	24.6	10.0
Peru, 2003 [c]	2.9	15.5	6.7
Max	15.1	59.2	50.8
Min.	1.2	12.4	6.7
Unweighted average	6.8	30.7	23.3

*

Sources: Figures shown are from the RIGA dataset, unless otherwise indicated in the notes below.

Notes: (a) In the RIGA[28] data one staple crop per conntry is used, as opposed to 2-3 in Aksoy and Isik-Dikmelik (2008).

(b) Share of Urban, Rural, and National Households respectively.

(c) Figures drawn from Aksoy and Isik-Dikmelik (2008).

69. The overall range of net seller households varies between 7 and 51 percent in this sample of countries. The same range in rural areas is between 12 and 59 percent. Taking an unweighted average across countries, only 23 percent of all households and 31 percent of rural households are net food sellers, indicating that, in this sample, a majority of households are net buyers of staple foods.

[28] Rural Income Generating Activities. The database is part of a joint FAO-WB-American University project http://www.fao.org/es/ESA/riga/index_en.htm

70. Taking a further look into this, to understand how the poor are represented within the group of net sellers, Table 14 reports the proportion of the poor that are net sellers, using the dollar-a-day international PPP poverty line. The bottom line is that even in rural areas, where agriculture and staple food production are important occupations for the majority of the poor, a vast share of the poor are net food buyers and stand to lose (or at least not gain) from an increase in the price of tradable staple food. At the same time, in two of the countries analysed, about half of the poor are net food sellers and, therefore, might benefit from the higher prices. Even among the rural poor, the impact of recent price trends can be heterogeneous.

Table 14. Share of dollar-day poor households that are net sellers

	Share of dollar-day poor households		
	Urban	*Rural*	*All*
Bangladesh, 2000	0.0	9.2	8.6
Pakistan 2001	5.0	22.0	18.8
Viet Nam, 1998	0.0	25.3	25.0
Guatemala 2000	7.9	11.9	11.7
Ghana 1998	29.2	46.5	43.6
Malawi 2004	2.6	7.8	7.6
Madagascar, 1993	15.4	59.6	54.4

Source: RIGA

71. Having characterized households in terms of their market position for main food staples, the next step is to gauge the likely welfare impact of a price change across different household types. The net impact of price changes on household welfare can be disaggregated into the impact on the household as a consumer of the good and the impact on the household as a producer of the good.

72. Given the same change in producer and consumer staple price, the net effect on household welfare depends on the household's condition as net seller or net buyer[29]. To quantify this change in welfare in an intuitive manner, we use the concept of compensating variation, which is the income/monetary transfer that is needed to restore the household to the initial position before the (price) shock occurred, expressed as a percentage of the initial level of total consumption expenditure.

73. In its simplest form, which is the one being computed here, substitution effects and household responses in production and consumption decisions are not accounted for. Therefore, the results are to be interpreted as the upper bound of the likely impact.[30] For simplicity, this exercise also assumes that price changes are transmitted to the same degree to

[29] Consumption and production are valued at the time of the survey and may not necessarily capture seasonal patterns.

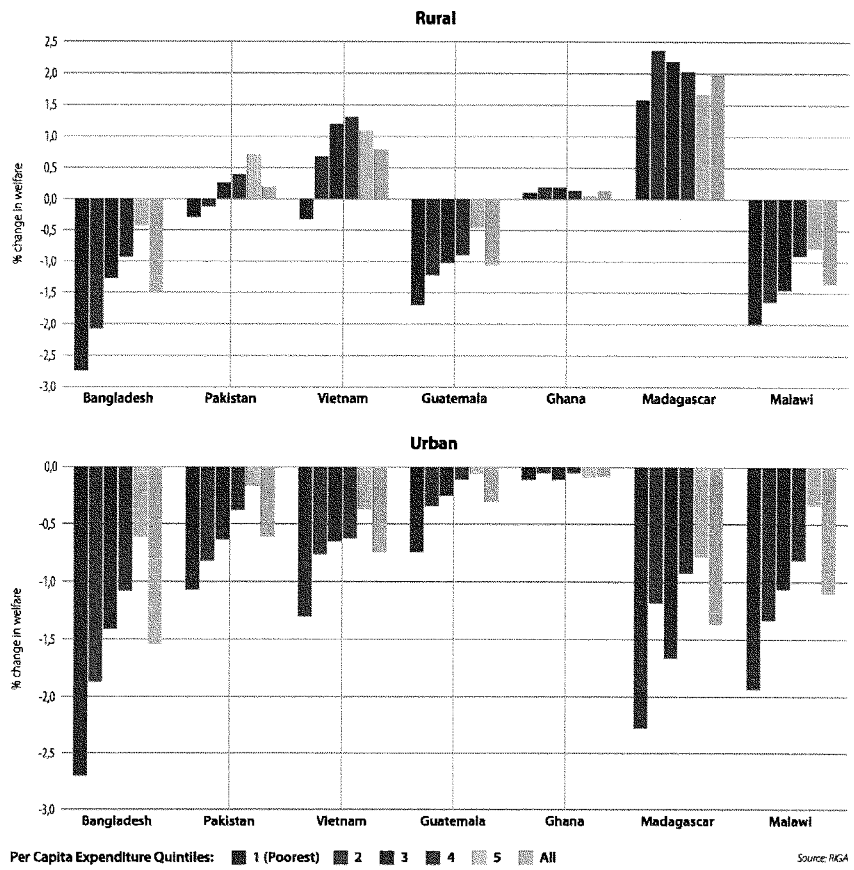
[30] It is also worth noting that adjustments in crop production are not possible in the very short term (they will take at least a cropping season to materialize), and that on the consumption side, the very poor are likely to have already exhausted most possibilities of substitution towards cheaper calories.

different types of households, be they urban consumers or smallholder farmers in a remote area with limited access to larger markets and, therefore, relatively insulated from international price movements.

74. On the other hand, the results presented below simulate the impact of a 10 percent increase in the price of the staple good, which is lower than the actual price increase currently being faced by households in many, but not all, countries. Also, these estimates refer to the increase in the price of one commodity only (the main staple), while as it has been shown above that the increase in prices is often generalized, affecting the price of non-tradable staples as well as some essential non-food items such as energy. In this respect, the results may underestimate the overall welfare impact.

75. Using the RIGA dataset, it is possible to examine the welfare impact of food price changes on different types of households. Given that the magnitude of the effects may represent an over or underestimate of the actual impacts, what matters in the analysis below is the relative effects among groups of households classified across different characteristics (net market position, income quintile, sources of household income). Several interesting observations can be drawn from these data. First, and as expected from both intuition and the discussion of Table 13 above, urban consumers are expected to lose in all countries. In rural areas, the situation is more mixed. But what is perhaps more important to note from the results reported in Figure 12, is that it is the poorest expenditure quintiles that are the worst affected in both urban and rural areas across the board. Even in some countries where rural households gain on average, such as Viet Nam and Pakistan, the poorest of the poor face a negative change in welfare following the staple price increase.

Figure 12 Percentage welfare gain/loss from a 10 percent increase in the price of the main staple, by income (expenditure) quintile



Source: RIGA

Note: The dark bars represent income (expenditure) quintile averages, from the poorest to the richest quintile (from left to right).

76. In Bangladesh, for instance, both rural and urban households are adversely affected by the increase in the price of rice, and the impact is, on average, of similar magnitude at 1.5 percent of their initial total expenditure level. In both rural and urban areas, however, it is the poorest of the poor (the bottom 20 percent) that are hit the hardest, facing a net loss of 2.7 percent following a 10 percent price increase, with the second poorest quintile losing around 2.0 percent. Among the African countries, losses of a comparable order of magnitude are found for Malawi and urban Madagascar. Only in rural Madagascar do the poorest households seem to stand a chance to gain from the increase in rice prices.

77. Viet Nam is another case in point. Here, rural households are expected to see their average welfare increase by 0.8 percent following a 10 percent increase in rice prices. However, these gains are not evenly distributed and the poorest quintile is still expected to face a small 0.3 percent net loss. The larger gains (1.1 to 1.3 percent) accrue to the three wealthier quintiles. Poor urban consumers are the group whose estimated welfare loss is greatest in Viet Nam.

78. As this analysis shows, it is extremely important to unpack the average impact estimates in order to understand how specific population subgroups stand to be affected, depending on their access to key assets and livelihood strategies. For instance, the outlook is systematically worse for the poor landless (Table 15) whose losses, with the exception of Guatemala, are far greater than those of the average rural dwellers. Taking once again the example of Bangladesh, the welfare loss for the landless is as high as 3.5 percent in the bottom quintile. Even in rural Viet Nam, where gains are estimated to accrue to a large share of the rural population, the one group that is expected to lose according to these estimates is the landless, whose average loss is estimated at 1.8 percent, with a 2.7 percent loss for the bottom 40 percent of the expenditure distribution. However, this group represents only about one tenth of the rural sample in Viet Nam (as opposed to one half in Bangladesh).

Table 15. Average welfare gain/loss from a 10% increase in the price of the main staple, by income (expenditure) quintile and land-ownership category

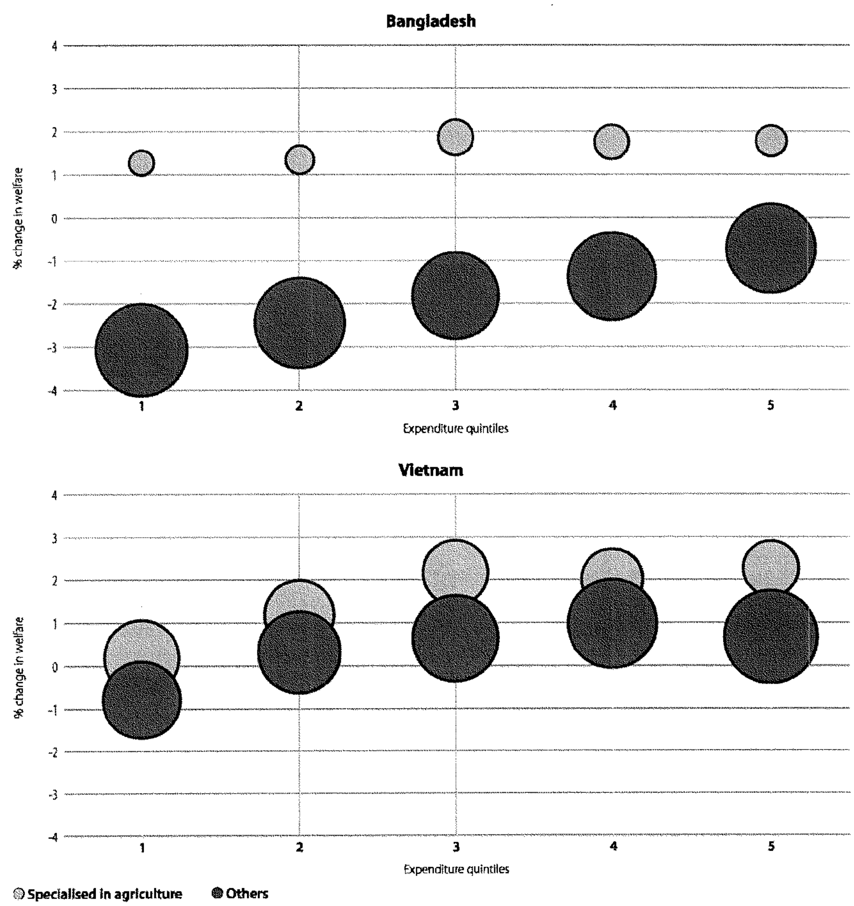
		Per Capita Expenditure Quintiles					
		1	2	3	4	5	All
Bangladesh	Landowners	-1.22	-0.86	-0.29	-0.06	0.15	-0.34
	Non-landowners	-3.48	-2.92	-2.36	-2.04	-1.45	-2.60
Pakistan	Landowners	1.16	1.20	1.65	1.65	1.91	1.58
	Non-landowners	-0.66	-0.63	-0.49	-0.39	-0.15	-0.48
Viet Nam	Landowners	-0.16	0.88	1.43	1.51	1.38	1.00
	Non-landowners	-2.71	-2.69	-1.85	-1.75	-0.96	-1.81
Guatemala	Landowners	-1.91	-1.27	-1.00	-1.23	-0.62	-1.27
	Non-landowners	-1.32	-1.22	-1.02	-0.89	-0.36	-0.83
Ghana	Landowners	0.5	0.31	0.32	0.19	0.15	0.29
	Non-landowners	-0.08	0.13	0.11	0.1	-0.01	0.05
Malawi	Landowners	-1.95	-1.62	-1.43	-0.85	-0.76	-1.34
	Non-landowners	-2.54	-2.05	-1.69	-1.39	-0.89	-1.45
Madagascar	Landowners	1.26	2.16	2.19	2.03	1.78	1.89
	Non-landowners	0.67	1.46	0.17	0.59	0.86	0.72

Source: RIGA

Note: This table refers to rural households only.

79. The one subgroup that, on the contrary, stands to systematically gain from the increase in prices, is the agricultural "specializers", those households that derive more than 75 percent of their income from farming. Figure 13 compares the impact on agricultural specializers versus all other households for Bangladesh and Viet Nam – the size of the bubbles is proportional to the share of the rural households in each subgroup. In Bangladesh, agricultural specializers, who form about one tenth of the rural sample, see their welfare improve by 1.7 percent on average (1.3 percent in the bottom quintile, 1.8 in the top). Also in Viet Nam, it is the richer agricultural specializers who gain the most, at around 2.2 - 2.3 percent. But in this case, agricultural specializers represent a larger share of the rural population, likely due to the more equitable distribution of land.

Figure 13 Percentage welfare gain/loss from a 10 percent increase in the price of the main staple, by expenditure quintile and income typology. Rural sample.



Note: The size of the bubble is proportional to the share of rural households in each group.

Source: RIGA

80. Other sources that use more or less complex modelling techniques obtain results that are qualitatively the same as the ones presented here. For instance, this is the case of Taylor, *et al.* (2006) who simulate, in a general equilibrium framework the effect of a 10 percent change in the price of the main staple in four countries in Central America. Ivanic and Martin (2008) simulate the percentage point change in the dollar-a-day poverty rate resulting from a 10 percent increase in a number of food products and obtain results that are very close to those presented here, even when they account for some possible labour market effects (via the wage rate).

High food prices and undernourishment: the case of Peru

81. The effects of an increase of food prices on nutrition will depend on a variety of underlying factors that vary from country to country. In this section, we analyze the case of Peru as an illustration of the mechanisms through which food price increases transmit into the overall nutrition status of a population. We simulate an increase in the price of wheat which is both a staple and tradable cereal.

82. The effect of the price increase on consumption will vary if the household produces wheat or is only a consumer of wheat products. For wheat farmers, nominal income increases which has a positive effect on consumption of all goods, but the price increase has a negative impact on real income and provides incentives for the household to substitute towards less expensive items. The net effect, positive or negative, will depend on the price and income elasticities of demand, the relative importance of the value of wheat production in total income, and how the household substitutes away from wheat goods into other foods. For the non-wheat producers, which includes all urban consumers, the net effect is most likely negative.

83. Wheat is not widely produced in Peru and, therefore, the positive pure income effects are likely to be minimal. However, the distribution of the producers across income categories is also important because it is regularly observed that poorer household have higher food income elasticity. The substitution possibilities will determine the final fall in both wheat and non-wheat goods. With high substitution possible, the fall in wheat consumption will be higher, but the net fall in food consumption will be lower as consumers move away from wheat products to other cereals and tubers. Further, the net caloric effect of these trade-offs will depend on the different caloric contents of wheat and its substitutes. In the case of Peru, with its traditional diet rich in non-tradable tubers and grains such as quinoa, a high degree of substitution[31] is expected, though increased demand may eventually lead to higher prices for these commodities as well.

84. The experiment of a 10 percent increase in the real price of wheat, using as a base the nutritional status of the population as calculated from the 2003-2004 national household survey, is presented in Table 16. The table shows, by population groups, average daily caloric intake and the prevalence of food deprivation, the latter of which is the share of individuals within a given population group that consumes fewer calories per day than the age- and gender-adjusted minimum necessary to maintain good health under light physical activity. A 10 percent hike in the price of wheat results in a national increase of food deprivation from 21 percent to 22 percent. However, the increase in undernourishment is higher in the capital Lima, where a fourth of the population lives, and in the coastal region, but lower in the poorer highlands region. Although the highlands region consumes a higher share of wheat and wheat products, it is also where most of the farms that benefit from a price increase are located. Similarly, when the results of the experiment are examined by income quintile, Table 16 reveals that, for the poorest quintile, the prevalence of undernourishment and the average caloric intake do not change.

---

[31] The Agricultural Information Agency of Peru recently informed that potato consumption in the capital Lima increased by 17 percent in March of this year compared to the previous year, suggesting as expected, that consumers are substituting into tubers. Further, public information campaigns that promote the use of alternative foodstuffs can have an important effect in promoting substitution and mitigating the nutritional impact of soaring food prices.

Table 16: Mean Caloric Intake and Food Deprivation in Peru (2003/04). Measured and predicted levels following a 10% real price increase in wheat and wheat goods.

	Initial Condition		Final After 10% Increase in Wheat Price			Initial Condition		Final After 10% Increase in Wheat Price	
Region	Mean Caloric Intake	Proportion of Food Deprived %	Mean Caloric Intake	Proportion of Food Deprived %	**Income Quintile**	Mean Caloric Intake	Proportion of Food Deprived %	Mean Caloric Intake	Proportion of Food Deprived %
Coast	2320	12	2310	13	Poorest	1490	80	1490	80
Highland	1950	36	1940	36	2nd Quintile	1880	36	1880	37
Amazon	2100	23	2100	23	3rd Quintile	2090	19	2080	20
Lima City	2280	14	2270	15	4th Quintile	2240	11	2230	12
National	2150	21	2140	22	5th Quintile	2450	5	2440	5

85. Even if the impact of higher food prices on cereal consumption is small, this does not imply that the impact of higher food prices is unimportant. Indeed, many poor people must protect their calorie intake in order to survive, so reductions in cereal consumption are not a realistic option. Instead of reducing cereal consumption, their response will be to reduce expenditures on other items such as more expensive and nutritious food (e.g. meat and dairy products), education and health care. As one example, Block et al (2004) found that when rice prices increased in Indonesia in the late 1990s, purchases of more nutritious foods were reduced in order to afford the more expensive rice. This led to a measurable decline in blood haemoglobin levels in young children (and in their mothers), increasing the probability of developmental damage. A negative correlation between rice prices and nutritional status has also been observed in Bangladesh (Torlesse et al 2003). Reductions in expenditures on education and health care can also obviously have adverse long-term consequences on their efforts to escape poverty. Households under distress may liquidate assets (distress sales) and deplete savings with uncertain prospects for re-building them.

High food price impacts: the gender dimension

86. An important question regarding the welfare effects of rising food prices is whether there are observable differences between male-headed and female-headed households. Table 17 illustrates how female-headed households in some countries are over-represented among the poor or, equivalently, are more likely to be poor, while in other countries the opposite is true. The welfare losses or gains due to staple food price increases, however, do not seem to be equally distributed among female- and male-headed households. As a matter of fact, with a few exceptions in which no differences could be established, in most urban, rural and national samples, female-headed households have greater proportional welfare losses (or smaller proportional welfare gains) than male-headed households. This effect is true for the population as a whole as well as for the poorest segments of the population.

87. These rather strong results can be explained. In the case of urban samples, the welfare effect is because of the share of the staple food in consumption: poorer households spend a greater percentage of their income on food than richer ones. Therefore, where female-headed

households are poorer, such as in Madagascar, it is expected that their welfare losses would be higher. However, even when in urban areas there is no poverty bias, such as Viet Nam, or male-headed households are over-represented among the poor, such as Nicaragua, it is still possible for female-headed households to have greater welfare losses. It has been observed in different contexts that all other things being equal, female-headed households tend to spend a greater share of their income on food. In the case of rural samples, the results in Table 17 mirror what has also been shown in different rural contexts, which is that female-headed households have less access to land and participate less in agricultural income generating activities. When this is the case, female-headed households cannot participate in the benefits of food price increases, which is what probably drives the gender bias displayed in the "Rural welfare losses" column of Table 17.

88. Although the sample of countries included in Table 17 is small, the strength of the results suggests that special attention should be paid to female-headed households within the safety-net programmes that are implemented in the context of rising food prices.

Table 17. Gender Bias in Poverty and Welfare Effects of Staple Food Price Increases

	Urban			Rural			National		
Country / Year	Share FHH (%)	Over-represented among Poor†	Welfare losses higher§	Share FHH (%)	Over-represented among Poor†	Welfare losses higher§	Share FHH (%)	Over-represented among Poor†	Welfare losses higher§
Ghana 1998	32.8	FHH	--	24.9	MHH	FHH	27.5	MHH	FHH
Madagascar 1993	20.8	FHH	FHH	13.2	FHH	--	14.6	FHH	FHH
Guatemala 2000	18.8	MHH	--	11.9	MHH	--	14.5	MHH	--
Nicaragua 2001	33.3	MHH	FHH	18.1	--	FHH	27	MHH	FHH
Bangladesh 2000	7.7	--	--	5.9	MHH	FHH	7.6	MHH	FHH
Pakistan 2001	6.3	MHH	--	6.7	MHH	FHH	6.6	MHH	FHH
Viet Nam 1998	37.8	--	FHH	16.9	MHH	FHH	21.6	MHH	FHH

Notes: FHH stands for female-headed households, and MHH stands for male-headed households. "--" Indicates that there is no statistical difference between MHH and FHH at the 95% confidence level.

† Poor households identified as those with per-capita expenditures below 2 Purchasing Power Parity dollars in 2000 prices.

§ Or welfare gains lower.

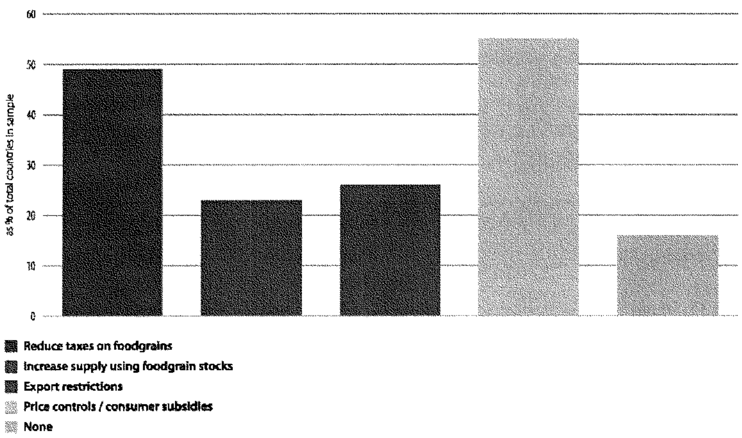
V. POLICIES FOR ADDRESSING HIGH FOOD PRICES: RESPONSES TO DATE AND POLICY OPTIONS

89. So far, national policy responses to soaring food prices have varied in nature and effectiveness. In general, the focus has been on guaranteeing an adequate and affordable food supply for the majority of consumers, providing safety nets for the most food insecure and vulnerable and, to a much lesser degree, fostering agricultural supply response.

90. As seen in Figure 14, approximately half of the governments in the 77 countries surveyed reduced grain import taxes, reflecting both the ease of use and political expediency of this measure. The table shows that 55 percent of the countries used price controls or consumer subsidies in an attempt to reduce the transmission of price increases to the consumer. One-quarter of the governments imposed some type of export restriction, and

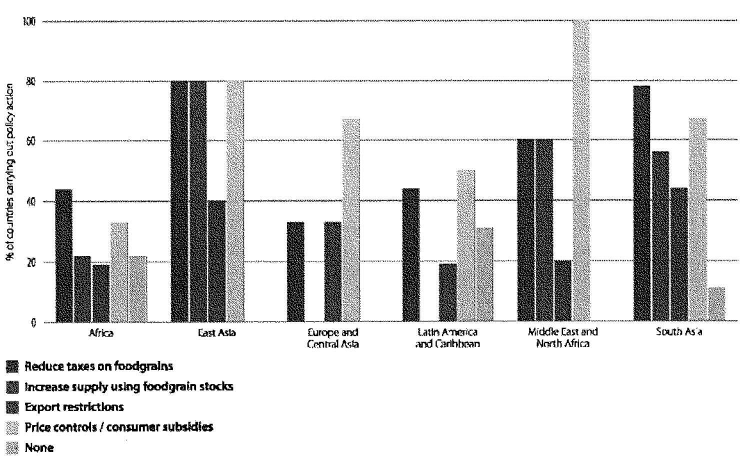
roughly the same proportion took action to increase supply, drawing on foodgrain stocks. Only 16 percent of countries surveyed showed no policy activities whatsoever.

Figure 14 Policy actions to address high food prices



91. Policy actions vary considerably by region. The governments sampled in East Asia, South Asia and the Middle East and North Africa have undertaken significant activities in all four areas of intervention. In every geographical region except sub-Saharan Africa, 50 percent or more of the countries reported using price controls or consumer subsidies. Sub-Saharan Africa and Latin America and the Caribbean regions showed the lowest policy activity, with roughly 20 percent and 30 percent of their countries, respectively, reporting no activity in any of the policy categories listed (see Figure 15).

Figure 15 Policy actions to address high food prices by region



High food prices: assessing policy options

92. The current situation serves as a reminder of the fragility of the balance between global food supplies and the needs of the world's inhabitants, and of the fact that earlier commitments to accelerate progress towards the eradication of hunger (especially through agricultural and rural development) have not been met. The immediate need is to prevent human suffering due to hunger and malnutrition and to induce a rapid supply response to restore a better balance between food supply and demand, especially in developing countries. But, if these immediate measures are to have a sustained impact, they must be followed up by actions in the medium term that will result in an accelerated and permanent reduction in the number of people suffering from hunger and malnutrition. These actions must take place not only at the national but also the global level, in relation to public goods, trade policies, markets, and responses to the impact of climate change. The focus for the longer term must be on generating and enabling farmers to apply sustainable technologies for agricultural intensification that will continue to meet the food needs of future generations in the face of rising population and effective demand, tightening availability of land and water resources, and increased risks associated with climate change processes.

93. This concluding section of the paper examines the policy options that are facing developing countries, especially those hit most hard by the price rise. It closes with a brief review of issues related to the maintenance of global food security.

National Responses

94. High food prices are associated with both threats and opportunities. The analysis in previous sections has shown that for the poorest net buyer households, high food prices of principal staple foods are associated with potentially serious welfare losses, at least in the short run. At the same time, high food prices increase the value of agricultural assets and have the potential of stimulating private sector investment in agriculture if the necessary public goods are present. In order to prevent the potential negative effects of high food prices on the extremely poor and a further increase in undernourishment, and to simultaneously take advantage of the potentially positive effects on agricultural investment, productivity and food production, a twin track approach will be essential.

95. The **twin track approach**, proposed by FAO, IFAD and WFP on the occasion of the Monterrey Conference on Financing for Development and the World Food Summit-*five years later*, addresses the dichotomy between needed actions to protect the welfare of the most poor and hungry by providing direct support on an emergency basis and beyond, while at the same time providing public resources and designing policies to re-launch agriculture and revitalize rural economies over the medium term. In the case of high food prices, emergency measures also include those intended to boost short-term supply response by facilitating smallholder access to essential production inputs.

96. Policy measures available in the short run include the provision of safety nets and social protection to the most vulnerable consumers in both rural and urban areas, as well as the enhancement of short-term supply response by smallholder farmers. Improved trade policies can also yield important gains. In the longer run, it will be important to address the fundamentals that increase investment in agriculture, both public and private, and improve the functioning of markets. Implementation of these policies offers the best option for putting the world on track to reach the World Food Summit target despite price increases.

Safety nets, social protection and rapid recovery of agriculture

97. Those most vulnerable to food price shocks need to be protected from nutritional deprivation, asset shedding and reductions in their real purchasing power. Such protection not only saves lives, it can also strengthen livelihoods and promote longer-term development. Safety nets and social protection can reduce malnutrition that has lifelong consequences, prevent distress sales of assets, and allow investments in education and health that high food prices make more difficult, all of which help keep households from falling into poverty traps.

98. In the very short run, protecting the most vulnerable may require direct food distribution, targeted food subsidies and cash transfers, and nutritional programmes including school feeding. The precise choice will depend on the extent to which some form of safety net or social protection mechanisms are already in place and can be mobilized.

99. In the short to medium run, social protection programmes must be set up or expanded and strengthened, allowing countries to phase out more generalised subsidies while making sure that all their people are able to meet their essential food needs. In order to become part of national development priorities, they must be integrated into national development plans such as national food security strategies and poverty reduction programmes. Successful implementation will generate beneficial impacts on the overall diet and nutritional status, an outcome which would not arise with input subsidies aimed at a single staple food crop. Well organized and targeted social protection systems are potentially capable of providing direct support to the neediest at a cost that is substantially lower than more broad-based actions which, in turn, makes them more sustainable.

100. Because cash economies are more prevalent and social networks are generally weaker in urban areas, strengthening of safety nets is especially important for the urban poor. Safety nets will also be especially important for nutritionally vulnerable groups, including children, pregnant women and the elderly.

101. For rural households, an integrated approach to social protection should be taken that combines traditional transfers (social safety nets) and policies that enable smallholders to respond quickly to the market opportunities created by higher prices. In the very short run, however, the supply response to higher price incentives, especially by smallholders, may be limited by their lack of access to essential inputs such as seeds and fertilizers. In these cases, social protection measures, including the distribution of seeds and fertilizers, directly or through a system of vouchers and "smart subsidies", may be an appropriate short-term response. If implemented effectively, such a programme will increase the income of small producers and may reduce price increases in local markets, thereby contributing to improvements in the nutritional status of net food-buying families.[32]

102. However, safety net programmes must be carefully designed. They may place large demands on institutional capacity, especially in countries where such programmes are most needed. Indeed, the implementation of various forms of transfer programmes has proven to be a major challenge. Particular risks include leakage of benefits to non-target groups, resale of vouchers by the target group and rent seeking by officials. It is also crucial that safety net

[32] One of the risks of subsidies on purchased farm inputs is that they draw farmers' attention away from making better use of the resources already available to them, such as the use of manure, compost and rotations involving nitrogen fixing legumes or cover crops to improve soil fertility and structure.

programmes do not impede the formation of a private marketing sector by driving out nascent, indigenous, private sector input suppliers.

Improving trade policies

103. As was elaborated above, many countries have restricted exports in attempts to ensure domestic food security. While such barriers sometimes help to contain pressures on domestic prices, they can also signal problems and lead to panic buying on domestic markets. On the other hand, in some countries where the barriers are effective, farmers have reduced planting of cereals in the face of low domestic prices for their products coupled with high prices for inputs such as fuel, seeds and fertilizers.[33]

104. Export restrictions also exacerbate price instability on world markets, especially when they are implemented in an ad hoc and uncoordinated manner. Increased world market volatility in turn will then often worsen food security in other countries. Fortunately for world food markets, some countries have started to relax those restrictions. Ukraine has recently increased the quantities of wheat exports that will be allowed, and, so far, Thailand has avoided government restrictions on rice exports.

105. Export restrictions have been given substantially less attention in the WTO than import barriers, but the current situation argues strongly that trade negotiations give more serious attention to export barriers. Indeed, many countries resort to import barriers out of fear that exporting nations may be unreliable suppliers. Thus, legal restraints on the use of export barriers may provide some spur to the reduction of import tariffs, which will lead to longer term welfare gains. Given that many of the poorest countries will have difficulties in implementing safety net programs (as noted above), export barriers may have a role to play in providing food security, but the use of such instruments should be restricted to the poorest countries.

106. Subsidies to and tariff protection of biofuel production may also need to be re-examined in light of their effects on food security. China and South Africa have already restricted the use of grains for ethanol production based on food security concerns, and some observers have called for other countries to also include food security considerations in the policymaking process.

107. While actions to free import restrictions and release foodgrain stocks into the market have had mostly immediate and favourable effects on consumers and on economic efficiency in general, these measures do have some shortcomings. First, they provide only one-time relief. Once the tariff or tax has been reduced to zero, no further reductions in price can take place through this measure. Second, they entail revenue losses for the government, which in some countries could be substantial. On the positive side, tariff reductions may make good policy sense in any case, especially if the original tariffs unduly distorted the trade regime. But if tariff reductions are to be sustainable, the government would need to undertake complementary reforms in the medium term, e.g. tax reform measures to help recoup at least part of the revenue loss. In addition, since tariff reductions imply a loss of protection for domestic producers, complementary measures (with credible exit strategies) may be needed to support and ease their transition to a liberalized environment. Such measures could include

---

[33] Financial Times, 18 April 2008

strengthening safety nets, public investment in rural infrastructure, improved extension services or other policies that facilitate response to the new market signals.

Stimulating agricultural investment and supply response as fundamental priorities

108. In the medium-term, there is a need for renewed attention to the agricultural sector. High food prices constitute an important element in the effort to re-launch agriculture since they provide incentives to the private sector to invest and produce. There is ample scope for substantial increases in agricultural production and productivity. Productivity increases will require significant and sustained improvements in long neglected areas such as research, extension, agricultural and general infrastructure along with credit and risk management instruments, all of which will complement increased price incentives. These initiatives will need to consider the challenges from possible long-term impact of climate change as well as more short-term effects of increased demand for biofuel feedstock.

109. Support needs to focus particularly on enabling poor rural producers – those least able to respond to changing market signals – to expand their production and marketed supply. The main areas of support include fostering agricultural research focused on the needs of poor rural producers, many of whom farm in increasingly marginal areas; enhancing access to agriculture services, including research, extension and financial services, and strengthening their capacity to take advantage of these; securing their access to natural resources such as land and water; and fostering their participation in non-agricultural sources of income including payments for environmental services. It is also important to assist poor rural households in strengthening their livelihoods in conditions of ever greater climatic uncertainty and their awareness of ways to benefit from new approaches to managing weather and other risks, including new forms of insurance.

The way ahead: creating a global enabling environment for carrying out policies

110. The risks to food security posed by the present regime of low worldwide food stocks and high food prices are substantial. The challenges of "managing" this crisis over the coming years are daunting. However, the costs of failure will be measured in terms of increased poverty and hunger, reversals in hard-earned gains in nutrition, health, education and social protection and, more broadly, social unrest and insecurity. The world community must ensure that governments have the human, financial, technical and material resources they need to implement the priority reforms listed above. These include avenues for – and access to – increased budgetary and technical support, strong policy guidance, heightened advocacy in international negotiations to reduce international trade barriers and market distortions, and the creation of new international protocols and agreements surrounding biofuels. Good governance and the support of the private sector are essential for improving effectiveness and for any measures to succeed domestically.

111. A fundamental economic incentive for stimulating the agricultural sector (higher prices) is in place for the first time in 25 years. Global attention is also now focused on the plight of the poor and hungry. At the national level, governments, supported by their international partners, must now undertake the necessary public investment and provide a suitable environment for private investments, while at the same time ensuring that the most vulnerable are protected from hunger. They must initiate actions to ensure accelerated progress towards the permanent eradication of chronic hunger and malnutrition in the world, making this a fundamental element of their development policies and poverty reduction

strategies. For as long as a large number of people remain hungry, the threat of a repetition of the current crisis will remain.

112. The international community must take immediate steps to increase its capacity to respond in a coordinated and expeditious way to requests from countries for professional assistance and financial support to enable them to meet the costs of emergency interventions without unduly compromising their economic and growth potential. The immediate and medium term funding needs are estimated below. It should be noted that these funding needs for agricultural investment (not for FAO) are already in need of updating as the cost of investment has risen and food prices have increased. Further, the time period in which the WFS target needs to be achieved is substantially shorter and therefore the effort needs to be stepped up. A mere inflation adjustment will bring the required amount to more than US$30 billion.

113. At the same time, it is necessary to set in motion steps towards ensuring long-term global food security, taking into account the probable risks to global food supplies posed by climate change. Amongst the big issues to be addressed are how to develop a new generation of technologies for agricultural intensification that is sustainable from financial, environmental and social perspectives and is resilient to climate change and how to prevent further reductions in the availability of fresh water and land resources for future food production. These and other major issues affecting mankind's continuing ability to feed itself will be the focus of a High-Level Meeting on How to Feed the World in 2050, being convened by FAO in December 2008.

BOX 2

Mobilizing resources to meet the WFS goal in the context of the twin-track approach: FAO's Anti-Hunger Programme*

The FAO Anti-Hunger Programme was initially proposed in June 2002 on the eve of the **World Food Summit:** ***five years later***, which convened Heads of State and Government, international agencies and nongovernmental organizations in Rome to discuss progress towards reducing hunger. The programme calls for an additional public investment of US$24 billion annually (in 2002 constant prices) with the objective to halve the number of hungry people by 2015 from their number in 1990-92. It also proposes combined investment in agriculture and rural development with measures to enhance direct and immediate access to food for the most seriously undernourished. It focuses mainly on small farmers and aims to create more opportunities for rural people, representing 75 percent of the poor, to improve their livelihoods on a sustainable basis. In particular, the FAO Anti-Hunger investment package includes the following:

- Programmes for enhancing access to food for the most needy through school meals, feeding of pregnant and nursing mothers and children under five, and food-for-work programmes. These activities would target the 200 million neediest people in the world. The cost would be US$5.2 billion per year, of which US$1.2 billion is needed for a school feeding programme.

- Start a process of on-farm innovation in poor rural communities. This would mobilize capital for raising farm productivity through investments in seeds, fertilizers, small irrigation pumps, school gardens and legal services to broaden access to land. A plausible target is to benefit 60 million households worldwide by 2015 with start-up capital of US$500 per family, on average. The total cost would be US$2.3 billion per year.

- Development and conservation of natural resources. Additional investment should be made in irrigation systems and in the conservation and use of plant genetic resources and aquatic ecosystems. More funding is also needed to ensure that the world's fisheries and forests are used in a sustainable way. Estimated costs are US$7.4 billion per year.

- Expansion of rural infrastructure. High priority should be given to upgrading basic infrastructure, such as rural roads, to stimulate private sector investment. Investment is also needed to assure food quality and safety, to prevent the spread of transboundary livestock diseases and to develop food handling, processing, distribution and marketing enterprises by promoting small farmers' cooperatives and associations. The additional public investment is estimated at US$7.8 billion annually.

- Improvements in international and national agricultural research, extension, education and communication, estimated to cost US$1.1 billion per year.

FAO proposed that additional public investments for agriculture and rural development should, on average, be equally shared between donor and recipient countries.

* The investment requirements need to be updated to account for increased investment costs and higher food prices (see main text).

References

Aksoy, M. A. & Isik-Dikmelik, A. 2008. *Are Low Food Prices Pro-Poor? Net Food Buyers and Sellers in Low Income Countries*. Mimeo, World Bank, Washington, DC.

Block, S., Kiess L., Webb P., Kosen S., Moench-Pfanner R., Bloem M.W. & Timmer C.P. 2004. Macro shocks and micro outcomes: child nutrition during Indonesia's Crisis. *Economics and Human Biology*, 2(1): 21-44.

Collier, Paul. 2007. "Managing Commodity Booms: Lessons of International Experience", Paper Prepared for the African Economic Research Consortium. Centre for the Study of African Economies, Department of Economics Oxford U. 2007

Collier, P, & Goderis, B. 2007. "Commodity Prices, Growth and the Natural resource Curse : Reconciling the Conundrum" Dept of Economics Oxford U, May 2007.

Dawe, D. 2008. *Have recent increases in international cereal prices been transmitted to domestic economies? The experience in seven large Asian countries*. ESA Working Paper 08-03.

FAO. 2007. *Food Outlook*, November.

Gunjal, K & Dawe, D. 2008. *Recent trends in price transmission in southern Africa cereal markets*, in process.

IMF. 2006 *World Economic Outlook 2006*, Chapter 5: The boom in commodity prices: Can it last?

Ivanic, M. & Martin, W. 2008. *Implications of higher Global Food Prices for Poverty in Low-Income Countries*. Mimeo, World Bank, Washington, DC

Johnston, Simon 2007. *The (Food) Price of Success*, **Finance & Development,** Vol 44, No. 4 December, The International Monetary Fund, Washington, DC

Mitchell, Donald. 2008. *A Note on Rising Food Prices*. World Bank, Washington, DC

OECD. 2008. *A note on the role of investment capital in the US agricultural futures markets and the possible effect on cash prices*, Document TAD/CA/APM/CFS/MD(2008)6.

Rashid, S. 2002. *Dynamics of agricultural wage and rice price in Bangladesh: a re-examination*. Markets and Structural Studies Division Discussion Paper No. 44. Washington, DC, International Food Policy Research Institute.

Ravallion, M. 1990. Rural welfare effects of food price changes under induced wage responses: theory and evidence for Bangladesh. Oxford Economic Papers, 42(3): 574-585.

Schmidhuber, J. 2006. *Impact of an increased biomass use on agricultural markets, prices and food security: A longer-term perspective*, Rome: Food and Agriculture Organization of the United Nations.

Senauer B, Sur M. 2001. Ending global hunger in the 21st century: projections of the number of food insecure people. Rev. Agr. Econ. 23(1):68-81.

Sharma, R. 2002. The transmission of world price signals: concepts, issues and some evidence from Asian cereal markets. OECD Global Forum on Agriculture.

Steenblik, R. 2007 *Biofuels – at what cost? Government support for ethanol and biodiesel in selected OECD countries*, Global Subsidies Initiative.

Taylor J.E, Yúnez, A., & Jesurum-Clemets, N. 2006. *Los posibles efectos de la liberalización comercial en los hogares rurales centroamericanos a partir de un modelo desagregado para la economía rural. Caso de Honduras,* Banco Interamericano de Desarrollo, Serie de Estudios Económicos y Sectoriales, RE2-06-13 (April), Washington, DC.

Torlesse H, Kiess L & Bloem MW. 2003. Association of household rice expenditure with child nutritional status indicates a role for macroeconomic food policy in combating malnutrition. J Nutr, 133(5): 1320-5.

Trusted Sources. 2008. *The end of grain self-sufficiency*, at http://www.trustedsources.co.uk/china/fault_lines/house_views/china_grains.

Tyner, W.E. & Taheripour, F. 2008. *Policy Options for Integrated Energy and Agricultural Markets,* Paper presented at the Transition to a Bio-Economy: Integration of Agricultural and energy Systems conference on February 12-13, 2008 at the Westin Atlanta Airport planned by the Farm Foundation.

Von Braun, Joachim. 2007. *The World Food Situation: New Driving Forces and Required Actions.* Food Policy Report No.18, International Food Policy Research Institute.

114 Oxfam Briefing Paper

EMBARGOED UNTIL 00:01 HRS GMT WEDNESDAY 25TH JUNE 2008

Another Inconvenient Truth

How biofuel policies are deepening poverty and accelerating climate change

The current biofuel policies of rich countries are neither a solution to the climate crisis nor the oil crisis, and instead are contributing to a third: the food crisis. In poor countries, biofuels may offer some genuine development opportunities, but the potential economic, social, and environmental costs are severe, and decision makers should proceed with caution.

Oxfam International

Summary

Biofuels are presented in rich countries as a solution to two crises: the climate crisis and the oil crisis. But they may not be a solution to either, and instead are contributing to a third: the current food crisis.

Meanwhile the danger is that they allow rich-country governments to avoid difficult but urgent decisions about how to reduce consumption of oil, while offering new avenues to continue expensive support to agriculture at the cost of taxpayers.

In the meantime, the most serious costs of these policies – deepening poverty and hunger, environmental degradation, and accelerating climate change – are being 'dumped' on developing countries.

Neither a solution to the climate crisis...

Rich countries' biofuel policies currently offer neither a safe nor an effective means to tackle climate change. By increasing aggregate demand for agricultural land, they will drive the expansion of farming into critical carbon sinks such as forests, wetlands, and grasslands, triggering the release of carbon from soils and vegetation that will take decades and in some cases centuries of biofuel production to repay, at a time when emissions need to peak and fall within the next 10 to 15 years:

- Analysis published in the journal *Science* calculates that the emissions from global land-use change due to the US corn-ethanol programme will take 167 years to pay back.
- European Union (EU) biodiesel consumption is driving spiralling demand for palm oil both for use in biodiesel, but also to replace rapeseed and other edible oils diverted into the European biofuel programme. Oxfam estimates that by 2020, the emissions resulting from land-use change in the palm-oil sector may have reached between 3.1 and 4.6 billion tonnes of CO_2 – 46 to 68 times the annual saving the EU hopes to be achieving by then from biofuels.

Even ignoring land-use change, biofuels are an overly expensive way of achieving emissions reductions from transport. Improving car efficiency is far more cost effective: while the *costs* of avoiding a tonne of CO_2 through biofuels run into the hundreds of dollars, ambitious improvements in vehicle efficiency can yield *profits*, as reduced fuel costs exceed technology costs. Biomass can be used far more efficiently in static applications such as commercial boilers or combined heat and power.

...nor a solution to the oil crisis

Rich countries' biofuel policies currently offer neither a safe nor an effective means to address fuel security. Consumption of oil in rich countries is so huge that for biofuels to be a significant alternative requires massive amounts of agricultural production. If the entire corn harvest of the USA was diverted to ethanol, it would only be able to replace about one gallon in every six sold in the USA. If the *entire world supply* of carbohydrates (starch and sugar crops) was converted to ethanol, this would only be able to replace at

most 40 per cent of global petrol consumption. Global oilseed production would be unable even to reach a 10 per cent share of diesel consumption.

Moreover, the costs of using biofuels to improve fuel security are prohibitively expensive. The European Commission's own research body has estimated that the EU's proposed 10 per cent biofuel target will cost about $90bn from now until 2020, and will offer enhanced fuel security worth only $12bn. Policies to reduce *demand* for transport fuels, such as regulation to improve vehicle efficiency, are far safer and more cost effective.

Meanwhile 30 million people are dragged into poverty

Biofuel mandates and support measures in rich countries are driving up food prices as they divert more and more food crops and agricultural land into fuel production. Meanwhile sugarcane ethanol from Brazil, production of which has a far less significant impact on global food prices, is excluded through the use of tariffs.

The World Bank estimates that the price of food has increased by 83 per cent in the last three years. For the world's poor people, who may spend 50–80 per cent of their income on food, this is disastrous. Oxfam estimates that the livelihoods of at least 290 million people are immediately threatened by the food crisis, and the Bank estimates that 100 million people have *already* fallen into poverty as a result. Thirty per cent of price increases are attributable to biofuels, suggesting biofuels have endangered the livelihoods of nearly 100 million people and dragged over 30 million into poverty.

The International Food Policy Research Institute (IFPRI) notes that by forcing up food prices, rich-country support for biofuels acts as a tax on food – a regressive tax felt most by poor people for whom food purchases represent a greater share of income. Last year, it is estimated that industrialised countries spent $13–15bn 'taxing' food, equal to the amount of funding required to assist those immediately threatened by the food crisis. These amounts will continue to spiral as rich countries increase their consumption of biofuels.

Herein lies the true attraction of ethanol and biodiesel for rich-country governments – an avenue for continued support to agriculture.

Oxfam calls on rich countries urgently to dismantle support and incentives for biofuels in order to avoid further deepening poverty and accelerating climate change.

Specifically, rich countries should:

- introduce a freeze on the implementation of further biofuel mandates, and carry out an urgent revision of existing targets that deepen poverty and accelerate climate change;
- dismantle subsidies and tax exemptions for biofuels and reduce import tariffs;
- tackle climate change and fuel security through safe and cost-effective measures, prioritising regulation to enforce ambitious vehicle-efficiency improvements.

An opportunity for developing countries?

For poor countries that tend to have comparative advantages in the production of feedstocks, biofuels may offer some genuine development opportunities, but the potential economic, social, and environmental costs are severe.

Oxfam recommends that developing countries move with caution and give priority to poor people in rural areas when developing their bioenergy strategies.

Specifically, developing countries should:

- prioritise bioenergy projects that provide clean renewable energy sources to poor men and women in rural areas – these are unlikely to be ethanol or biodiesel projects;
- consider the costs as well as the benefits involved in biofuel strategies: the financial costs of support, the opportunity costs of alternative agriculture and poverty reduction strategies, and social and environmental costs.

If they decide to proceed with biofuel strategies, developing-country governments should:

- carry out their obligations under international law and conventions, including obligations to protect the right to food, to ensure decent work, and to ensure that the Free, Prior and Informed Consent of affected communities is obtained before biofuel projects commence;
- give priority to feedstocks and production models which maximise opportunities for men and women small farmers.

And companies and investors operating in developing countries should:

- ensure no biofuel project takes place without the Free, Prior and Informed Consent of local communities, and that men and women workers at all stages of production in their value chains enjoy decent work;
- treat men and women smallholder farmers fairly and transparently;
- provide smallholders in their value chains sufficient freedom of choice in their farming decisions to ensure food security for them and their families.

1 Introduction

Oil, the lifeblood on which the global economy depends, is running out. And as a result of all the oil (and coal and gas) we've sucked out of the Earth and burned, the planet is getting warmer. But melting polar ice caps should not be interpreted as an opportunity to start drilling in the arctic. Nor can we continue to turn to dirtier and heavier sources of oil as the economics presented by a soaring crude price become more favourable. To avoid global catastrophe, any solution to the oil crisis has to also be a solution to the climate crisis.

The proponents of biofuels (see Box 1) argue that they have the solution, or at least a part of it. Ethanol and biodiesel will allow us to continue our love affair with the internal combustion engine, while simultaneously reducing our greenhouse gas (GHG) emissions. Sounds too good to be true? It is.

Biofuels currently provide a solution neither to the oil nor to the climate crisis, and are now contributing to a third: the food crisis. In recent years, food prices have nearly doubled, placing poor people, who often spend over half of their income on food, in an untenable situation. The World Bank estimates that the crisis has *already* pushed over 100 million people into poverty;[1] Oxfam estimates that the crisis has endangered the livelihoods of at least 290 million of the world's rural and urban poor.[2]

The West's biofuels boom is contributing to deeper global poverty and accelerated climate change, while allowing governments to avoid difficult but urgent decisions about how to reduce spiralling demand for energy in transport.

This paper explains how a sustainable development opportunity has instead turned into an unsustainable nightmare, and examines the conditions under which some of the original promise, particularly for poor people, might still be realised.

Box 1: What are biofuels?

Biofuels are liquid fuels made from organic matter – typically crops. There are two principal kinds – ethanol, produced from carbohydrates (e.g. sugarcane, sugar beet, corn, wheat) and biodiesel, manufactured from oilseeds (e.g. rapeseed [canola], oil palm, soy, jatropha).

They can be blended in relatively small quantities with existing petroleum fuels for use in unmodified internal combustion engines, making them most relevant to transport. Ethanol can be blended with petrol (gasoline) in blends of up to 5 per cent or 10 per cent, and new 'flex-fuel' technology

now allows much higher blends. Biodiesel can be blended with diesel in blends up to 20 per cent, above which relatively modest engine refinements such as replacement of rubber hoses may be required.

Source: Worldwatch Institute (2007)

2 The root of the problem

Biofuels are important because they tackle two of the most difficult challenges we face in energy policy...security of energy supply...and climate change.

Andris Piebalgs, European Energy Commissioner, keynote speech at the International Biofuels Conference, Brussels, 5 July 2007.

All over the world, governments are setting targets for biofuel production or use.[3] Many are mandatory - placing a legal obligation on fuel companies to blend a certain volume or percentage of biofuels with the petrol and diesel they sell.

The European Commission has proposed that by 2020, all member states must meet at least 10 per cent of their transport energy needs through 'renewable sources' - in practice biofuels - as part of their obligations under the Renewable Energy Sources Directive.[4] Meanwhile, in the USA, the Renewable Fuel Standard established in the Energy Policy Act of 2005 and amended with the 2007 Energy Independence and Security Act mandates the annual use of 36 billion gallons of renewable fuels, mainly ethanol, by 2022. In Canada, the Renewable Fuels Bill, now before Parliament, would require 5 per cent ethanol in gasoline by 2010 and 2 per cent biodiesel in diesel by 2012. These are all justified as measures to tackle climate change and improve fuel security.

Saving the climate?

A kind of reverse Murphy's Law in effect creeps into biofuel papers: if anything can go right, it will.

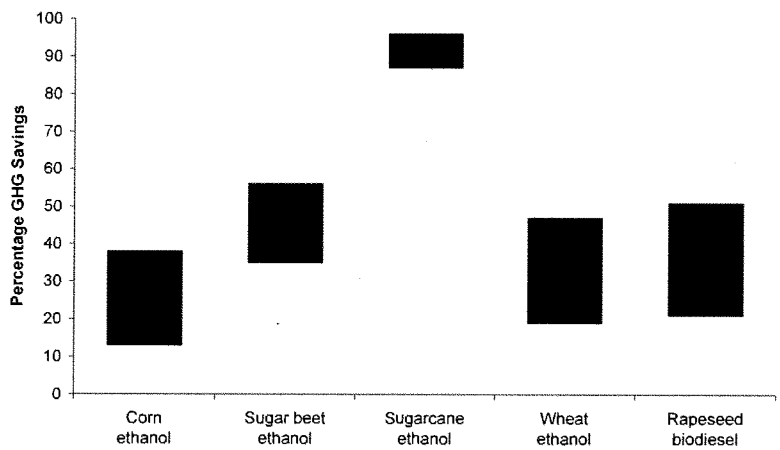
Tim Searchinger, Visiting Scholar and Lecturer in Public and International Affairs, Woodrow Wilson School, Princeton University.

Much of the original attraction of biofuels lay in their perceived GHG neutrality. As crops grow, they fix carbon from the atmosphere. When they are burned (as biofuel), this carbon is simply released back, so that over the lifecycle of the fuel, the net impact on atmospheric carbon is neutral.

Of course, in reality, biofuels are not GHG neutral. There are emissions associated with all stages of their lifecycle, particularly if

the crops are grown intensively, using nitrogen-based fertilisers and machinery, or if the refining process requires large inputs of (fossil) energy. Nevertheless, biofuels do not have to have zero GHG emissions to be of benefit; they only need to emit less than the fossil-fuel alternative.

Figure 1: Estimated ranges for lifecycle GHG savings compared to fossil fuels



Source: Worldwatch Institute (2007)

Estimates of the lifecycle GHG savings of biofuels when compared with fossil fuels are shown in Figure 1. The shaded area for each biofuel shows the range of savings estimated - so for example, studies for corn ethanol suggest savings in the range of 13 to 37 per cent compared with fossil fuel (differences in estimates are due to different production pathways and differing assumptions in the calculations themselves). At first glance these results suggest that biofuels provide net GHG savings when compared with their fossil-fuel counterparts. However, the science of lifecycle analyses (LCAs) continues to be refined and improved, and the results of this process are deeply disconcerting.

Emissions from nitrogen-based fertilisers

New research published this year by the Nobel Laureate Paul Crutzen has cast serious doubt on the idea that biofuels provide net GHG savings.[5] Crutzen and his co-authors investigated emissions of nitrous oxide, a GHG 296 times more potent than carbon dioxide, released through the decomposition of nitrogen-based fertilisers, commonly used in the production of corn-based ethanol in the USA and rapeseed oil-based biodiesel in the EU. They found that release

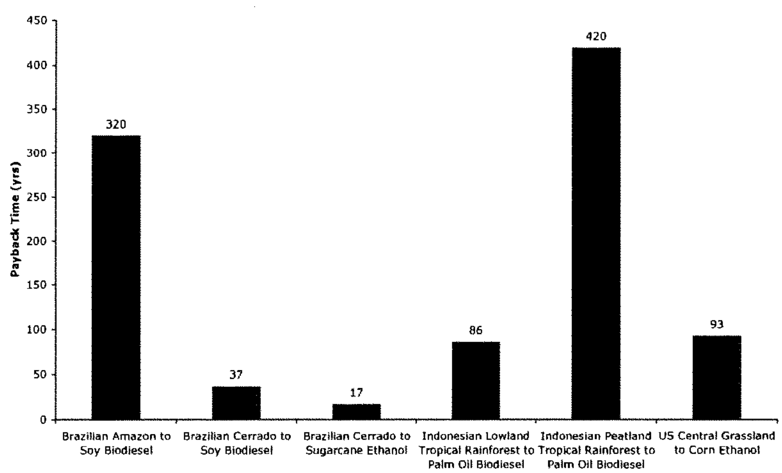
rates for the gas were typically three to five times higher than had been assumed in previous LCAs. The results suggest that the use of biofuels produced from maize and rapeseed oil may actually be *increasing* emissions and worsening global warming.

Direct land-use change

There are further GHG emissions associated with the process of bringing new land into production - as we burn or let rot trees, grasses, and other vegetation, and as we plough up soil, allowing carbon previously held underground to oxidise. Together, soils and vegetation store nearly three times as much carbon as the atmosphere.[6] So clearing new land to grow biofuels results in potentially significant emissions. The LCAs in Figure 1 all ignore land-use change, implicitly assuming biofuels are only produced on existing cultivated land. But as demand for biofuels increases, new land will be cleared to grow the crops.

A recent paper in the journal *Science* estimated the emissions from direct land-use change and compared this 'carbon debt' to the annual emissions saved through using the resultant biofuel.[7] The authors then estimated the number of years of biofuel production required to 'pay back' the initial 'carbon debt'. Their results are displayed in Figure 2.

Figure 2: Pay-back times for different biofuels and land-use changes



Source: Fargione *et al.* (2008)

The results reflect the ratio between the carbon stocks of the land in question, and the GHG savings offered by the biofuel. Most disastrous is the production of palm oil-based biodiesel from the

conversion of Indonesian peatland tropical forest, requiring 420 years of biofuel production to pay back the carbon debt. Corn-based ethanol from conversion of US grasslands is a net contributor to emissions for 93 years.

In order to avoid catastrophic climate change, global emissions must peak and then fall within the next 10 to 15 years.[8] All of the biofuel expansions analysed here, including Brazilian sugarcane encroaching onto the Cerrado (a biodiverse savannah-type ecosystem), will contribute to emissions over this period.

Indirect land-use change, or where standards fail

It is often argued that emissions from land-use change can be avoided by setting standards for the types of land on which biofuel feedstocks may be cultivated, and managed by including an estimate of the emissions due to land-use change in the LCA.

Both are proposed by the European Commission,[9] but this fails to account for *indirect* land-use change as global agriculture expands in response to the additional aggregate demand created by biofuels for land and/or crops. Such *indirect* effects are transmitted by the invisible hand of the market, and so ripple across borders and commodities, making them impossible to manage.

Demand for corn in the USA has skyrocketed as a result of the ethanol programme. In response, American and Canadian farmers are switching out of soy and into corn. This in turn pushes up the price of soy, which is correlated to rates of deforestation in the Amazon basin - South American soy farmers respond to higher prices by bringing new (in this case rainforested) land into production.[10] There are similar concerns that expansion of sugarcane for ethanol in Brazil is also pushing cattle and soy farmers further into the Amazon (see Box 2).

An important attempt to model indirect emissions was made by Tim Searchinger and colleagues at Princeton University.[11] He and his team modelled *global* cropland expansion and associated emissions in response to the US corn-ethanol programme. On incorporating both indirect and direct effects, they found the pay-back time for corn ethanol to be 167 years. The USA has recognised the seriousness of this, and the Energy Act requires that new domestic biofuel plants meet GHG performance standards *including indirect land-use change effects*.

Indirect effects are as much a problem for the EU, which plans to meet the vast majority of its biodiesel demand through domestically grown rapeseed oil. At first glance, this might seem safe - it is grown on existing agricultural land, thousands of miles away from the

nearest rainforest. But the sheer ambition of the 10 per cent target means that the EU will have to divert a huge amount of its edible oil production into biofuel, leaving a gaping hole in the food market that will have to be plugged by imports - largely palm oil - the expansion of which is inextricably linked to the destruction of tropical peatland forest in Indonesia and Malaysia. Palm-oil imports are already surging in response to rising biofuel demand (more than doubling between 2000 and 2006) and are forecast to accelerate as the hole in the European edible-oil market grows.[12] By 2020, this hole will necessitate the annual import of 5.4 billion litres of vegetable oils.[13]

Vegetable-oil imports will also increase for direct use in biodiesel manufacture. The Commission forecasts that by 2020, 27 per cent of biodiesel will be produced from imported vegetable oils[14] - a further 5.5 billion litres per year. So by the time the EU 10 per cent target is reached, it will necessitate the import of *at least*[15] a further 10.9 billion litres of vegetable oils - more than a 100 per cent increase over current imports.[16]

Many of these imports for direct use in biodiesel manufacture are also likely to come from palm oil. Malaysia and Indonesia hope between them to directly supply 20 per cent of EU biodiesel demand through palm oil.[17] Further indirect emissions will result as production for these imports, which will be certified as sustainable for EU purposes, displaces uncertified palm oil into rainforest and peatland.

Based on the Commission's own forecasts for biofuel consumption and feedstock supply (which assume that over a quarter of biodiesel demand will be met by as yet unavailable second-generation fuels), Oxfam estimates that 3.1 billion tonnes of CO_2 could be released as a result of *unmanageable indirect land-use change within the palm-oil sector* (see Annex). This figure ignores emissions from expansion of other cropland, which will be significant. Nevertheless, it is 46 times the Commission's estimate for the annual saving from *all* biofuels in 2020[18] - meaning that it would take at least 46 years of biofuel use at 2020 levels to repay this 'carbon debt'. If second-generation biodiesel does not become commercially available in time (and many believe it will not[19]), this increases to 68 years. And of course, the Commission's estimate does not take into account Paul Crutzen's new evidence on emissions from nitrogen-based fertilisers, which suggests that in the case of rapeseed biodiesel at least, there may be no emission savings at all, meaning the carbon debt will never be repaid.

Box 2: Can Brazil produce its ethanol sustainably?

Of all biofuels currently available, Brazilian sugarcane ethanol provides the most favourable GHG balance. Mechanisation of harvesting on a growing number of plantations means that it is no longer necessary to burn the crop before cutting. Meanwhile, new ethanol plants allow the burning of waste products including bagasse and straw to provide energy for the production process, with surplus electricity being sold back to the grid. Currently, this surplus 'bioelectricity' is able to supply about 3 per cent of Brazil's overall needs, but it is hoped this will rise to 15 per cent by 2015, as the practice spreads and more efficient high-pressure boilers are installed.[20]

This highly efficient production process combined with suitable growing conditions and the natural advantages of sugarcane as an ethanol feedstock means that Brazilian ethanol is able to achieve GHG reductions in the region of 90 per cent compared with reductions of about 20 per cent for American corn-based ethanol, *before the emissions from direct and indirect land-use change are taken into account*.

But huge targets for biofuels in the USA and EU are triggering rapid expansion of sugarcane and inevitable land-use change. There are currently 7.8 million hectares of sugarcane under cultivation. This is expected to grow to around 14 million by 2020 over which time output will double from 487 million tonnes to one billion.[21] Brazil has some 90 million hectares of arable land, and although most of this cultivation takes place far away from the Amazon, particularly in São Paulo State, this expansion may push other agriculture, most notably cattle and soy, further into the Amazon, thus triggering indirect emissions.[22]

By increasing the productivity of cattle grazing, from one cow per hectare to 1.4 cows (an improvement already achieved in certain areas), potentially 50–70 million hectares (an area two to three times the size of Great Britain) of degraded pastureland could be freed up. This could easily absorb the sugarcane expansion without significant land-use change emissions. But this requires land management at a national level and enforced co-ordination between different agricultural sectors, and it is questionable whether this will be achieved. The lack of will on the part of the sugarcane sector to comply with existing rules requiring mills to keep a certain percentage of their plantations from sugarcane monoculture is disappointing.[23] New areas identified for sugarcane expansion place important carbon sinks and biodiverse areas such as the Pantanal and Cerrado under pressure and paint a somewhat different picture of sugarcane expansion from that presented by the industry.[24] Meanwhile the Amazon continues to retreat.[25]

While on *some* plantations, improvements in working conditions have been made, on other plantations, sugarcane cutters continue to work in appalling conditions.[26] Three hundred and twelve labourers are reported to have died while at work between 2002 and 2005, with 83,000 suffering injuries.[27] Amnesty International recently reported various cases of forced labour and inhumane working conditions within the sector over the course of last year.[28] For the least fortunate members of the industry, sugarcane production is far from sustainable.

The economics of biofuels as a climate mitigation strategy

Forgetting land-use change for the moment – which appears to be the approach of the European Commission – there is a further question regarding whether or not biofuels represent a cost-effective means of achieving GHG reductions. After all, governments have finite resources with which to achieve this important objective, and so should give priority to strategies that provide the greatest return (in terms of avoided emissions) on their investment.

Work by the Global Subsidies Initiative of the International Institute for Sustainable Development looks into this question. Using LCAs available at the time, which did *not* include emissions from land-use change or take account of emerging evidence on emissions from nitrogen-based fertilisers, it still found the cost of abating a tonne of CO_2-equivalent through biofuels to be extremely high due to the level of support they require in the form of subsidies. In the EU the cost ranged from €575–800 ($900–1,250) for sugar-beet ethanol, and over €600 ($930) for rapeseed biodiesel.[29]

To achieve emissions reductions, biomass can be used far more efficiently in other applications outside the transport sector. For example, replacing oil and gas in commercial boilers yields abatement costs in the region of €60 ($90) down to -€60 (-$90) per tonne of CO_2 avoided – i.e. an abatement *profit*. Similar savings are available from using biomass in combined heat and power applications. Co-firing with coal to generate electricity has costs in the range of €75–200 ($120–310) per tonne of CO_2 abated.[30]

So, even if we ignore the growing evidence regarding emissions from land-use change and fertilisers, and make the huge leap of faith that temperate biofuels will reduce GHG emissions, they are still an overly expensive way of doing so.

Emissions from transport are among the fastest growing – so it is understandable that governments may wish to focus on this sector. But there are far more cost-effective and less risky options available, such as:

- ambitious and enforced vehicle efficiency standards for new cars
- increasing support for public transport
- promotion of car-sharing schemes
- promotion of more efficient driving methods
- congestion charging
- better enforcement of speed limits

- promotion of low-rolling resistance tyres (LRRTs).

For example, a study in the UK found that emissions from transport could be reduced by 8 per cent if speed limits were enforced through Intelligent Speed Adaptation systems.[31] This compares extremely favourably with the UK's biofuel legislation which mandates the blending of 2.5 per cent biofuels, at a current annual cost of £550m ($1bn) to the Treasury. Assuming (generously) that the biofuels consumed offer GHG savings of 30 per cent, this will achieve overall emissions reductions of less than 1 per cent.

On a per vehicle basis, the use of LRRTs is estimated to offer further emissions savings of the order of 3 to 6 per cent, with an additional 2.5 per cent available from electronic monitoring systems to ensure correct tyre pressures are maintained - already beyond what can realistically be achieved with a 10 per cent biofuels blend.[32]

Vehicle efficiency standards

Critically, far greater GHG savings are available from pursuing vehicle efficiency gains. For example, a recent review in the UK concluded that GHG emissions per car could be reduced by 30 per cent using technology that is already available or close to market:[33] even if biofuels offered 100 per cent GHG savings, a 10 per cent biofuel blend would only be a third as effective on a per vehicle basis.[34]

Unfortunately, nothing like enough is being done in this area. In the EU, attempts to introduce meaningful fleet efficiency standards have been delayed for years and watered down from 120g CO_2 per km to 130g as a result of concerted lobbying on the part of the European car industry (which at the same time has joyfully promoted biofuels[35]). Analysis by the European Federation for Transport and Environment shows that long-term fleet efficiency targets for European car manufacturers of 120g per km by 2012 and 80g per km by 2020 would offer an annual reduction in EU transport emissions of 95 million tonnes of CO_2 by 2020[36] - considerably more than the highly questionable 68 million tonnes the Commission believes it will be saving by then through the 10 per cent biofuel target.[37] And unsurprisingly the abatement costs of pursuing fleet efficiency gains are far lower than for biofuels - the now defunct 120g per km target offered costs of just €19 ($30) per tonne of CO_2, while separate analysis shows that improving vehicle efficiency can yield abatement *profits* as the reduced fuel costs outstrip technology costs.[38]

In the USA, new vehicle efficiency standards have been imposed as part of the same legislation mandating the consumption of 36 billion gallons of renewable fuel by 2022. This demands that car

manufacturers reach fleet efficiency standards of 35 miles per gallon by 2020, improving on previous standards of 27.5 miles per gallon for cars and 22.2 for SUVs. As in the EU, previous attempts to introduce meaningful efficiency standards had been obstructed by the car industry.[39] In January 2008, Canada announced its intention to match the new US standards.

This sounds like a big improvement, and it is - estimates suggest that new US efficiency standards will save 1.2 million barrels of oil a day,[40] 40 times the oil consumption of Ethiopia.[41] But average fuel economy in Japan is already 45 miles per gallon, and even the watered-down targets of the EU should achieve average vehicle economies of about 44 miles per gallon.[42] The USA, and Canada, still have much further to go in reducing their emissions from transport.

Improving fuel security?

Here we have a serious problem: America is addicted to oil.

President George W. Bush, 2006 State of the Union Address.

Another justification for biofuel targets popular with the EU and USA is to reduce dependency on foreign oil: it's running out, the price is going up, and it's produced in geopolitical hotspots. Biofuels can be directly substituted for oil, and grown on 'safe' home soil.

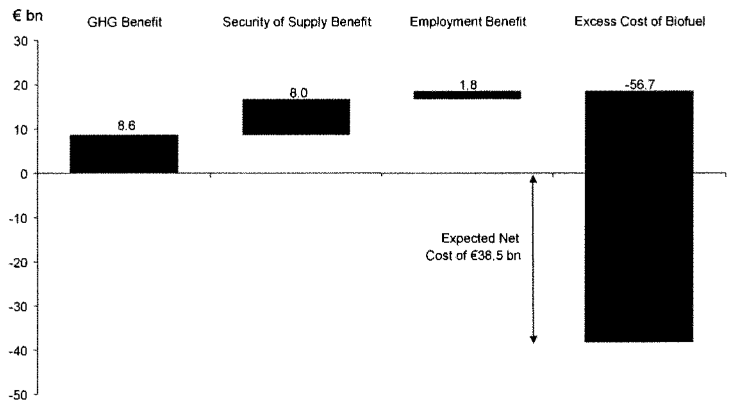
First of all, all of the alternatives to biofuels listed above reduce GHG emissions by *reducing demand for oil.* So they will also reduce dependency on foreign oil - potentially far more than biofuels, which due to the huge areas of land required, face serious limitations.

The USA currently grows enough corn to meet 16 per cent of its oil use, if it used the entire corn harvest for ethanol, and left none for feed, fuel, food, or export. In the case of the EU, the European Environment Agency's Scientific Committee, after estimating the amount of available arable land for bioenergy production, concluded 'the land required to meet the 10 per cent target exceeds this available land area even if a considerable contribution of second-generation fuels is assumed'.[43] Analysis by LMC International suggests that if *all the carbohydrates in the world* were converted to ethanol, this would still only provide enough ethanol to replace 40 per cent of global petrol consumption. Converting all global oilseeds to biodiesel would only displace 10 per cent of diesel.[44]

So the current generation of biofuels does not offer an alternative to oil for industrialised countries. But at the margin, do they offer a cost-effective way to reduce dependency on oil? The Joint Research Centre (JRC), the European Commission's research body, has analysed this question.[45] It placed a value on the security of supply provided by the

EU target, by estimating the cost of a rolling strategic fuel reserve equivalent to 10 per cent of transport fuel needs. The expected value of this benefit during the period from 2007 to 2020 was €8bn ($12bn). Unfortunately the expected *cost* of meeting the biofuel target over the same period was estimated to be nearly €60bn ($90bn) - over seven times the 'value' of the fuel security achieved. The JRC also estimated the value of GHG savings (before the effects of land-use change) and employment creation within the EU. Overall, the expected costs of achieving the target outweighed the expected benefits by nearly €40bn ($60bn) over the period in question - see Figure 3.

Figure 3: The net cost of the EU 10 per cent target



Source: JRC (2007)

Relative to other uses for biomass in energy generation and other strategies to reduce demand for transport fuel, the evidence shows that biofuels do not offer a safe or cost-effective way to reduce GHG emissions, nor a safe or cost-effective way to improve fuel security. So why are the EU, the USA, Canada, and a growing number of other industrialised countries forging ahead with targets regardless?

Digging deeper

Energy security and climate change are two of the most significant challenges confronting humanity. What we see, in response, is the familiar capture of policymaking by well-organised special interests. A superb example is the flood of subsidies for biofuels.

Martin Wolf, *Financial Times*, 31 October 2007.

Biofuel targets in rich countries are best understood as one part of a wide array of support measures provided to domestic interest groups. Last year, support provided to biofuels among Organisation

for Economic Cooperation and Development (OECD) countries cost around $13–15bn, for fuels that accounted for less than 3 per cent of their transport fuel demand,[46] but accounted for nearly half of the worldwide increase in consumption of principal food crops.[47] These measures include:

- mandates that create demand for uneconomic biofuels - demand which otherwise would not exist;
- tariffs which protect domestic industries by limiting imports of cheaper biofuels from developing countries; and
- a cornucopia of subsidies and tax exemptions along the entire value chain, from feedstock production, to refining, distribution, and consumption.

The costs of these subsidies and incentives are most pronounced in the USA and EU - in 2006 coming in at just under $6bn and $5bn respectively. In Canada the cost was $0.16bn. These costs will increase as consumption climbs towards mandated levels. In the USA, total support measures for 2008 may reach $13bn,[48] and federal excise-tax credits could cost $19bn a year by 2022 (when the 36 billion gallon mandated volume would be reached).[49] In the EU, assuming current rates of subsidisation, the 2020 target will end up costing European taxpayers over $34bn (€22bn) a year (see Table 1). At projected rates of production increases, Canada's taxpayers will be paying $1bn per year in subsidies by 2010.[50]

Put another way, by the time their targets are reached, the EU, the USA, and Canada between them will likely be wasting more on support to their biofuel industries than the costs of helping developing countries adapt to climate change - an urgent responsibility that rich countries are shirking.[51]

Table 1: Estimated EU subsidies in 2020[52]

	Ethanol	Biodiesel
Subsidy rate (€/litre)	0.74	0.50
Consumption (litres)	16.4bn	20.6bn
Total subsidy	€12.1bn	€10.3bn

Source: Hebebrand and Laney (2007); Kutas *et al.* (2007); author's own calculations.

The USA, EU, and Canada implement these support measures in such a way as to favour domestic feedstocks and biofuels over imports,[53] securing as large a slice as possible of these politically created markets for their agricultural and industrial lobbies.

Ethanol tariffs

The most salient example of this in both the USA and the EU is the tariff raised on ethanol imports. The USA applies a tariff of 2.5 per cent and \$0.54 per gallon added duty (\$0.1427 per litre); the EU €0.192 (\$0.30) per litre; Canada C\$0.0492 (\$0.047) per litre. While in all cases, preferential access is available to certain countries, these tend not to be significant producers of ethanol. Most notably, the tariff applies to Brazilian ethanol in each case. The net effect is to significantly reduce imports.

Although Brazilian ethanol production is far from perfect and presents various social and environmental sustainability problems discussed elsewhere in this paper, it *is* the most favourable biofuel in the world in terms of both cost and GHG balance. To argue that your policy objective is emissions reduction while simultaneously restricting imports of Brazilian ethanol is incoherent.

The costs of these distortions extend beyond the financial. The most profound example is the USA, where production of corn-based ethanol, sheltered from competition with its sugarcane cousin, continues to snowball. This is not a good thing: corn ethanol is heavily dependent on fossil fuels, often coal, endowing it with one of the worst GHG and energy balances of all (see Table 2).

Table 2: Relative performance of US and Brazilian ethanol

	US ethanol	Brazilian ethanol
Typical GHG savings*	~20 per cent	~90 per cent
Typical energy balance	1.5	8
Yield (litres per hectare)	3,100	6,500
Typical cost per litre	\$0.56	\$0.42

*GHG savings excludes any effects due to land-use change.

Source: Worldwatch Institute (2007).

It is also a heavy user of nitrogen-based fertilisers, the true emissions of which we may only now be starting to understand, and the run-off from which is creating a 'dead-zone' in the Gulf of Mexico.[54]

But it is perhaps the implications for worldwide food security that are most serious – while sugarcane is not a principal food crop, and its price is relatively uncorrelated with other food crops, corn is a global staple and the USA accounts for about 40 per cent of global production. Last year, about a quarter of the US corn harvest went to ethanol. This is set to grow to just under a third this year.[55] This means that the US ethanol programme will consume about 12 per cent of *global* corn production, and displace about 6 per cent of *US* transport fuel.[56]

Box 3: Second-generation biofuels, poverty, and development

The problems associated with the current generation of biofuels are often dismissed as a painful but short transition on the way to a brighter future of 'second-generation' fuels produced using new production pathways not yet commercially available. Examples include the production of ethanol from lignin and cellulose (which could allow us to use trees or grasses as feedstocks) and the production of biodiesel from algae.

It is argued that biofuel targets are necessary to provide industry with the assurances it needs to invest in second-generation, which will have fewer adverse impacts on poverty and the environment. But is this necessarily the case?

It is quite possible that using first-generation as a 'stepping stone' to second-generation may backfire – we could just as conceivably become 'locked in' to first-generation, particularly if interest groups become too dependent on it. This risk is already apparent in the USA, where legislation has positioned second-generation biofuels as a supplement to (rather than a replacement for) corn ethanol, production of which is set to hit 15 billion gallons a year by 2015. After this, so-called 'advanced biofuels' should make up the remainder necessary to reach 36 billion gallons by 2022.

Even if first-generation is *a* route to second-generation, is it the *right* route? The greatest costs – to nutrition and the environment – are irreversible. The billions of dollars currently spent in the OECD on support would therefore be better spent on research and development (R&D) into second-generation biofuels. Yet, the USA and EU only spend a tiny fraction (about 8 per cent and 2 per cent respectively) of their biofuel subsidies on R&D.[57]

So will second-generation biofuels have fewer adverse impacts on poverty and the environment? Although yields are likely to be higher, many second-generation technologies may still pose similar problems because they will depend on large-scale monocultures that threaten biodiversity, food production, or land rights. Just because a second-generation biofuel does not use food as a feedstock, it does not necessarily mean that it does not threaten food security: it may still compete with food for land, water, and other agricultural inputs. And the idea that second-generation biofuels will use less land is questionable, as higher yields will likely translate to higher targets – the European industry is already lobbying for a 25 per cent biofuel target by 2030[58] in anticipation of second-generation fuels becoming commercially available by then.

Technologies that do not require extensive monocultures, and therefore do not put food production or vulnerable people's land rights at risk, will present the least risks to poor people. Therefore biofuels produced from municipal waste, crop residues (as long as sufficient residues are left to enrich the soil), or non-arable feedstocks such as algae, may present the most promising avenues for development.

3 Impacts on poverty

The fashion for biofuels could be a catastrophe.

Louis Michel, European Commissioner for Development, addressing the Belgian Senate, 15 April 2008.

The big losers from the rich countries' biofuel boom are poor people, at risk from spiralling food prices, and a 'scramble to supply' that places their land rights, labour rights, and human rights under threat.

Food security

After decades of subsidised agricultural dumping by rich countries, resulting in stagnant commodity markets and a pervasive agricultural malaise in the developing world, suddenly, food prices have shot up, by an estimated 83 per cent in the last three years.[59] For poor households, which may spend in the region of 75 per cent of their income on food,[60] the implications are devastating. Within these households, all too often women will suffer the most, as men's consumption takes precedence.

Of course, biofuels are not responsible for all of this price rise, nor even most of it. A number of factors have combined together to create a 'perfect storm', including:

- shifting consumption patterns - as incomes increase in emerging markets, people are eating more meat and dairy products;[61]
- rising oil prices, which push up the costs of inputs such as fertilisers as well as transport and storage costs;
- climatic events such as the drought in Australia, which lost 60 per cent of its wheat crop last year and almost 98 per cent of its rice crop; and
- speculation in commodities markets.[62]

But biofuels are also playing a significant role in the food crisis and have been identified as a major culprit by the UN, World Bank, and International Monetary Fund (IMF). The IMF estimates that last year they accounted for almost half of the increase in demand for major food crops.[63] The OECD has estimated that between 2005 and 2007, almost 60 per cent of the increase in consumption of cereals and vegetable oils was due to biofuels.[64] And biofuels do not just consume food directly, they compete with it for land, water, and

other inputs, pushing up prices further. The International Food Policy Research Institute (IFPRI) has commented that support for biofuels, which incentivises the diversion of crops and agricultural land away from food production and into fuel production, acts as a tax on food - a tax that is felt most by poor people.[65] Commentary by the Food and Agriculture Organization (FAO) suggests biofuels may explain 10 per cent of recent food price rises. IFPRI estimates that biofuels explain 30 per cent of food price rises, an estimate corroborated by the IMF.[66] Research from the World Bank puts the contribution of biofuels even higher, at 65 per cent.[67]

Perhaps even more worryingly, this is only the tip of the iceberg: the International Energy Agency predicts that total biofuel consumption is set to increase tenfold between 2004 and 2030.[68]

30 million and counting?

It is a gross-oversimplification to suggest, as for example the European Commission has done,[69] that higher prices are 'bad' for poor people in urban areas, but 'good' for poor people in rural areas. While it is certainly true that small farmers in poor countries have suffered as a result of decades of stagnation in commodity markets - in large part due to protectionist agricultural policies in the industrialised world and chronic underinvestment in agriculture - current food price rises do not so much represent a reversal of this trend (to which they might respond) as an economic shock. In fact, price rises may be even more acute in rural areas due to poor infrastructure and low competition among retailers. And poor farmers may be without access to the necessary resources (land, credit, infrastructure, and inputs) to take advantage of the opportunity.

Most poor rural households are actually net consumers, not producers, of food[70] - so, just like urban households, they are worse off when prices rise. This is captured in World Bank analysis which estimates that recent price rises have led to an increase in global poverty of 105 million people.[71] Oxfam estimates that the livelihoods of at least 290 million people worldwide are now endangered, necessitating $14.5bn in immediate assistance - the same as rich countries are estimated to have spent on support to biofuels last year.[72]

If recent food price inflation - of which IFPRI estimates 30 per cent is attributable to biofuels - is responsible for an increase in the poverty headcount of 100 million and endangering the livelihoods of nearly 300 million, then biofuels may already be responsible for dragging over 30 million people into poverty and similarly endangering the livelihoods of nearly 100 million.[73]

By some estimates, the current biofuels rush, if it continues as forecast, could result in an extra 600 million hungry people by 2025[74] - 16 million extra for each percentage point increase in food prices until then. Biofuel targets and subsidies are therefore completely undermining the first Millennium Development Goal of eradicating poverty and hunger.

Land rights

Access to land is a fundamental precondition in realising the potential role of agriculture in reducing poverty. Unfortunately, one of the side effects of biofuel targets - particularly those set in the absence of any requirements for companies to behave responsibly - is a 'scramble to supply', in which companies or rich and powerful investors rush to buy up new land, potentially displacing vulnerable communities whose rights to the land are poorly protected. This can sometimes be a violent process.[75] Frequently, though by no means always, these may be indigenous people (the UN has identified 60 million at risk of displacement by biofuels).[76] More often than not, they will be women, who are more vulnerable than men to displacement as a result of systematic and pervasive discrimination within land tenure systems throughout the developing world.[77]

Marginal land

A trend is now emerging among governments and companies to target 'marginal', 'idle', or 'degraded' lands, the idea being that these areas are unsuitable for food production and poor in biodiversity. But there is no accepted definition of marginal land. The Indian government, for example, has identified 400,000 hectares of wastelands for jatropha - an oilseed-yielding tree that can grow in relatively dry conditions.[78] However, these lands, largely classified as Common Property Resources (CPRs), are integral to the livelihood strategies of poor people who use them for food, fuel, and building materials. Separate studies have shown CPRs can contribute up to a quarter of poor household incomes - with the poorest households being most dependent on them.[79] In any case, 'marginal' lands are often likely to be worth far more to poor people than their market values reflect.

Once again, it is women who stand to lose the most, as it is they who tend to be allocated the most marginal lands for growing subsistence crops or medicinal herbs.[80] As well as being most at risk (due to less secure access to land), and with more to lose (due to greater reliance on marginal lands), women may also have less to gain from biofuels, as production of cash crops is usually dominated by men.

Tanzania

Nearly half Tanzania's land area has been identified as suitable for biofuel production.[81] Already this is causing tensions as investors' land requirements come into conflict with those of communities. For example, 1000 farmers in the Wami Basin - a rice-growing area - currently face clearance to make way for a Swedish investor looking to develop 400,000 hectares of sugarcane plantations.[82]

Box 4: Case study – 'Jatropha comes to Kisarawe'

Mtamba, in the coastal district of Kisarawe, is one of 11 villages forming a circle within which Sun Biofuels Tanzania Ltd, a subsidiary of British company Sun Biofuels plc, is about to invest $20m in 8,200 hectares for jatropha, of which Mtamba owns the majority. Together, the villages are home to about 11,000 people, 850 of whom live in Mtamba.

Although uncultivated, the land is used by the villagers of Mtamba, principally for charcoal-making, firewood, and collecting fruits, nuts, and herbs. Mtamba was invited to a meeting of all 11 villages with Sun Biofuels to discuss the investment, but their invitation did not arrive until after the meeting had taken place. They were soon visited by the District Land Officer who urged them to make a quick decision, sparking a hastily convened meeting at which the investment was agreed in principle.

However, the first many of the villagers knew about the scale of the investment was when they saw men laying beacons marking out the area for development. They still do not know how much land they have conceded, but many of the villagers are convinced that this is a big opportunity. 'They're giving us seeds and a market, so this is good for the villagers', says Mussa Mrisho, a local farmer.

Despite the investment being in its final stages, confusion still reigns. According to local press reports, the 11 villages were entitled to total compensation of 800m Tanzanian Shillings (about $630,000) – equating to about $77 per hectare. However, Sun Biofuels has confirmed compensation of $220,000 to be shared between 152 people with trees on their land, and a further $10 per hectare – suggesting total compensation of less than half that reported in the press.

In Mtamba, most do not know whether they will receive any compensation. The Village Council received a letter from the District Land Officer requesting villagers to apply for compensation. But the village committee was unsure what to do. As a result, they say only six people have returned it. The deadline has now passed. The District Land Office says that everyone who is receiving compensation has been informed.

Although they do not know how much land they are actually conceding to Sun Biofuels, the villagers do know it includes a waterhole which is the only place that they can collect water when it is dry. They also collect clay there to build houses. They say they have had assurances from Sun Biofuels that they will retain access to the waterhole and clay once the development is under way. However, they have nothing agreed in writing and when asked about this, Sun Biofuels was unaware of the waterhole.

What the people of Mtamba really want are jobs. During a meeting with Sun Biofuels, they were told that 4,000 of the 11,000 villagers in the area would be employed. Two hundred people from Mtamba have applied for jobs as drivers, guards and farmers, but none have heard anything back. Sun Biofuels estimate that there will initially be about 1,500 jobs to clear the land and in the longer term expects to create one job for each hectare. The villagers have been told that they will be given priority, but they remain uncertain, and wish they had something in writing to confirm this.

Source: Oxfam research, including interviews, field visits, and desk research

The Tanzanian government has yet to finalise its biofuels policy, but hopes to create rural employment and new opportunities for small farmers, to increase access to energy in marginalised areas, and to reduce the need for increasingly expensive oil imports. These are important objectives. Although oil only provides about 6.5 per cent of the country's energy, 26 per cent of foreign currency earnings are used to buy petroleum products.[83] Agricultural areas are home to about three-quarters of the population, but are grindingly poor with average per capita income of about $160 per year.[84] Only one rural household in 100 has access to electricity.[85]

However, as yet, there is no discernible strategy regarding this flood of investment or how to regulate it: the emerging picture is one of investment for export with seemingly no requirements on companies to maximise value-addition within country, supply national markets, form links with local companies, adopt production models likely to maximise opportunities for poor people, or work with local communities to increase access to energy.

In this regard, the proliferation of Bilateral Investment Treaties and free trade agreements restricting the ability of developing countries to regulate investment is a serious problem. For example, if Tanzania negotiates a 'full' Economic Partnership Agreement with the EU, its ability to regulate European biofuel companies in order to achieve many of these kinds of policy objective may be seriously undermined.[86]

In addition, the lack of transparency with which much of the investment is taking place, particularly regarding the allocation of land, is equally worrying (see Box 4).

Indonesia

In Indonesia, the palm-oil sector is inextricably linked to land conflict as the interests of politicians, plantation companies, indigenous peoples, and resettled communities collide. The explosion of biofuel targets is a huge driver of palm-oil expansion. The government has stipulated that 40 per cent of palm-oil production should be set aside for biofuel. Along with Malaysia, Indonesia hopes to supply a fifth of

EU biodiesel demand.[87] Twenty million hectares (an area nearly six times the size of the Netherlands) has been identified for expansion by 2020 – more than three times the area currently under cultivation.[88]

This places literally millions of people at risk. The UN has identified 5 million indigenous people in West Kalimantan alone who may lose their land because of biofuels.[89] Under the Indonesian constitution, indigenous peoples' 'customary' rights are subordinate to the 'national interest', which in practice is interpreted as the interests of the palm-oil industry.

When an area is identified for oil-palm development, the law requires that the indigenous people and local communities should be consulted about the development and the level of compensation. But the reality is a litany of deception, corruption, and broken promises in which the communities involved may find themselves in a struggle against the palm-oil industry, local politicians, and the judiciary. The result is conflict, poverty, and the destruction of entire communities.[90]

Labour rights

The labour conditions of agricultural workers across the world are a continued cause for concern. Many of the problems associated with the exploitation of labour in biofuel production are discussed in the Oxfam Briefing Note 'Bio-fuelling Poverty'[91] (also see Box 5). They include:

- the persistence of forced and bonded labour, often perpetuated through the use of gangmasters and subcontractors;
- denial (*de jure* and *de facto*) of the right to organise and bargain collectively;
- inhumane conditions including exhausting work over long hours, lack of access to clean water and sanitation facilities, and cramped and unclean living quarters;
- lack of adequate health and safety training, particularly regarding the use of dangerous equipment and pesticides;
- use of piece-rate systems that systematically discriminate against women and may result in the exhaustion of workers and the use of child labour.

Box 5: 'Investing in Poverty'

Investments are flooding into the Brazilian sugarcane industry – from 2008 to 2012 they are expected to total $33bn, over which time the share of plants under foreign control is expected almost to double. Investors are coming from everywhere, including India and China, as well as the more familiar international agribusiness firms – Cargill, Bunge, ADM, and Louis Dreyfus. Financial investors are also apparent – Goldman Sachs, Merrill Lynch, George Soros, and Carlyle Riverstone.

The Brazilian Renewable Energy Company's (BRENCO's) investors include former President of the USA Bill Clinton, former President of the World Bank James Wolfensohn, former CEO of AOL Steve Case, and former CEO of Sun Microsystems and current biofuel mega-investor Vinod Khosla. BRENCO is managed by the former President of Petrobras, Henri Philippe Reichstul.

Despite this high level of involvement, following an inspection of its operations in the State of Goias by the Ministry of Labour, in 2008, BRENCO was found to be employing workers in degrading conditions.

Problems reported by the inspection team included use of the exploitative 'gato' sub-contracting system, inadequate access to food, lack of sanitation facilities, and cramped and squalid living conditions. In one case seven people shared a room of 11 square metres; others had to sleep on wet mattresses and in rat-, cockroach-, and garbage-infested quarters.

BRENCO has apologised and has said it is fixing the problems. But for the labour prosecutor allocated the case, this is not enough – he intends to prosecute the company in order to compensate the workers.

Source: Reporter Brasil and other media[92]

4 A pro-poor role for biofuels?

Energy consumption differs drastically between rich and poor countries (per capita oil consumption in the USA for example is more than 100 times that of Tanzania[93]), prompting many to wonder whether biofuels, which can be produced more efficiently in the South, offer an opportunity to redress this imbalance.

The current era of high oil prices places a huge strain on the balance of payments of many of the poorest countries in the world, with direct implications for poverty. Some poor net oil-importing countries spend up to six times as much importing oil as they do on essential services such as health.[94] For countries such as these, the opportunity to offset some of their oil imports (by no means large, at least by industrialised country standards) with biofuels is understandably of interest.

Other developing countries, aware of their comparative advantages in feedstock cultivation, are hoping to earn foreign exchange from

exporting feedstocks, or better still finished biofuels, to the burgeoning markets in the North.

Of all countries, industrialised and developing, none has more experience with biofuels than Brazil - since the mid 1970s it has been using ethanol as a substitute for oil, and is now pursuing an export strategy. It is also embarking on an ambitious biodiesel programme targeting smallholder farmers in some of its poorest regions.

Easing the balance of payments

Import substitution of oil

The Brazilan ethanol programme (ProAlcool) was launched in 1975 in response to the oil crisis. Over time, the programme has ebbed and flowed depending on the level of governmental support and relative prices of oil and sugar. It was liberalised in 2002 and is currently enjoying a renaissance due to a combination of factors including the high oil price, the advent of flex-fuel cars (which can run on blends of ethanol up to 100 per cent), and emerging demand in the USA and EU.

In the last eight years, ethanol is estimated to have saved Brazil $61bn in avoided oil imports - the total amount of the Brazilian external public debt.[95]

But it has not always been plain sailing. Now largely free of subsidy, the programme in the past required heavy support. Over its first decade, it barely turned a profit - from 1975 to 1987 saving $10.4bn but costing $9bn,[96] at which point it collapsed when falling oil prices, rising sugar prices, and a national economic crisis meant that the cost of subsidies became too great to bear.

The experience of Brazil illustrates that biofuel programmes are an expensive business. Not only is considerable capital investment required, but biofuels require financial support in order to remain viable. In Tanzania for example, estimated production costs for jatropha-based biodiesel are about five times the cost of fossil diesel, suggesting that a 10 per cent biofuel blend could easily consume 10 per cent of total tax revenues.[97]

Over the last 15 years, prices for soy, coconut, rapeseed, and palm oil have generally been higher than diesel prices, meaning that countries producing biodiesel from these feedstocks would be better off selling the oils into the commodities markets and buying diesel instead.[98] This is likely to persist: the OECD and FAO predict biodiesel prices will remain well above fossil diesel prices for the next decade.[99] This should provide food for thought to developing countries hoping to

make significant savings on their oil-import bills by producing biofuels – it is easier said than done (see Box 8).

Brazil has got round this problem by developing plants that can switch between sugar and ethanol production according to their relative prices, and reducing ethanol blending during periods of high prices. But even then, analysis suggests that it may not always have got the balance quite right.[100]

Biofuels for export

Brazil consumes about 85 per cent of its ethanol and exports the remainder, but is still the world's largest exporter. The cost, energy, and GHG characteristics of Brazilian ethanol make it a very promising export. Brazil is now working frantically to turn ethanol into a global commodity with internationally accepted specifications. Promoting an internationally diversified production base is key, so that potential importers will not worry too much about having all their eggs in one basket. To this end, Brazil is actively exporting its ethanol technology to other developing countries, particularly in Africa.[101] However, while this may certainly provide an attractive opportunity for countries seeking to 'leapfrog' up the learning curve, they should also be aware that the Brazilian ethanol model is premised on extensive monoculture, concentration of land, and a now rapidly decreasing employment level.

Estimates for the number of people employed in the ethanol industry are typically around 700,000 to 1 million, but many of these are migrant sugarcane cutters – often working in desperately poor conditions.[102] Moreover, these numbers are set to drop dramatically as mechanised harvesting sweeps through the industry. One machine reportedly replaces 100 workers and pays for itself in two years. In the main sugarcane-producing state of São Paulo, mechanisation already accounts for 40 per cent of the harvest, and it is hoped that this will reach 70 per cent by 2010, with mechanisation becoming obligatory in 2017. This process therefore has huge implications for the livelihoods of up to half a million unskilled, often migrant, labourers, and presents an urgent challenge to the government and the industry.

Sugarcane expansion in Brazil has not been inclusive, and in its early years was associated with the displacement of rural communities.[103] Although in certain areas co-operatives do operate,[104] production remains dominated by large-scale plantations, resulting in the concentration of land and resources.

Various other countries also see significant trade opportunities, including Malaysia, Indonesia, and a number in Africa. As we have

seen, Tanzania is currently attracting considerable export-oriented foreign direct investment, but without a clear strategy as to how to manage this to achieve national objectives. There is a similar lack of clarity in Mexico (see Box 6).

Box 6: Trade and food security – the case of Mexico

The road to national biofuel legislation in Mexico has been fraught with controversy and confusion. In April 2007 the senate passed the Law for Promotion and Development of Bioenergy, only for the president to freeze the legislative process a few months later. The presidential veto was employed in response to criticism regarding the use of corn as a feedstock. Concerns were raised not only around its poor GHG performance, but also regarding its importance as a national staple of huge cultural significance.

Nevertheless, in February 2008, the law eventually came into effect with stated objectives of reducing dependency on petroleum imports (Mexico currently exports crude and imports petrol and diesel), reducing GHG emissions, and stimulating agricultural development. The immediate goal for urban areas is to blend 5.7 per cent ethanol into petrol by 2012, which will largely be produced from sugarcane and corn. But Mexico has its work cut out. Ethanol is corrosive, necessitating substantial investment in transport and storage infrastructure that will compete for funding with existing initiatives to improve fuel quality and build domestic refining capacity. Nor does the state oil company, PEMEX, appear willing to invest in an ethanol infrastructure itself. This suggests that a more likely destination for Mexican ethanol is the USA, to which Mexico can export ethanol tariff-free under the North American Free Trade Agreement (NAFTA).

The Mexican government has an even bigger task ahead in ensuring its population's food security. During the 'Tortilla Crisis', the price of tortillas rose by 30 per cent in three months, underpinned by surging demand from the US ethanol programme.[105] For the poorest families in Mexico, who spend 65 per cent of their incomes on food, this was untenable, and riots erupted.

Currently, the law states that only surplus corn (i.e. beyond that required for food consumption) may be used for ethanol – but Mexico is not self-sufficient in corn, currently importing about 30 per cent of its consumption. Despite this, of the ten companies currently investing in ethanol production in Mexico, half are developing capacity to process corn, bringing into question if and how this will be enforced in practice. If Mexican ethanol production grows rapidly in response to spiralling US demand, this could have serious implications for food security.

Source: Hugo Garcia (2008)

While in some cases an export strategy may make sense, as it certainly does for Brazil, which is able to produce a significant exportable surplus, it is not without its risks. In particular, developing countries should be aware that:

- biofuel export markets are politically created, and therefore at risk of being revised, particularly in light of emerging evidence regarding their negative consequences;
- the impact of second-generation technologies, when they become available, remains uncertain, but if their application and use is restricted to industrialised countries, they could dramatically curtail demand for tropical biofuels;[106]
- export markets in biodiesel and ethanol (feedstocks) are likely to be dominated by a handful of major exporters such as Brazil, Malaysia, and Indonesia, meaning that prices will be set by these countries, rendering smaller exporters 'price takers';
- the international biofuel value chain demonstrates high downstream concentration, particularly in distribution, which is typically controlled by a select number of fuel companies; and in feedstock trading, which is controlled by an even smaller number of agribusiness companies such as Cargill and ADM - experience shows that such structures are associated with lower returns for producers; and
- the cost efficiencies demanded by export markets will make it harder to pursue social objectives such as maximising rural employment.[107]

Putting poor people first

Models of production which maximise employment opportunities for rural populations may not be the most efficient from an export perspective, but may offer greater benefits for rural communities. Developing countries that favour smallholder over large-scale production can expect higher returns on their public spending due to greater economic multiplier effects and reduced demand for social welfare expenditure.[108] Biodiesel (which also has lower transport and infrastructure costs[109]) in particular lends itself to small-scale agriculture, providing a happy coincidence with the predominance in developing countries of diesel in both transport and electricity generation. The economic viability of smallholder agriculture in oilseed production is underlined by the performance of smallholdings in the Malaysian palm-oil industry[110] and the promotion of outgrower schemes among biodiesel companies such as D1 Oils.

Brazil and biodiesel

In 2003, the National Biodiesel Production Programme (PNPB) was created by decree, proposing mandatory blending of 2 per cent

biodiesel by 2008, rising to 5 per cent by 2013. A fundamental objective of the PNPB is the inclusion of smallholder farmers, initially in oilseed production, and ultimately in processing and refining. The programme ensures their participation through the use of the 'social seal' awarded to biodiesel companies that purchase a certain minimum percentage of their feedstock from family farmers, and enter into contractual arrangements to establish a minimum price and provide technical assistance. Companies awarded the social seal are eligible for tax incentives and allowed to participate in national auctions to supply the state fuel company, Petrobras.

Box 7: Case study – 'Biodiesel comes to Coopaf'

The north-east region of Brazil is one of the poorest in the country. Family agriculture is widespread, but the farmers struggle with semi-arid conditions and lack of infrastructure. The biodiesel programme is bringing new opportunities, which the Coopaf co-operative hopes to grasp with both hands. Now they grow castor for biodiesel, intercropped with corn, and sometimes beans. Many of them keep a plot aside for vegetables and livestock.

Many of Coopaf's 5,000 members are descendents of escaped slaves who have farmed the land for generations. But they're noticing some changes of late. 'I think the prospects from the biodiesel programme are good', says Jose Brito Lima, 'but we are worried about the rain. In the last 12 years, we've been having less rain'. The increase of drought in the region has meant that there have only been two good bean harvests in the last decade. But castor is more drought-resistant, requiring only one month of rain instead of the three required for beans. Jose joined the co-operative last year, and started to sell castor for biodiesel when he saw other farmers benefiting from the technical assistance and fixed price provided through the programme. 'In the past, we could only get 12 Reals (about $7) for a 60 kilo bag of castor beans. With the biodiesel programme, this has increased to 36 Reals.' For next season, Coopaf has agreed a price of 45 Reals with the biodiesel company. 'The programme is creating a better life for us because of the guaranteed price', Jose adds.

The co-operative's president, Érico Sampaio da Souza, is optimistic. 'People are seeing that the programme has credibility – that the prices are guaranteed and that there is technical assistance. The farmers are planting with more confidence that they will see results.' But he also recognises that there are many challenges ahead. 'The main ones are to consolidate family agriculture not just in the production of a crop, but the production of the fuel, to innovate with seed varieties, and to improve access to credit. But the main challenge is to organise farmers as a whole.'

Source: Oxfam research

The minimum percentages of feedstock that companies must purchase from family farmers are set by region according to the scale and productivity of family farming. Acceptable oilseeds are also defined on a regional basis, depending on climatic conditions.

In 2007 the Brazilian government reported about 200,000 farmers involved in the programme, forecast to rise to nearly 350,000 as blending of biodiesel increases to 5 per cent.[111] For many of these farmers, the PNPB has provided an important opportunity to diversify or raise income streams and benefit from technical assistance and a guaranteed price (see Box 7). However, the programme faces a number of challenges.

First, during 2007, more attractive international prices meant that biodiesel companies sold feedstocks into commodity markets rather than honouring their contracts with Petrobras - although 800 million litres of biodiesel had been agreed at auction, only half of this was delivered. Farmers also were unprepared to swallow the opportunity costs and failed to honour their contracts: as a result of its members selling instead to middlemen, the Coopaf co-operative discussed in Box 8 was only able to deliver 6,500 tonnes of castor beans to its buyer, despite having agreed 15,000 tonnes. For the future, Coopaf has agreed a scheme in which it will buy half its members' castor for biodiesel, leaving them the remaining half to sell into alternative markets. From now on, biodiesel companies that fail to honour their contracts with Petrobras will be fined heavily.

Second, the primary feedstock for biodiesel is soy oil, meeting about 90 per cent of demand last year. Soy oil tends to be produced by agribusiness rather than family agriculture, and although some family farms are involved in soy production, being relatively large and well-off, they do not represent the intended beneficiaries of the PNPB.

Third, biodiesel-blending mandates are increasing too rapidly. The obligatory use of 3 per cent biodiesel will commence from July 2008, and a new decree has brought forward the 5 per cent target three years to 2010. The accelerated timetable is understood to be the result of lobbying by biodiesel companies that over-invested at the beginning of the PNPB, and now have considerable excess capacity. However, it is unclear whether family farmers, particularly in the poorest regions, will be able to keep pace with the increase in demand; if not, they risk losing even more ground to soy.

Finally, but perhaps not unsurprisingly, the programme has struggled to really penetrate family agriculture in the poorest regions - the relative success of Coopaf is the exception, rather than the rule. Instead, family farmers in the south and south-east regions, who enjoy better conditions, infrastructure, and organisation, have been the main beneficiaries of the programme so far.[112]

Indonesia

In 2006, the Indonesian government passed Presidential Decree 5/2006, setting a target for biofuel consumption in the total national energy mix of 5 per cent by 2025. This was followed shortly by a further decree establishing a national biofuel authority (Timnas BBN) to develop and manage the country's biofuel strategy.

Through biofuels, the government wishes to:

- reduce its dependency on oil (Indonesia became a net importer in 2004);
- earn foreign exchange from exports, particularly to the EU; and
- reduce poverty in rural areas through the creation of income opportunities and the development of schemes to increase access to energy.

Timnas BBN estimates that industry development will require Rp100 trillion (about $10.8bn) over five years,[113] although other estimates have put the figure higher - at as much as Rp250 trillion[114] (about $27bn) - nearly five times the 2007 budget for the national poverty reduction programme.[115]

A critical objective for Indonesia is substitution for oil, which it not only imports, but also subsidises heavily. Oil subsidies are expected to total Rp126 trillion ($13.8bn) this year[116] - 12 per cent of the national budget, and twice the national education spend. For its part, the government hopes that the effect of reducing oil imports will save it $5–6bn a year, which it can spend on poverty reduction.[117] But this is not happening, because the soaring palm-oil price makes biodiesel uncompetitive with (heavily subsidised) petroleum products (see Box 8).

Box 8: Case study – 'Indonesia and palm oil'

Indonesia is one of the world's biggest consumers of palm oil, partly for the manufacturing industry (detergents, etc.) but also because palm-based cooking oil is a staple in the Indonesian diet. In 2007 the consumer price of cooking oil went up 40 per cent, against an overall inflation rate of 6.6 per cent, and continues to rise in 2008.[118] The poorest households feel the strain most, especially in rural areas where incomes are lower and prices of cooking oil are higher – ironically even in areas growing oil palms.

Some areas have seen outright shortages and queues, while food vendors and home industries have been forced out of business. 'With the new prices we can't sell', says Sanuri, a small-scale manufacturer of Indonesia's ubiquitous krupuk crackers, 'but if we make our krupuk smaller, customers will complain'.[119]

Food and fuel prices have provoked a massive public outcry, with demonstrations in Jakarta and other centres. The government has been

quick to take action. Export tax on crude palm oil was tripled last year and import taxes on soy scrapped. Direct market intervention programmes are providing cooking oil and soybeans to the poorest families – a programme that will cost the government Rp500bn ($54m) between March and September 2008.

Biofuels may be one of the drivers of the palm-oil price internationally, but not within Indonesia itself. Following Indonesia's co-commitment with Malaysia in 2006 to devote 40 per cent of palm-oil production to biodiesel and to build a world-leading industry in the two countries, investment in processing facilities was rapid and production capacity topped 2 million tonnes in 2007.[120] The Indonesian government agreed a target of 5 per cent of renewables in the transport fuel mix by 2025. But by January 2008 only five biofuel companies remained in operation, at around 15 per cent of their combined production capacity, while at least 17 others had suspended operations.[121] The problem is simple: domestic biodiesel manufacturers cannot afford the international price of crude palm oil, and the government's fuel-subsidy bill is high enough without further subsidisation of biofuel production. For the time being at least, biodiesel in Indonesia just cannot compete with fossil fuels.

Source: Oxfam research

Higher palm-oil prices though are good news for farmers, and the benefits are being felt by even the smallest of small-scale producers. But price transmission is not perfect. Farm-gate prices are calculated according to a government-set formula of the global crude palm-oil price minus the costs of transport and processing in the mill. However, the mills, owned mainly by big companies with local processing monopolies, refuse to divulge how mill costs add up. Independent smallholders can gain better prices by selling to smaller independent mills, but these are largely confined to the more established production areas such as Sumatra, and are under threat of closure by the government, which is concerned about rising palm-oil smuggling - a result of high prices and export taxes.

The right to food and the right to choose

A risk for many developing countries is that a rapid shift in domestic agriculture away from food production to fuel production may increase food insecurity at both the household and national levels.

At the household level

Small-scale biofuel production in particular should be compatible with food production. A number of oilseed crops suitable for biodiesel production can benefit from intercropping with nitrogen-fixing leguminous vegetables such as beans, or can form part of a more diversified farming strategy (see Box 7). However, in some instances, rather than promoting diversification and food security when dealing with smallholders, companies have discouraged or

prevented it. Whereas palm-oil smallholders in the north of Brazil are encouraged to keep aside a proportion of their land for food production,[122] in Indonesia and Papua New Guinea, households have not been allowed by companies managing the schemes to produce as much food as they would like.[123] Smallholders must be allowed a set-aside area in which they have free choice in their farming decisions, and with which companies should not interfere. Governments should regulate to ensure such set-aside areas in smallholder schemes are respected, and should not create policies that favour monoculture over diversified production.

At the national level

As well as promoting diversification and set-aside land for food production, governments may also need to take national-level decisions regarding for example to what extent staple crops may be used for biofuel production,[124] or where energy feedstocks may be grown. There are likely to be winners and losers from such decisions, so considerations of equity will be key - in particular, it will be important to ensure that the most vulnerable people are consulted and heard.

It is important to move very cautiously with biofuel developments, to avoid precipitating a rush from food to fuel production. Biofuel strategies must be fully integrated with other relevant policies on food security and poverty reduction, and in particular, must be consistent with governments' obligations under international law to ensure the right to food.[125]

Addressing energy poverty

It is rural areas where energy poverty is highest and where feedstocks are grown. A model of decentralised production and consumption is an obvious opportunity, and has the added advantage of locating the entire value chain in the local economy, so maximising incomes and economic spillovers.[126] One such example is the Cuiabá Biofuels Cooperative in Brazil which has established a biodiesel plant in Mato Grosso. The objective is not to supply the national market; it is to reduce the fuel costs of the co-operative's members by avoiding the need to buy at the pump, which the co-operative estimates generates savings of up to 40 per cent.[127]

Generally speaking though, biodiesel and ethanol are of little use for poor people, who tend not to own cars. Other forms of bioenergy are more appropriate and able to address poverty more effectively. In particular, biomass for clean cooking fuels offers huge opportunities to address the effects of poverty among women. Gathering fuel wood

can consume up to five hours per day of a woman's time - time that could otherwise be spent on other, more productive (and paid) activities.[128] Women may also spend several hours a day in a confined, unventilated space burning fuel wood or cow dung for cooking and heating purposes - resulting in serious respiratory health issues. Using biomass to produce biogas for use as a clean heating and cooking fuel offers far greater opportunities for poor women than the production of biofuels for transport.

Other models promote the use of biomass for rural electrification. While biogas can also be used to generate electricity, a number of NGOs in Africa such as TaTEDO in Tanzania and the Mali-Folkecenter (MFC) in Mali are experimenting with community projects involving Multi-functional Platforms (MFPs) - essentially adapted lister diesel engines with various attachments such as husking and grinding machines, oilseed presses, and electric induction motors. This allows communities to use unrefined jatropha oil as a fuel for agricultural processing and electricity generation, in turn used to provide lighting, charge batteries, power communication equipment, and even pump water. Again, the benefits may be particularly felt by women, able to reduce time spent on unpaid activities.[129]

Conclusions and recommendations

The current biofuel policies of industrialised countries offer neither safe nor effective means to combat climate change or improve fuel security. They allow governments to avoid difficult but urgent decisions about how to reduce consumption, while providing new avenues to continue costly support to agriculture at the expense of taxpayers. In the meantime, the real costs of these policies - deepening poverty, environmental degradation, and accelerating climate change - are being 'dumped' on developing countries.

In poor countries, biofuels may provide some opportunities for national consumption or for export. But experience so far has generated some important lessons from which governments must learn if their own biofuel policies are to have a pro-poor impact:

1 There is no reason to suppose that biofuel production will be automatically pro-poor or inclusive. While very efficient, the Brazilian ethanol industry is characterised by high concentration of land and resources, and a rapidly declining employment rate. It is also plagued by poor working conditions. In its early stages, it was associated with the displacement of rural communities.

2 Biofuel programmes are very expensive, requiring billions of dollars in investment and continued support that may represent a serious strain on developing-country budgets and could well be better spent on other development strategies. What is more, the opportunity costs associated with diverting feedstocks into biofuel production rather than selling them into commodities markets can be significant.

3 Some of the greatest pro-poor potential of bioenergy may lie with using biomass to provide clean energy in rural areas, rather than producing biofuels. These potential benefits are particularly profound for women.

4 Opportunities from biofuels for poor people in rural areas are likely to be greatest with feedstocks that favour smallholder production – typically oilseeds used for biodiesel. Strategies that assist communities in gaining access to higher value-added activities such as processing and refining, although difficult, may offer important opportunities for poor people.

5 Secure access to land is a critical part of livelihoods for men and women in rural areas. This is threatened by unregulated biofuel expansion which is pushing vulnerable communities aside and undermining agrarian reform programmes.

Oxfam recommends the following:

For industrialised countries

- Introduce a freeze on implementing new biofuel mandates.
- Urgently revise existing biofuel mandates that deepen poverty and accelerate climate change.
- Dismantle subsidies and tax exemptions for biofuels.
- With some of the savings, invest in:
  - R&D into second-generation biofuels, prioritising technologies that will not require monoculture expansion, nor pose a threat to vulnerable people's food security or land security
  - more efficient use of biomass for energy, such as heat and power
  - addressing emissions from transport through safer and more cost-effective means such as investment in public transport and intelligent speed adaptation schemes.
- Set and enforce ambitious vehicle efficiency standards for car manufacturers.

- To avoid perpetuating existing inequalities in consumption, ensure that such second-generation technologies are made accessible to developing countries and provide assistance to developing countries pursuing their own renewable energy research agendas.
- Ensure that all biofuels consumed offer real GHG savings based on LCAs that properly account for the emissions from direct and indirect land-use change, and nitrogen-based fertilisers.
- Reduce tariffs on biofuels and commit to engage in and support the development of international sustainability standards (including social and environmental criteria).
- Require companies to gain the Free, Prior and Informed Consent of affected communities and ensure decent work (as defined by the International Labour Organization) within their value chains.
- Through support to developing countries' bioenergy programmes, promote research into increasing access to clean energy in rural areas and research into small-scale production.

For developing countries

Move with extreme caution and plan for the long term - avoid ambitious national targets for biofuels, and perform a thorough analysis of environmental and social risks before commencing.

- Perform economic cost/benefit analyses weighing the required support for biofuels against the expected benefits. These should include:
  - financial costs of support to biofuel industries
  - impacts on food prices and import requirements
  - savings on energy imports
  - foreign exchange earnings from exports
  - opportunity costs of alternative agriculture strategies - for example simply selling feedstocks into commodity markets
  - opportunity costs of alternative poverty-reduction strategies such as health and education programmes
  - non-monetary economy costs and benefits associated with impacts on women's unpaid and paid time
  - environmental costs and benefits, including emissions from land-use change

- social costs and benefits, including impacts on employment, displacement, and social transfers.

If it is decided to proceed with biofuel strategies:

- Integrate them with other relevant policies including food-security strategies and poverty-reduction strategies.
- Invest in R&D appropriate to local conditions, and to maximise opportunities for poor people; for example in appropriate oilseed production, small-scale processing, and in bioenergy technologies (not necessarily biofuel) able to increase access to clean energy in remote areas.
- Ensure secure access to land for men and women and that Free, Prior and Informed Consent is obtained before the commencement of any biofuel project.
- Implement and enforce national legislation to protect vulnerable people's access to land and regulate the private sector's access to land, particularly to avoid displacement and concentration of land resources.
- Implement and enforce national legislation to ensure that all biofuel workers, men and women, enjoy decent work as defined by the International Labour Organization.
- Commit to engage in and support the development of international sustainability standards for biofuels (including social and environmental criteria).
- Prioritise feedstocks and production models which maximise opportunities for men and women small farmers and preserve their natural resources such as soil and water (e.g. oilseeds produced using sustainable agricultural models through outgrower schemes, contract farming, crop shares, etc.). Ensure adequate access to finance to allow communities to take ownership in processing and refining.
- Promote diversified farming strategies and ensure that men and women farmers are allowed to grow the food that they require.
- Regulate investing companies to maximise pro-poor impacts of biofuels, for example by:
    - promoting smallholder production models or long-term, equitable lease arrangements with communal and customary landowners where smallholder production is unattractive
    - maximising value-addition within country

  - supplying a certain percentage of biofuel to local or national markets
  - developing access to energy projects.
- Strengthen South-South collaboration on research and production models that foster sustainability and social inclusion.

For companies and investors

- Ensure no biofuel project takes place without the Free, Prior and Informed Consent of local communities.
- Ensure that men and women workers at all stages of production in the value chain enjoy decent work as defined by the International Labour Organization.
- Where applicable, promote smallholder organisation, and work with men and women farmers on a fair and transparent basis including:
  - clear, freely negotiated and respected contracts
  - transparent pricing and credit arrangements
  - timely payment with procedures for regular review and procedures for objections and recourse.
- Where applicable, promote diversification strategies for smallholder farmers and allow them sufficient freedom of choice in their planting decisions to ensure food security for them and their families.
- Promote access to energy projects in remote areas.

Annex: Estimation of indirect emissions through palm-oil expansion as a result of the EU 10 per cent biofuel target

Calculation basis

This calculation seeks to provide a conservative estimate of the emissions from indirect land-use change which will result from palm-oil expansion into rainforest and peatlands. There will of course be other indirect land-use change emissions generated as a result of the EU target, but it is beyond the scope of this calculation.

The indirect emissions arise from:

- Palm-oil expansion as a result of increased demand for direct use in biodiesel - although the Commission's proposed certification scheme will block the use of palm oil grown at direct expense of rainforest or peatland, the net effect of increasing aggregate demand will simply be to displace uncertified palm oil, frequently into rainforest and peatland - it is this indirect expansion we are seeking to capture here.
- Palm-oil expansion as a result of increased demand in order to substitute for European edible oils displaced into biodiesel production, predominantly rapeseed.

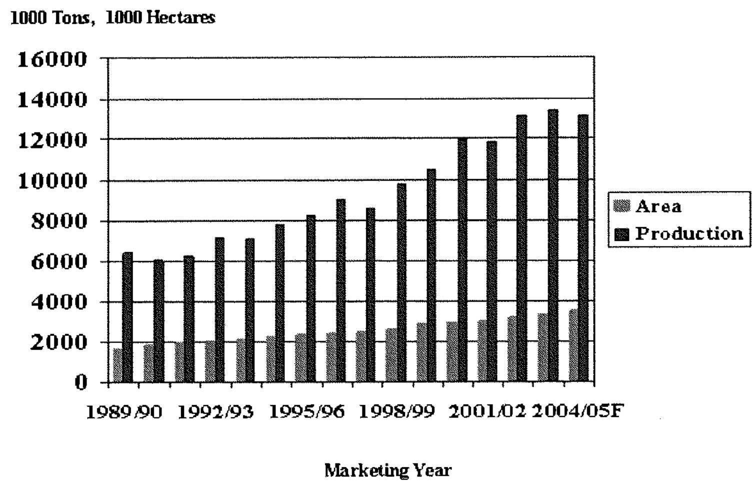
We focus the calculation on Indonesia and Malaysia, which between them intend to supply 20 per cent of the EU's biodiesel demands through palm oil directly (Tauli-Corpuz and Tamang 2007). As the two largest producers of palm oil in the world (between them accounting for about 90 per cent of global production and trade[130]), it is also Malaysia and Indonesia that will meet most of the additional demand to replace diverted rapeseed oil.

A note on yields

It is commonly argued by the Commission that higher demand for feedstocks will predominantly be met through increases in yield rather than expansion. This will not be the case for palm oil, the yields for which, as the FAO shows, have been stagnant for the last 20 years.[131] This means that increases in demand are met through expansion - illustrated quite clearly in the chart below from the

Malaysian Palm Oil Board, which shows that as production has doubled, so has the total area under cultivation.

Malaysian palm-oil production and cultivated area



F – 2004/05 production is a regression model forecast
Source: Malaysian Palm Oil Board

The reason for this is most probably hard economics – it is more lucrative to log rainforest and sell the timber than to invest in increasing yields.

Methodology

Expected 2020 biofuel consumption volumes are taken from Hebebrand and Laney (2007). DG-AGRI analysis of where feedstocks in 2020 are expected to come from is taken from JRC (2007).

It is assumed that Malaysian and Indonesian palm oil supplies 20 per cent of overall EU biodiesel:[132]

Total biodiesel consumption in 2020	20.6bn litres
Of which palm oil	4.1bn litres
Of which diverted domestic edible oils	5.3bn litres
Of which second-generation	5.7bn litres
Of which diverted exports of edible oils	0.5bn litres
Of which increased domestic production	3.6bn litres

European edible oils diverted into biodiesel will have to be replaced by imports of 'vegetable oil and oilseeds, especially palm oil' (JRC 2007). Other candidates include sunflower oil and soy oil, though neither of these is expected to make significant contributions to the

deficit – the former is of limited supply, and GM soy is widely rejected for food use in the EU.[133] The FAO predicts that palm oil will account for 68 per cent of global trade in vegetable oils in 2015/16[134] – it is therefore assumed that palm oil will replace 68 per cent of the diverted edible oils. Assuming that Malaysia and Indonesia continue between them to supply 90 per cent of traded palm oil, this means that about 61 per cent of the diverted edible oils will be replaced with Malaysian and Indonesian palm oil.

It is assumed conservatively that 1 litre of vegetable oil yields 1 litre of biodiesel:[135]

Increase in demand for palm oil	7.3bn litres
For biodiesel	4.1bn litres
To replace diverted domestic edible oils	3.2bn litres

It is assumed that actual expansion occurs within Indonesia – Malaysia is already reaching its limits for oil-palm expansion.[136] Meanwhile Indonesia has identified a further 20 million hectares of land for palm-oil expansion.[137]

Yields in Indonesia are below those in Malaysia, with reported averages in the range of 2.8–3.5 tonnes per hectare[138] – 3.3 tonnes per hectare is assumed here. These increases in demand will therefore require the following expansion:[139]

Total additional area required	2.1m ha
For biodiesel	1.2m ha
To replace diverted domestic edible oils	0.9m ha

Over 50 per cent of new plantations in Indonesia are planned on tropical peatlands.[140] Although the proportion planned on forested land is unclear, historically, about half of plantations have been on deforested land.[141] It is therefore assumed that 50 per cent of this expansion occurs into peatland, and 50 per cent into rainforest (note that these are not mutually exclusive – there is likely to be significant overlap between both as tropical forest grows on peatland). This expansion will therefore lead to the destruction of the following areas:

	Rainforest	Peatland
For biodiesel	0.6m ha	0.6m ha
To replace diverted domestic edible oils	0.5m ha	0.5m ha
Total	1.1m ha	1.1m ha

Estimates for the resultant carbon debts are based on Fargione *et al.* (2008). These are 702 tonnes of CO_2 per hectare for rainforest, and 2,750 tonnes of CO_2 per hectare for peatlands (reflecting the

continued annual emissions from peat oxidation). The total carbon debt arising is therefore:

Total carbon debt	3.6bn tonnes CO_2
For biodiesel	2.0bn tonnes CO_2
To replace diverted domestic edible oils	1.6bn tonnes CO_2

As per Fargione *et al.* (2008), this is allocated among the co-products of the oil palm with weightings based on 2007 average market values, resulting in an allocation of 87 per cent to palm oil.

The final carbon debt allocated to the palm oil is therefore 3.1bn tonnes of CO_2.

This assumes that 28 per cent of biodiesel demand is met through second-generation. However, the Joint Research Centre argues that second-generation biofuels 'will not make a significant contribution to supply by 2020'.[142]

Assuming that second-generation is not commercially available in time, and as under the same set of assumptions above, 61 per cent of the shortfall in diverted edible oils is met by Malaysian and Indonesian palm oil, the associated indirect land-use change effects increase the carbon debt to 4.6bn tonnes of CO_2.

Notes

[1] M. Ivanic and W. Martin (2008) 'Implications of Higher Global Food Prices for Poverty in Low-Income Countries', Policy Research Working Paper 4594, Washington DC: World Bank.

[2] A. Fraser and F. Mousseau (2008) 'The Time is Now: How World Leaders Should Respond to the Food Price Crisis', Oxfam Briefing Note.

[3] See for example Worldwatch Institute (2007) 'Biofuels for Transport'. Countries that have set or are setting mandates include Australia, Argentina, Brazil, Canada, China, Colombia, the EU, India, Japan, Malaysia, Indonesia, Philippines, Thailand, and the USA.

[4] Directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources, 2008/0016 (COD), European Commission, Brussels, 23 January 2008.

[5] P.J. Crutzen, A.R. Mosier, K.A. Smith, and W. Winiwarter (2008) 'N2O release from agro-biofuel production negates global warming reduction by replacing fossil fuels', *Atmospheric Chemistry and Physics* 8(2): 389–95.

[6] W. Schlesinger (1997) *Biogeochemistry: An Analysis of Global Change*, San Diego: Academic Press, second edition, cited in J. Fargione *et al.* (2008).

[7] J. Fargione *et al.* (2008).

[8] To avoid average serious global warming of over 2°C above pre-industrial temperatures, a threshold at which some of the most extreme impacts of climate change are expected to begin, the Intergovernmental Panel on Climate Change (IPCC) has shown that global emissions must peak by 2015 and then fall by 50–85 per cent below 2000 levels.

[9] Directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources, *op.cit.*

[10] D. Morton, R. S. DeFries, Y. E. Shimabukuro, L. O. Anderson, E. Arai, F. del Bon Espirito-Santo, R. Freitas, and J. Morisette (2006) 'Cropland expansion changes deforestation dynamics in the Southern Brazilian Amazon', *Proceedings of the National Academy of Sciences of the United States of America*, 103(39): 14637–41.

[11] T. Searchinger, R. Heimlich, R. A. Houghton, F. Dong, A.Elobeid, J. Fabiosa, S. Tokgoz, D. Hayes, and T.-H. Yu (2008) 'Use of US Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land-Use Change', *Science* 319(5867): 1238–40.

[12] EU imports of palm oil more than doubled from 2000–2006, mostly to substitute for rapeseed oil diverted into fuel. See P. Thoenes (2006) 'Biofuels and Commodity Markets – Palm Oil Focus', FAO. The Commission's research body, the Joint Research Centre, identified palm oil as the principal replacement for diverted rapeseed oil. See JRC (2007). M. Jank *et al.* (2007) 'EU and US Policies on Biofuels: Potential Impacts on

Developing Countries', The German Marshall Fund of the United States, predicts imports of palm oil to more than double again by 2012 in order to substitute for diverted edible oils.

[13] The Joint Research Centre identifies about 26 per cent of EU biodiesel demand in 2020 coming from domestically produced edible oils diverted into biodiesel, and notes that these will have to be replaced by imports. Assuming total biodiesel consumption in 2020 of 20.6 billion litres, this suggests a 'hole' of 5.4 billion litres.

[14] JRC (2007).

[15] The actual figure is likely to be higher, as the Commission's estimates assume that nearly 28 per cent of biodiesel demand will be met by as yet commercially unavailable second-generation technologies. See Note 19. JRC (2007) estimates that without second-generation, EU biodiesel demand will account for nearly a fifth of global vegetable-oil production in 2020.

[16] Estimated 2007 imports of vegetable oils for the EU-27 were 9.1 million tonnes – equivalent to about 9.8 billion litres. See W. Schulz-Greve, 'EU potentials for biomass – will the targets be achieved?', presentation at Krafstoffe der Zukunft, Berlin, 26–27 November, 2007.

[17] V. Tauli-Corpuz and P. Tamang (2007).

[18] The European Commission predicts an annual emissions saving in 2020 of 68 million tonnes of CO_2. See 'Biofuels – relevant data and analysis', extracted from the annex to the impact assessment for the climate and energy package, European Commission, 2008.

[19] The Joint Research Centre of the European Commission concludes that '[second-generation biofuels] are still at the pilot plant stage and will not make a significant contribution to supply by 2020'. See JRC (2007). The OECD and FAO do not expect second-generation biofuels to be commercially available at any time before 2018. See 'OECD-FAO Agricultural Outlook 2008–2017', OECD and FAO, 2008.

[20] C. Costa (2007) 'Brazilian Perspectives on Biofuels', UNICA.

[21] 'Frequently Asked Questions About the Brazilian Sugarcane Industry', UNICA.

[22] Gonçalves (2007) cited in Wilkinson and Herrera (forthcoming). See also Friends of the Earth (2008) 'Sustainability as a Smokescreen', for a discussion of cattle and soy displacement in Brazil, and for further information on the damage sugarcane expansion has caused to the Cerrado and Atlantic Forest. 'Brazil disputes cost of sugar in the tank', the *Guardian*, 10 June 2008, reports that as a result of sugarcane expansion in São Paulo State, the price of land has soared so that one hectare of land there is the same price as 800 hectares in the Amazon, encouraging displacement of other agriculture northwards.

[23] Of the 12 principal areas in which sugarcane investments are taking place, Cardoso da Silva finds that seven have already been developed more than their legal limits allow, and only one has what is described as a reasonable state of formal conservation. More than a third of the area

identified for sugarcane was key to biodiversity. See Cardoso da Silva (2007) cited in Wilkinson and Herrera (forthcoming). This is not only a problem for sugarcane. For example, in São Paulo, if the law was adhered to, 3.7 million hectares planted with sugarcane, oranges, coffee, corn, etc. out of 18.9 million would return to natural reserves. See J.S. Gonçalves and E.P. Castanho Filho (2006) 'Obrigatoriedade da reserva legal e impactos na agropecuária paulista', *Informaçoes Econômicas*, SP, 36(9): 71–84.

[24] The Brazilian government and sugarcane industry have identified ethanol production with the Centre-South and North-West regions, arguing that there is no sugarcane produced in the Amazon, and that it is not appropriate to grow sugarcane there. But this is contested by many of the state governments in the north of the country, encircling the Amazon, which are seeking to attract ethanol investments. For example the state of Pará, to the east of Amazonas, is campaigning for investment. The state of Acre, to the south-west of Amazonas, has a mill producing 3 million tonnes of sugarcane. Roraima, to the north of Amazonas has two projects under consideration. Even in the state of Amazonas itself, the Governor defends ethanol investments to the extent that they are limited to 'degraded lands'. And in Figueiredo, 100 kilometres from Manaus in the heart of the Amazon, a sugarcane plantation operated by Coca Cola is testimony to the viability of sugarcane production in the Amazon. Meanwhile, new ethanol investment programmes are extending into the Centre-West region's Cerrado – a highly biodiverse savannah system to the north-west of São Paulo State; and into Mato Grosso do Sul, home to the Pantanal – the world's largest wetland and a massive carbon sink – although official policy is to prevent investments in the Pantanal itself. Taken from Wilkinson and Herrera (forthcoming). Also see 'Brazil disputes cost of sugar in the tank, the *Guardian*, 10 June 2008, in which it is claimed that 250,000 hectares of the Amazon are already being used for sugarcane.

[25] In the last five months of 2007, 3,235 square kilometres of rainforest disappeared. See BBC (2008) 'Brazil Amazon deforestation soars', 24 January, http://news.bbc.co.uk/1/hi/world/americas/7206165.stm

[26] R. Bailey (2007) 'Bio-fuelling Poverty: Why the EU Renewable-Fuel Target May be Disastrous for Poor People', Oxfam International Briefing Note.

[27] Figures from the social security administration reported in 'Brazil disputes cost of sugar in the tank', the *Guardian*, 10 June 2008.

[28] Amnesty reports that last year, 288 workers were rescued by the Ministry of Labour from six plantations in São Paulo State; 409 (including 150 indigenous) workers were rescued from a distillery in Mato Grosso do Sul; and a further 831 indigenous cutters were lodged in appalling conditions at another plantation in the same state. A further 1000 workers were released from conditions 'analogous to slavery' from a plantation in Pará State. See 'Amnesty International Report 2008: The State of the World's Human Rights', 2008.

[29] Kutas *et al.* 2007.

[30] See 'UK Biomass Strategy 2007 Working Paper 1', Department for Trade and Industry, 2007 for a comparison of the carbon abatement costs for different biomass energy applications.

[31] University of Leeds and the UK Motor Industry Research Association (2000) 'External Vehicle Speed Control', cited in European Federation for Transport and Environment (2005) 'Road transport speed and climate change'.

[32] European Federation for Transport and Environment (2007) 'Reducing car CO_2 emissions through the use of low rolling resistance tyres'.

[33] HM Treasury (2008) 'The King Review of Low Carbon Cars'.

[34] If biofuels offered 100 per cent GHG savings, then a 10 per cent biofuel blend would provide a 10 per cent reduction in emissions on a per vehicle basis – one third of that available from improvements in vehicle efficiency.

[35] The role of the car industry, particularly of German manufacturers, in lobbying to have proposed fleet efficiency standards delayed and then watered down from 120g/km to 130g/km is well known. See for example European Federation for Transport and Environment (2008) 'CO_2 Emissions from New Cars: position paper in response to the European Commission proposal'. In the context of attempts to force *them* to cut emissions from transport, car manufacturers promoted biofuels as an alternative requiring no action on their part – the motor industry was the best represented sector on the Commission's Biofuels Research Advisory Council, the vision of which was an EU in which as much as 25 per cent of transport fuel needs are met by biofuels in 2030. See for example BIOFRAC (2007) 'Biofuels in the European Union. A Vision for 2030 and Beyond'.

[36] European Federation for Transport and Environment (2008), *op.cit.*

[37] 'Biofuels – relevant data and analysis', extracted from the annex to the impact assessment for the climate and energy package, European Commission, 2008.

[38] For a discussion, see European Federation for Transport and Environment (2007) 'Regulating CO2 emissions of new cars: response to the EU "Public consultation on the implementation of the renewed strategy to reduce CO2 emissions from passenger cars and light-commercial vehicles"'.

[39] See for example: www.washingtonpost.com/wp-dyn/content/article/2007/06/21/AR2007062101026_pf.html

[40] This is more than the USA currently imports from Iraq. See: www.35mpgby2020.com/the-facts.html

[41] Based on daily oil consumption for Ethiopia of 29,000 barrels, from the CIA World Factbook: https://www.cia.gov/library/publications/the-world-factbook/

[42] www.washingtonpost.com/wp-dyn/content/article/2007/06/21/AR2007062101026_pf.html

[43] Opinion of the EEA Scientific Committee on the environmental impacts of biofuel utilisation in the EU, 10 April 2008, www.eea.europa.eu/highlights/suspend-10-percent-biofuels-target-says-eeas-scientific-advisory-body

[44] LMC International (2006) 'A Strategic Assessment of the Impact of Biofuel Demand for Agricultural Commodities', cited in M. Kojima, D. Mitchell, and W. Ward (2007) 'Considering Trade Policies for Liquid Biofuels', Energy Sector Management and Assistance Program, World Bank.

[45] JRC (2007).

[46] R. Steenblik (2007) 'Biofuels – at what cost? Government support for ethanol and biodiesel in selected OECD countries', Geneva: Global Subsidies Initiative of the International Institute for Sustainable Development.

[47] IMF (2008) 'World Economic Outlook', April.

[48] D. Koplow (2007) 'Biofuels – at what cost? Government support for ethanol and biodiesel in the United States: 2007 update', Geneva: Global Subsidies Initiative of the International Institute for Sustainable Development, and Steenblik (2007).

[49] R. Steenblik (2007), *op.cit.*

[50] *Ibid.*

[51] The annual costs of adapting to climate change are estimated to be at least $50bn a year. See K. Raworth (2007) 'Financing Adaptation: Why the UN's Bali Climate Conference Must Mandate the Search for New Funds', Oxfam International.

[52] The Commission has recently indicated that it intends to eliminate the Energy Crop Scheme, which pays €45 per hectare subsidy to farmers for growing biofuels. However the Energy Crop Scheme currently makes up a tiny amount of total support for biofuels – less than 2 per cent of support for biodiesel and less than 1 per cent of support for ethanol. This will therefore have a negligible impact on support rates. See Kutas *et al.*

[53] C. Hebebrand and K. Laney (2007).

[54] Fertiliser run-off from the US corn-belt eventually finds its way via the Mississippi to the Gulf of Mexico, causing an oxygen-free 'dead zone' each summer in recent years, reaching 20,000 square kilometres in area. Recent analysis in *the Proceedings of the National Journal of Sciences* suggests new US targets will make it almost impossible to solve. See for example www.publicaffairs.ubc.ca/media/releases/2008/mr-08-025.html

[55] USDA Long-Term Projections to 2017, United States Department of Agriculture, February 2008.

[56] Similarly, conversion of Canada's corn crop to ethanol is expected to rise from 4 per cent of the total in 2006, to more than 13 per cent in 2008. According to government research, Canada would have to use 36 per cent of its farmland to produce enough biofuels to replace just 10 per cent of the fuel currently used for transport. Half of Canada's total corn-seeded area

and 11–12 per cent of the wheat-seeded area would have to be grown for ethanol for Canada to reach its domestic biofuel target of 5 per cent of national fuel consumption by 2010. See F. Forge (2007) 'Biofuels: an Energy, Environmental or Agriculutral Policy?', Library of Parliament, Science and Technology Division.

[57] In 2006, the USA is estimated to have spent $465m on federal grants, demonstration projects, and R&D for ethanol, out of a total support package of $5.1–6.8bn. See D. Koplow (2007), *op.cit.* In 2006, the EU spent €91m on biofuels R&D, out of total support of €3.7bn. See Kutas *et al.*

[58] The European Biofuel Technology Platform, heavily dominated by energy, car, and biotech companies, has proposed a biofuel target of 25 per cent by 2030.

[59] World Bank (2008) 'Rising Food Prices: Policy Options and World Bank Response'.

[60] M. Ivanic and W. Martin (2008), *op.cit.*

[61] Although consumption of meat and dairy products is increasing in emerging economies, there is still a long way to go before it reaches the level in rich countries. US Department of Agriculture statistics suggest for example that total foodgrain consumption of the average American is more than five times that of the average Indian and three times that of the average Chinese, and is increasing. See http://timesofindia.indiatimes.com/US_eats_5_times_more_than_India_per_capita/articleshow/3008449.cms

[62] The extent of the role of speculation in the food crisis remains contested. See for example: www.ft.com/cms/s/0/e299bd06-1fbc-11dd-9216-000077b07658.html

[63] IMF World Economic Outlook, April 2008.

[64] 'Rising Food Prices: Causes and Consequences', OECD, paper prepared for the DAC High Level Meeting, 20–21 May 2008.

[65] 'The World Food Situation: New Driving Forces and Required Actions', IFPRI, 2007.

[66] For IFPRI commentary, see www.guardian.co.uk/environment/2008/feb/26/food.unitednations. Also see IFPRI (2008) 'Biofuels and Grain Prices: Impacts and Policy Responses'. Simon Johnson, Chief Economist of the IMF, estimated that biofuels account for '20–30 per cent' of price rises on *The Today Programme*, BBC Radio 4, 14 April 2008. For FAO commentary, see: www.ft.com/cms/s/0/a503b8ce-131a-11dd-8d91-0000779fd2ac.html

[67] D. Mitchell (2008) 'A Note on Rising Food Prices', World Bank, cited in 'Soaring Food Prices: Facts, Perspectives, Impacts and Actions Required', FAO, 2008.

[68] IEA (2007) 'Renewables in Global Energy Supply, An IEA Fact Sheet'.

[69] For example, the Commission argues that 'the rise in prices of agricultural products should benefit farmers and rural communities, notably in

developing countries'. See 'Biofuels – relevant data and analysis', extracted from the annex to the impact assessment for the climate and energy package, European Commission, 2008.

[70] See for example M. Ivanic and W. Martin (2008), *op.cit.*

[71] *Ibid.*

[72] A. Fraser and F. Mousseau (2008), *op.cit.*

[73] Calculated as 30 per cent of the increase in poverty headcount and endangered livelihoods.

[74] C. Runge and B. Senauer (2007) 'How Biofuels Could Starve the Poor', *Foreign Affairs*, May/June.

[75] See for example R. Bailey (2007), *op.cit.*

[76] The chair of the United Nations Forum on Indigenous Issues has warned that 60 million indigenous people are at risk of being driven from their land to make way for biofuels. See: http://mwcnews.net/content/view/14507/235/

[77] International Union for the Conservation of Nature (2007) 'Gender and Bioenergy'.

[78] D. Rajagopal (2007) 'Rethinking current strategies for biofuel production in India', Energy and Resources Group, University of California, Berkeley.

[79] H. Gundimeda (2005) 'Can CPRs Generate Carbon Credits without Hurting the Poor?', *Economic and Political Weekly* 40(10), cited in FAO (2008) 'Gender and Equity Issues in Liquid Biofuels Production: Minimizing the Risks to Maximize the Opportunities'.

[80] FAO (2008), *op.cit.*

[81] German Technical Cooperation (GTZ) (2005) 'Liquid Biofuels for Transportation in Tanzania: Potential and Implications for Sustainable Agriculture and Energy in the 21st Century'.

[82] African Biodiversity Network (2007) 'Agrofuels in Africa: the Impacts on Land, Food and Forests'.

[83] '2004 Energy Balances for Tanzania', IEA, www.iea.org/Textbase/stats/balancetable.asp?COUNTRY_CODE=TZ

[84] FAO (2007) 'State of Food and Agriculture 2007'.

[85] A. Croppenstedt and I. Maltsoglou (no date) 'Bioenergy in Tanzania: a Problem or an Opportuunity?', FAO.

[86] As part of the East African Community bloc, Tanzania is currently negotiating an Economic Partnership Agreement (EPA) with the EU. EPAs are Free Trade Agreements which, among other things, limit the development policy space of poor countries, particularly with regards to regulation of foreign direct investment. See E. Jones (2008) 'Partnership or Power Play? How Europe Should Bring Development into its Trade Deals with African, Caribbean, and Pacific Countries', Oxfam International Briefing Paper.

[87] V. Tauli-Corpuz and P. Tamang (2007).

[88] S. Martin (2008) 'Losing Ground: The Human Rights Impacts of Oil Palm Plantation Expansion in Indonesia', Friends of the Earth, LifeMosaic, and Sawit Watch.

[89] See Note 77.

[90] See for example S. Martin (2008), *op.cit.*

[91] R. Bailey (2007), *op.cit.*

[92] See for example: www.reporterbrasil.org.br/exibe.php?id=1310; www.community-hug.org/brazilnetdev/index.php?option=com_content&task=view&id=142&Itemid=793; http://earth2tech.com/2008/04/01/brencos-big-uh-oh-ethanol-workers-terrible-conditions/; http://www.thealarmclock.com/mt/archives/2008/04/brencos_brazil.html

[93] Based on data from the CIA World Factbook, https://www.cia.gov/library/publications/the-world-factbook/

[94] 'Sustainable Bioenergy: A Framework for Decision Makers', UN-Energy, 2007.

[95] FAO (2007) 'A Review of the Current State of Bioenergy Development in G8 +5 Countries', Global Bioenergy Partnership.

[96] Worldwatch Institute (2007) 'Biofuels for Transport'.

[97] J. Peters and S. Thielmann (2008) 'Promoting Biofuels: Implications for Developing Countries', Ruhr Economic Paper No. 38, RWI Essen.

[98] Kojima *et al.* (2007), *op.cit.*

[99] OECD and FAO, *op.cit.*

[100] Analysis by the World Bank suggests that between 1990 and 2005, the split between ethanol and sugar may not have been optimal, with more sugarcane being diverted to ethanol over the period than would have been the case if left to market forces. See Kojima *et al.* (2007), *op.cit.*

[101] Brazil is entering into numerous agreements with African nations on ethanol production, and its ethanol industry is investing heavily in the continent. Countries entering into agreements with Brazil or accepting foreign direct investment from Brazilian ethanol companies include Nigeria, Senegal, Ghana, Mozambique, and Angola. See for example: www.ecoworld.com/home/articles2.cfm?tid=389; www.scidev.net/en/news/brazil-and-india-join-senegal-for-biofuel-producti.html; www.thelocal.se/11536/20080504/; www.macauhub.com.mo/en/news.php?ID=4004; www.sarwatch.org/page.php?84

[102] R. Bailey (2007), *op.cit.*

[103] J. Goldemberg, T. Johansson, A. Reddy, and R. Williams (1998) *Energy for a Sustainable World*, Chichester: John Wiley and Sons.

[104] In the South of Brazil, a number of co-operatives involved in ethanol production challenge the dominant large-scale model. One of these is Cooperbio, which counts 20,000 farmers among its members and produces

ethanol through ten decentralised micro-distilleries for sale to the state oil company Petrobras. The co-operative has diversified production, also producing oilseeds for the national biodiesel programme, alongside food crops and livestock. See Wilkinson and Herrera (forthcoming).

[105] A. Keleman and H. García (2007) 'La Crisis de Maíz y la Tortilla en México: ¿Modelo o Coyuntura?', Oxfam GB, ANEC, and Procientec.

[106] On the basis of patent applications filed, the vast majority of R&D into second-generation biofuels is taking place in the industrialised world, most notably the USA. If and when these become available, many first-generation biofuels may be rendered less competitive, possibly reducing developing countries to exporters of feedstock such as wood chip. See JRC (2007).

[107] 'Sustainable Bioenergy: A Framework for Decision Makers', *ibid.*

[108] A. Dufey, S. Vermeulen, and B. Vorley (2007) 'Biofuels: Strategic Choices for Commodity Dependent Developing Countries', Common Fund for Commodities.

[109] A. Dufey, L. Peskett, R. Slater, and C. Stevens (2007) 'Biofuels, Agriculture and Poverty Reduction', London: DFID.

[110] S. Vermeulen and N. Goad (2006) 'Towards Better Practice in Smallholder Palm Oil Production', International Institute for Environment and Development.

[111] J. Wilkinson and S. Herrera (forthcoming) 'Making Biofuels Work for the Poor – Brazilian Case-Study', Oxfam International.

[112] *Ibid.*

[113] See for example: http://en.ce.cn/World/Asia-Pacific/200608/13/t20060813_8117046.shtml

[114] See 'Profil Bahan Bakar Nabati' in http://tkpkri.org/content/view/180/229/lang,id

[115] The 2007 budget allocation to the national poverty reduction programme was 61 trillion rupiahs, according to the Ministry of Social Welfare, cited in C.R. Septyandrica *et al.* (2008) 'Saatnya DPR Berpihak: Panduan bagi DPR dalam Mendorong APBVN Pro-Poor', Perkumpulan Prakarsa.

[116] Ministry of Finance Budget 2008. Also see Reuters 'Indonesia sees 2008 fuel subsidy bill rising', http://in.reuters.com/article/asiaCompanyAndMarkets/idINJKB00054020080218

[117] Kehati Foundation (2007) 'Revising the Hope: Review on Bio-fuel Development Policy and its Role in Poverty Reduction in Indonesia.'

[118] Indonesian Ministry of Finance statistics.

[119] Taken from an article in *Sinar Harapan* by Purwandi, 7 May 2007, 'Harga minyak goreng tak terkendali: usaha kecil mulai kesulitan'.

[120] See: http://renewenergy.wordpress.com/2008/01/17/indonesia-biodiesel-output-seen-doubling/

[121] See R. Mahabir (2008) 'Failed policies knock biodiesel production by 85 per cent', *Jakarta Post*, 24 January.

[122] Smallholder oil-palm farmers in the Agropalma outgrower scheme in Pará, North Brazil keep 2 hectares of their plots aside for other crops. See Wilkinson and Herrera (forthcoming), *op.cit.*

[123] S. Vermeulen and N. Goad (2006), *op.cit.*

[124] For example, South Africa and China have both placed a limit on the amount of corn that may be used in ethanol production.

[125] Article 11 of the 1966 International Covenant on Economic, Social and Cultural Rights.

[126] A. Dufey *et al.* (2007), *op.cit.*

[127] J. Wilkinson and S. Herrera (forthcoming), *op.cit.*

[128] E. Larson and S. Kartha (2000) 'Bioenergy Primer: Modernised Biomass Energy for Sustainable Development', United Nations Development Programme.

[129] *Ibid.*

[130] P. Thoenes, *op.cit.*

[131] P. Thoenes, *op.cit.*

[132] It is sometimes asserted that palm oil is unlikely to make up a significant part of European biodiesel, due to the fact that at cooler European temperatures palm-based biodiesel can solidify. However, the Malaysian Palm Oil Board has reportedly already licensed technology for making EU and US winter-specification-compliant palm-based biodiesel – see for example Kojima *et al.* (2007), *op.cit.* Greenpeace recently analysed biodiesel being sold in London on 3 April 2008 (a week during which London experienced snowfall) and found that it was based on 30 per cent palm oil. See: www.timesonline.co.uk/tol/news/environment/article3740163.ece

[133] P. Thoenes, *op.cit.*

[134] P. Thoenes, *op.cit.*

[135] This conservatively assumes perfect conversion ratios, which are not achieved in practice. See for example: www.biodieselexpertsintl.com/AboutBiodiesel/tabid/71/Default.aspx

[136] P. Thoenes, *op.cit.*

[137] 'How Unilever Palm Oil Suppliers are Burning up Borneo', Greenpeace, 2008.

[138] See for example M. Chandran (2006) 'Country Perspectives: Indonesia/Malaysia', presentation at the 75th IASC World Congress, San Francisco, 13–16 June – reports 3.3 tonnes per hectare; J. W. van Gelder (2004) 'Greasy Palms: European Buyers of Indonesian Palm Oil', Friends of the Earth – reports 3.2 tonnes per hectare; GAPKI (the Indonesian Palm Oil Association) reports 3.5 tonnes per hectare – cited in *Down To Earth* No. 63, 'Sustainable palm oil: mission impossible?', 2004; separate industry

correspondence reports average yields of 2.8 tonnes per hectare for Indonesia.

[139] Based on a density for palm oil of 0.93 kg per litre.

[140] Wetlands International (2007) 'Palm Oil and Tropical Peatlands Factsheet'.

[141] See for example: Royal Society for the Protection of Birds (2008) 'A Cool Approach to Biofuels'.

[142] JRC (2007).

References

Dufey, A., S. Vermeulen, and B. Vorley (2007) 'Biofuels: Strategic Choices for Commodity Dependent Developing Countries', Common Fund for Commodities.

Fargione, J., J. Hill, D. Tilman, S. Polasky, and P. Hawthorne (2008) 'Land Clearing and the Biofuel Carbon Debt', *Science* 319(5867): 1235–8.

Hebebrand, C. and K. Laney (2007) 'An Examination of U.S. and EU Government Support to Biofuels: Early Lessons', International Food & Agriculture Trade Policy Council.

Hugo García (2008) 'Biofuel in Mexico: Transition to ethanol use and its social and environmental effects', research report for Oxfam International.

JRC (2007) 'Biofuels in the European Context: Facts, Uncertainties and Recommendations', JRC Working Paper, 19 December.

Kojima, M., D. Mitchell, and W. Ward (2007) 'Considering Trade Policies for Liquid Biofuels', Energy Sector Management Assistance Program, World Bank.

Koplow, D. (2007) 'Biofuels – At What Cost? Government Support for Ethanol and Biodiesel in the United States: 2007 Update', Geneva: Global Subsidies Initiative of the International Institute for Sustainable Development.

Kutas, G., C. Lindberg, and R. Steenblik (2007) 'Biofuels – At What Cost? Government Support for Ethanol and Biodiesel in the European Union', Geneva: Global Subsidies Initiative of the International Institute for Sustainable Development.

Martin, S. (2008) 'Losing Ground: The Human Rights Impacts of Oil Palm Plantation Expansion in Indonesia', Friends of the Earth, LifeMosaic, and Sawit Watch.

Steenblik, R. (2007) 'Biofuels – At What Cost? Government Support for Ethanol and Biodiesel in Selected OECD Countries', Geneva: Global Subsidies Initiative of the International Institute for Sustainable Development.

Tauli-Corpuz, V. and P. Tamang (2007) 'Oil Palm and Other Commercial Tree Plantations, Monocropping: Impacts on Indigenous Peoples' Land Tenure and Resource Management Systems and Livelihoods', United Nations Permanent Forum on Indigenous Issues, 6th Session, New York, 14–25 May.

Wilkinson J. and S. Herrera (forthcoming) 'Making Biofuels Work for the Poor – Brazilian Case-Study', Oxfam International.

Worldwatch Institute (2007) *Biofuels for Transport*, London: Earthscan.

This paper was written by Robert Bailey. Oxfam acknowledges the assistance of Sonja Vermeulen, Sophia Murphy, John Wilkinson, and Selena Herrera in its production. It is part of a series of papers written to inform public debate on development and humanitarian policy issues.

For further information on the issues raised in this paper please e-mail advocacy@oxfaminternational.org.

Oxfam International is a confederation of thirteen organizations working together in more than 100 countries to find lasting solutions to poverty and injustice: Oxfam America, Oxfam Australia, Oxfam-in-Belgium, Oxfam Canada, Oxfam France - Agir ici, Oxfam Germany, Oxfam GB, Oxfam Hong Kong, Intermón Oxfam (Spain), Oxfam Ireland, Oxfam New Zealand, Oxfam Novib (Netherlands), and Oxfam Québec. Please call or write to any of the agencies for further information, or visit www.oxfam.org.

Oxfam America 226 Causeway Street, 5th Floor Boston, MA 02114-2206, USA +1 617 482 1211 (Toll-free 1 800 77 OXFAM) E-mail: info@oxfamamerica.org www.oxfamamerica.org	**Oxfam Hong Kong** 17/F., China United Centre, 28 Marble Road, North Point, Hong Kong Tel: +852 2520 2525 E-mail: info@oxfam.org.hk www.oxfam.org.hk
Oxfam Australia 132 Leicester Street, Carlton, Victoria 3053, Australia Tel: +61 3 9289 9444 E-mail: enquire@oxfam.org.au www.oxfam.org.au	**Intermón Oxfam (Spain)** Roger de Llúria 15, 08010, Barcelona, Spain Tel: +34 902 330 331 E-mail: info@intermonoxfam.org www.intermonoxfam.org
Oxfam-in-Belgium Rue des Quatre Vents 60, 1080 Brussels, Belgium Tel: +32 2 501 6700 E-mail: oxfamsol@oxfamsol.be www.oxfamsol.be	**Oxfam Ireland** Dublin Office, 9 Burgh Quay, Dublin 2, Ireland Tel: +353 1 635 0422 Belfast Office, 115 North St, Belfast BT1 1ND, UK Tel: +44 28 9023 0220 E-mail: communications@oxfamireland.org www.oxfamireland.org
Oxfam Canada 250 City Centre Ave, Suite 400, Ottawa, Ontario, K1R 6K7, Canada Tel: +1 613 237 5236 E-mail: info@oxfam.ca www.oxfam.ca	**Oxfam New Zealand** PO Box 68357, Auckland 1145, New Zealand Tel: +64 9 355 6500 (Toll-free 0800 400 666) E-mail: oxfam@oxfam.org.nz www.oxfam.org.nz
Oxfam France - Agir ici 104 rue Oberkampf, 75011 Paris, France Tel: + 33 1 56 98 24 40. E-mail: info@oxfamfrance.org www.oxfamfrance.org	**Oxfam Novib (Netherlands)** Mauritskade 9, Postbus 30919, 2500 GX, The Hague, The Netherlands Tel: +31 70 342 1621 E-mail: info@oxfamnovib.nl www.oxfamnovib.nl
Oxfam Germany Greifswalder Str. 33a, 10405 Berlin, Germany Tel: +49 30 428 50621 E-mail: info@oxfam.de www.oxfam.de	**Oxfam Québec** 2330 rue Notre Dame Ouest, bureau 200, Montreal, Quebec, H3J 2Y2, Canada Tel: +1 514 937 1614 E-mail: info@oxfam.qc.ca www.oxfam.qc.ca
Oxfam GB Oxfam House, John Smith Drive, Cowley, Oxford, OX4 2JY, UK Tel: +44 1865 473727 E-mail: enquiries@oxfam.org.uk www.oxfam.org.uk	

Oxfam International Secretariat: Suite 20, 266 Banbury Road, Oxford, OX2 7DL, UK
Tel: +44 1865 339100 Email: information@oxfaminternational.org. Web site: www.oxfam.org

Oxfam International advocacy offices:
E-mail: advocacy@oxfaminternational.org
Washington: 1100 15th St., NW, Ste. 600, Washington, DC 20005-1759, USA
Tel: +1 202 496 1170.
Brussels: Rue Philippe le Bon 15, 1000 Brussels, Belgium
Tel: +322 502 1941
Geneva: 15 rue des Savoises, 1205 Geneva, Switzerland
Tel: +41 22 321 2371.
New York: 355 Lexington Avenue, 3rd Floor, New York, NY 10017, USA
Tel: +1 212 687 2091.
Brasília: SCS Quadra 8 Bloco B-50 Sala 401, Edifício Venâncio 2000, Brasília-DF, 70333-900, Brazil
Tel: +55 61 3321 4044

Linked Oxfam organizations. The following organizations are linked to Oxfam International:
Oxfam Japan Maruko bldg. 2F, 1-20-6, Higashi-Ueno, Taito-ku, Tokyo 110-0015, Japan
Tel: + 81 3 3834 1556. E-mail: info@oxfam.jp Web site: www.oxfam.jp
Oxfam Trust in India B - 121, Second Floor, Malviya Nagar, New Delhi, 1100-17, India
Tel: + 91 11 2667 3 763. E-mail: info@oxfamint.org.in Web site: www.oxfamint.org.in
Oxfam International and Ucodep Campaign Office
Via Masaccio, 6/A 52100 Arezzo, Italy
Tel +39 0575 907826, Fax +39 0575 909819
email: ucodep-oi@oxfaminternational.org

Oxfam observer member. The following organization is currently an observer member of Oxfam International, working towards possible full affiliation:
Fundación Rostros y Voces (México) Alabama 105, Colonia Napoles, Delegacion Benito Juarez, C.P. 03810 Mexico, D.F.
Tel: + 52 5687 3002 / 5687 3203 Fax: +52 5687 3002 ext. 103
E-mail: comunicación@rostrosyvoces.org
Web site: www.rostrosyvoces.org

INTERNATIONAL FOOD
POLICY RESEARCH INSTITUTE
sustainable solutions for ending hunger and poverty
IFPRI®
Supported by the CGIAR

Policy Brief • May 2008

High Food Prices: The What, Who, and How of Proposed Policy Actions

Joachim von Braun
with
Akhter Ahmed
Kwadwo Asenso-Okyere
Shenggen Fan
Ashok Gulati
John Hoddinott
Rajul Pandya-Lorch
Mark W. Rosegrant
Marie Ruel
Maximo Torero
Teunis van Rheenen
Klaus von Grebmer[1]

Executive Summary

The complex causes of the current food and agriculture crisis require a comprehensive response. In view of the urgency of assisting people and countries in need, the first set of policy actions—an emergency package—consists of steps that can yield immediate impact:

1. expand emergency responses and humanitarian assistance to food-insecure people and people threatening government legitimacy,
2. eliminate agricultural export bans and export restrictions,
3. undertake fast-impact food production programs in key areas, and
4. change biofuel policies.

A second set of actions—a resilience package—consists of the following steps:

5. calm markets with the use of market-oriented regulation of speculation, shared public grain stocks, strengthened food-import financing, and reliable food aid;
6. invest in social protection;
7. scale up investments for sustained agricultural growth; and
8. complete the Doha Round of World Trade Organization (WTO) negotiations.

Investment in these actions calls for additional resources. Policymakers should consider mobilizing resources from four sources: the winners from the commodity boom among countries; the community of traditional and new donor countries; direct or indirect progressive taxation and reallocation of public expenditures in the affected countries themselves; and mobilization of private sector finance, including through improved outreach of banking to agriculture.

Because of countries' diverse situations, the design of programs must be country driven and country owned. Accountability for sound implementation must also rest with countries. At the same time, a new international architecture for the governance of agriculture, food, and nutrition is needed to effectively implement the initiatives described, and especially their international public goods components. Global and national action is needed, through existing mechanisms, well-coordinated special initiatives, and possibly a special fund.

[1] The coauthors' titles appear on the last page of this paper. This paper was developed with the help of many colleagues at IFPRI. Bella Nestorova and Tolu Olofinbiyi provided excellent research assistance throughout the development of this paper. We greatly appreciate the input and comments of many IFPRI staff members, especially Ousmane Badiane, Antoine Bouet, Betina Dimaranan, Nick Minot, Siwa Msangi, David Orden, Miguel Robles, and Tingju Zhu. We gratefully acknowledge the peer reviews of an earlier draft of this paper by Sartaj Aziz (Pakistan), Eugenio Diaz-Bonilla (Argentina), Franz Heidhues (Germany), Per Pinstrup-Andersen (USA), and Harris Mule (Kenya), whose comments and critiques were extremely helpful.

I. Introduction

The sharp increase in food prices over the past couple of years has raised serious concerns about the food and nutrition situation of people around the world, especially the poor in developing countries; about inflation; and—in some countries—about civil unrest. Although the relative influence of various factors on global food price inflation remains somewhat open to discussion and debate, the underlying causes are increasingly well understood and noted at the highest policymaking levels. IFPRI drew attention to the problem early on and identified the main actions needed to prevent and mitigate the emerging crisis.[2] This paper aims to identify more specifically what needs to be done now. The set of policy actions, and in particular their sequencing, scale, adaptation to diverse regional and national conditions, and the arrangements for and governance of their implementation, need frameworks and clarity. Developing- and developed-country governments as well as international organizations have key roles to play in reducing and stabilizing prices by facilitating urgently needed trade and investment actions and in helping poor people cope with higher food bills through social protection. Some of these actions require global coordination in order to be effective.

Nearly every agricultural commodity is part of the rising price trend. Since 2003, world maize and wheat prices have more than doubled (Figure 1). The price of rice has jumped to unprecedented levels and doubled in the past four months alone. Dairy products, meat, poultry, palm oil, and cassava, among other agricultural commodities, have also experienced price hikes. Since the beginning of 2003, the prices of butter and milk have tripled and the price of poultry meat has almost doubled. When adjusted for inflation and the dollar's decline (by reporting in euros, for example), food price increases are smaller but still dramatic. What really matters for the poor, however, is the effect on their purchasing power. Some of this effect is reflected in the declining ratio of wages of unskilled labor to food prices. The high global agricultural prices do not appear likely to fall to their 2000–03 levels, and fluctuations may be even higher, according to the global scenario analysis of the International Food Policy Research Institute (IFPRI).[3]

The surge in food prices has been transmitted in varying degrees from international to local markets.[4] For example, in Tanzania, 81 percent of the change in international maize prices between 2003 and 2008 has been captured by local price changes. In Indonesia, on the other hand, the transmission of maize prices is -5 percent in Jakarta and 32 percent in Surabaya. Similarly, in Ghana and the Philippines local rice prices have adjusted to around 50 percent of the world price change. The food price surge also has a direct impact on overall inflation because the weight of food in the consumption baskets is high. In Latin America, where the share of food in the consumer price index ranges from 23 to 50 percent, food inflation has reached double digits. Food price inflation has also picked up in China, where it now contributes to about 90 percent of overall inflation. In India the contribution of food price inflation to overall inflation has been less than 20 percent during 2007–08, yet it has created political concerns in the Parliament. India has used its subsidy, trade, and tariff policies to absorb much of the shock in global food and energy prices. The least-developed countries, however, many of which are in Africa, have fewer resources to respond in a similar manner.

National governments and international actors are taking various steps to try to minimize the effects of higher international prices on domestic prices and to mitigate impacts on particular groups. Some of these actions are likely to help stabilize and reduce food prices, whereas others may help certain groups at the expense of others or actually make food prices more volatile and seriously distort trade. What is needed is more effective and coherent action to help the most vulnerable populations cope with the drastic and immediate hikes in their food bills, to help developing-country farmers swiftly respond to the opportunity posed by the rising demand for their products, and to bring more stability to highly volatile food markets.

II. Sources and Features of the Price Increases

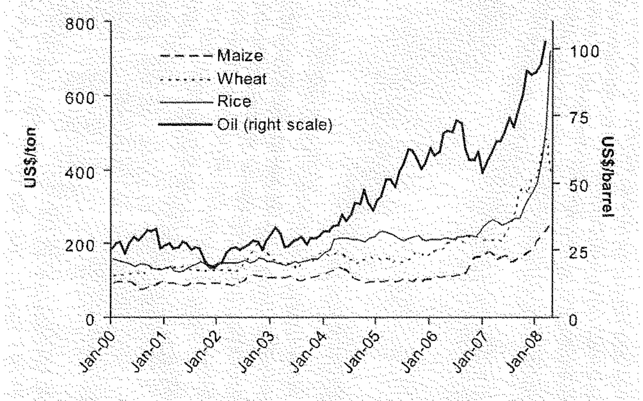
The combination of new and ongoing forces is driving the world food situation and, in turn, the prices of food commodities. Rising energy prices and subsidized biofuel production, income and population growth, globalization,

[2] See www.ifpri.org and, for example, Joachim von Braun, Mark W. Rosegrant, Rajul Pandya-Lorch, Marc J. Cohen, Sarah A. Cline, Mary Ashby Brown, and María Soledad Bos, *New Risks and Opportunities for Food Security: Scenario Analyses for 2015 and 2050*, 2020 Discussion Paper 39 (Washington, DC: IFPRI, February 2005); Joachim von Braun, *The World Food Situation: New Driving Forces and Required Actions*, Food Policy Report (Washington, DC: IFPRI, December 2007).

[3] IFPRI's global scenario analysis is based on the International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT). This modeling activity is instrumental for IFPRI's outlook. It is directed by Mark W. Rosegrant.

[4] Certain elements can prevent a perfect transmission of prices from international markets to local markets. Three forces are normally identified: (1) transportation cost and natural market segmentation; (2) domestic policies and discretionary market segmentation: and (3) imperfect transmission related to market structure and the existence of monopolistic/monopsonistic power. As a result the transmission of price changes from international to local markets varies between countries.

Figure 1—World Commodity Prices, January 2000–April 2008



Sources: International commodity prices database of the Food and Agriculture Organization of the United Nations (FAO), 2008; International Financial Statistics database of the International Monetary Fund (IMF), April 2008.

Note: Although there is a strong correlation between food price levels and oil price levels, this is not the only forceful relationship. Other factors, such as high demand for food due to economic growth and lack of response in production, play a role in food price increases as well.

and urbanization are among the major forces contributing to surging demand. On the supply side, land and water constraints, underinvestment in rural infrastructure and agricultural innovation, lack of access to inputs, and weather disruptions are impairing productivity growth and the needed production response. Between 2000 and 2007, cereal demand exceeded cereal production, and cereal stocks have consequently declined. Demand for agricultural commodities for food, feed, and fuel is likely to continue to escalate. Climate change risks and rising energy demand could re-accelerate food prices in the future. Ad hoc market and trade policies such as export bans and import subsidies add further volatility in the international food market. It is important to keep in mind that the factors playing a role in the current crisis vary in nature—some are cyclical, some are structural, and some are unique—and can change, as shown by tales of previous commodity booms, like the one in 1974.

2. 1. Energy and biofuels

One key factor behind rising food prices is the greatly increased price of energy. Energy and agricultural prices have become increasingly intertwined (Figure 1). With oil prices at an all-time high of more than US$120 a barrel in May 2008 and with the U.S. government and the European Union subsidizing agriculture-based energy, farmers have massively shifted their cultivation toward crops for biofuel. In the United States, as much as one third of the maize crop goes to ethanol production, up from 5 percent a decade ago, and biofuel subsidies range between US$11 billion and US$13 billion a year. In addition, the large agricultural subsidies in developed countries have for years distorted markets and undercut the competitive advantage of developing-country farmers.

Expanded production of biofuels such as ethanol and biodiesel has a strong effect on prices because biofuel production draws largely on agricultural products. Increased biofuel demand in 2000–07 is estimated to have contributed to 30 percent of the weighted average increase of cereal prices. Incorporating new developments in supply and demand as well as actual biofuel investment plans, IFPRI's IMPACT projects that real prices of maize and oilseeds in 2020 will be 26 and 18 percent higher compared with a scenario that keeps biofuel production at 2007 levels. These are conservative estimates that do not factor in speculation and triggered trade restrictions (export bans). Also, future oil prices will factor heavily in the actual price changes, because a higher oil

price will increase demand for biofuels and put a further squeeze on food supplies, unless biofuel policies are changed.

High energy prices have also made agricultural production more expensive by raising the cost of inputs like fertilizers, irrigation, and transport of inputs and outputs. Whereas the share of energy in the cost of crop production is around 4 percent in most developing countries, it is between 8 and 20 percent in some large countries such as Brazil, China, and India.

2. 2. Income and population growth

Many parts of the developing world continue to face high population growth, and an increasing number of countries have experienced high economic growth in recent years. Developing Asia, especially China and India, continues to show strong sustained growth. Real gross domestic product (GDP) in the region increased by more than 9 percent a year between 2005 and 2007. Sub-Saharan Africa also experienced rapid economic growth of more than 6 percent in the same period. Even countries with high incidences and prevalences of hunger reported strong growth rates. With higher incomes, shifting rural-urban populations, and changing preferences, domestic consumer demand for food has increased. At the same time, the growing world population is demanding more and different kinds of food. Food consumption patterns are shifting from grains and other staple crops to vegetables, fruits, meat, and dairy, and this consumption cuts into land and water use for grains.

2. 3. Agricultural production

On the supply side, the global production response to rising demand has been slow. Production has grown only slowly in some traditionally grain-surplus and grain-exporting countries. Output declined in Australia owing to severe drought and stagnated in China, the European Union, India, and the United States. Some recovery is expected in 2008, but overall productivity growth in agriculture along past trends is simply too low to cope with the increase in demand. In most regions that have already reached high levels of production and trade, yields have been growing very slowly.

Typically, global agriculture supply increases by 1 to 2 percent when prices increase by 10 percent.[5] In the new high-price situation, it is not clear how strongly farmers will respond. Farmers in Brazil, China, and India may be able to respond quickly owing to relatively strong infrastructure, services, and government capacity. Farmers in Africa, however, may be left further behind. In some regions, such as Central Asia, Eastern Europe, and Russia, the current high grain prices are attracting substantial foreign direct investments combined with technical, management, and marketing assistance in the agricultural sector, but the production response has yet to be seen.

The production response to high prices is impeded by land and water constraints, as well as by underinvestment in agricultural innovation and deficient agricultural banking. Land available for cultivation is limited, and the cost of bringing new land into production (including the environmental cost) can be high.[6] For instance, focus group discussions with farmers in Bangladesh in April 2008 reveal that even many marginal farmers and landless laborers have leased small pieces of land using cash that they borrowed at annual interest rates as high as 240 percent.[7] And some of them borrowed cash from nontraditional moneylenders such as shopkeepers, friends, relatives, and neighbors. Some landless laborers temporarily migrated to cities to earn money as rickshaw pullers to pay for inputs such as irrigation water and fertilizers. The financing of such food security actions by the poor needs further attention, and an expanded role of microfinance for investment as well as for temporary consumption credit should be considered.

Climate change will pose further threats to agricultural production in the long term, and weather conditions are currently an increasingly critical factor for prices and farmer risks. Adverse climate conditions (drought, excessive rain, flood, windstorm, frost, hail, sunburn, snow; pest and disease attack; and fire) can significantly disturb production and deplete farmers' assets. There is a need for an innovative response to the age-old policy problem of how to safeguard smallholders against weather-related income shocks—one example is the new generation of weather insurance systems. Crop insurance schemes increasingly cover high-value agriculture products in some developing countries, but extending these schemes to cereals would stimulate investment in the small-farm sector and stabilize incomes.

Accelerated innovation is needed to address the challenges; research and guaranteed output prices will be of

[5] Conclusions based on past analyses with data from the 1980s and 1990s must be interpreted cautiously because the elasticities should be expected to be non-linear.

[6] It is questionable how much arable land is available in practice and at what cost for future agricultural expansion. According to the FAO, twice as much land as that currently farmed is available for rainfed production. Much of the potential land, however, is in practice unavailable (forests, protected areas, human settlements, and infrastructure) or difficult to cultivate. Compared with 1997–99, arable land is projected to increase by 15 percent by 2015 in Sub-Saharan Africa and 10 percent in Latin America and the Caribbean. It is projected to stay constant in East and South Asia (FAO, *World Agriculture: Towards 2015/2030* [Rome: 2003]). In certain developed countries, especially in Europe, if policies regarding "set-aside" lands are changed, a bigger supply response is possible. In certain developing countries, such as India, increased irrigation investments can increase agricultural production by raising cropping intensity.

[7] Field observations by Akhter Ahmed (IFPRI) and DATA team, Dhaka, Bangladesh, April 2008.

critical importance for increasing yields. The South Asian Green Revolution experience shows that farm yields can double or even triple in a few years if modern seeds, irrigation, and fertilizers are combined with assured output prices. But growth in global public agricultural research and development (R&D) expenditures has slowed around the world and even declined during the 1990s in developed countries.

Favorable weather and rising agricultural production in the coming years could overcome the acute price crisis and allow for some rebuilding of stocks. It is also possible that production could overshoot demand, and policymakers should plan for the stabilization of food markets in this direction as well.

2. 4. Market and trade policy

Many countries are taking ad hoc steps, such as export restrictions and price controls, to try to minimize the effects of higher prices on their populations. As of April 2008, 15 countries,[8] including major producers, had imposed export restrictions on agricultural commodities. For instance, China has banned rice and maize exports, and India has banned exports of rice and pulses. Argentina has raised export taxes on soybeans, maize, wheat, and beef, and Ethiopia and Tanzania have banned exports of major cereals. Among the countries imposing new or additional price controls are Benin, China, Malaysia, and Senegal.

These steps can add up to policy failures. Policy responses such as export bans or high export tariffs may reduce risks of food shortages in the short term for the relevant country, but they are likely to backfire by making the international market smaller and more volatile. Export restrictions have harmful effects on import-dependent trading partners. For example, export restrictions on rice in India affect Bangladeshi consumers adversely and also dampen the incentives for rice farmers in India to invest in agriculture, which is a long-term driver of growth. In addition, export bans stimulate the formation of cartels, undermine trust in trade, and encourage protectionism. At the country level, price controls can also backfire by reducing farmers' incentives to produce more food and diverting resources away from those who need them most.

Other countries have contributed to the expansion of global food demand. Some net food-importing developing countries, for example, have reduced import barriers—in principle a welcome move toward more open trade but in practice a factor in the upward pressure on prices. Morocco has cut tariffs on wheat imports from 130 to 2.5 percent, Nigeria has slashed duties on rice imports from 100 to 2.7 percent, Peru has removed import taxes on wheat and maize, and Senegal has waived duties on cereal imports.

The increases in food prices now have a dominant role in increasing inflation in many countries. It would be inappropriate to address these specific inflation causes with general macroeconomic instruments such as monetary and interest rate policies, which have the potential to trigger a general slowdown and make the economic situation even worse. But the restrictive agricultural trade policies adopted by several developing countries also undermine the benefits of global integration, adding to the distortions already created by rich countries' longstanding trade policies. Agricultural globalization is put in "reverse gear," with adverse effects for the poorest nations. The WTO Doha Round still needs to be completed, and it would be a damaging side effect if the current crisis were to divert attention from that goal. Rule-based, fair, and free international trade is particularly needed in times of crisis, as the export ban problems underline.

2. 5. Speculation and market fundamentals

Formation of the actual food commodity prices is a result of real market conditions of supply relative to demand, expectations of future prices, and speculative participation in the market (including manipulative interventions). Thus there are three categories of "speculators"—(1) governments, farmers, households, small traders, and others whose speculation is not a major factor under normal conditions, but whose actions can add up to have large effects in a price crisis; (2) commercial traders who are hedging in futures markets and providing a useful risk management function; and (3) noncommercial traders who are seeking profits through speculation. Supply and demand fundamentals do not fully explain the recent drastic increase in food prices. Rising expectations, speculation, hoarding, and hysteria are among the additional factors that have played a role in the increasing level and volatility of food prices.

Yet speculation is mainly a symptom, not a major source of the current price crisis. The so-called speculators, as broadly defined here, actually include governments that react in excessively precautionary ways, small and large traders, farmers, and consumers that hedge informally and build up some storage. In Bangladesh, for instance, rice traders started releasing their speculative paddy (unhusked rice) and rice stocks in April 2008 in the market mainly in anticipation of a very good upcoming Boro paddy harvest and in response to the government's plans to build up its stocks by procuring a large quantity of Boro rice as it is harvested and as rice imports arrive.[9]

[8] Argentina, Bangladesh, Bolivia, Cambodia, China, Egypt, Ethiopia, India, Kazakhstan, Malaysia, Pakistan, Russia, Tanzania, Vietnam, and Zambia.

[9] Although India promised to export rice to Bangladesh earlier in 2008 despite its recently imposed ban on rice exports, the imports from India have yet to arrive.

The flow of speculative capital from financial investors into agricultural commodity markets has been a factor too. In the first quarter of 2008, the volume of globally traded grain futures and options increased by 32 percent compared with the same period in 2007.[10] The possibility cannot be excluded that "hot money" from the collapsing housing market has found its way into commodity markets, including the market for food futures. But there is no precise information on or analysis of the impact of speculative funds on food prices.

Low levels of stocks and ill-designed public policies foster speculation by many actors. Excessive speculation in the commodity futures market could, in principle, push up futures prices and spot prices (through arbitrage opportunities) above levels justified by fundamentals. Speculation is sometimes confused with hedging against risks, however, which stem from genuine concern about future supply and demand. Although commercial traders mainly enter into future markets for hedging purposes, noncommercial traders mainly speculate in search of financial profits.[11] The latter is not necessarily harmful because it indicates some investment opportunities in the agricultural sector. The countries imposing export controls, however, are indirectly harming the operational efficiency of the futures markets. In addition, in some countries, such as India, political forces are demanding that several agricultural commodities be suspended from futures trading.

Grain reserves could be used to prevent speculative attacks and correct for the misalignment between the underlying physical market and the futures market. Global cereal stocks, however—especially wheat—are at their lowest levels since the early 1980s.

III. The Impacts of High Food Prices on the Poor

Higher food prices have radically different effects across countries and population groups. At the country level, countries that are net food exporters benefit from improved terms of trade, although some of them are missing out on this opportunity by banning exports to protect consumers. Net food importers, however, struggle to meet domestic food demand. Given that most countries in Africa are net importers of cereals, they are hard hit by rising prices. At the household level, surging and volatile food prices hit hardest those who can afford it the least—the poor, including the 160 million ultra poor, who have incomes of less than half a dollar a day, and the food and nutrition insecure. The few poor households that are net sellers of food benefit from higher prices, but households that are net buyers of food are harmed. The net food buyers represent most of the world's poor and include the overwhelming majority of the urban poor. Adjustments in the rural economy through wages and capital inflows, which can create new income opportunities, will take time to reach the poor and vulnerable. Also, there is a real risk that large numbers of vulnerable people who had managed to escape absolute poverty in recent years will be unable to cope with the shock of rapidly rising food prices and will fall back into poverty.

Progress toward achieving the poverty and hunger Millennium Development Goal is compromised for some time to come. Progress on the goal of cutting hunger in half was disappointing even before the price increases set in. Three malign effects are of particular concern: (1) deterioration of the nutritional status of pregnant and lactating women and of preschool children; (2) the withdrawal of children, especially girls, from school; and (3) the distress sale of productive assets. All three have potentially irreversible consequences and compromise the future ability of individuals and households to escape poverty. For example, malnutrition that leads to stunting in preschool children directly affects their ability to learn in school and thus their ability to earn income as adults.

The food security and nutrition of the poor are at risk when they are not shielded from the price rises. Higher food prices lead poor people to limit their food consumption and shift to even less-balanced diets, with potentially harmful effects on their nutritional status and health in the short and long run. At the household level, it is common for the poor in developing countries to spend 50 to 70 percent of their budget on food, and a large proportion of the food budget on staple foods. Further, the poor tend to have remarkably monotonous diets, getting the vast majority of their caloric intake from staple crops and consuming little in the way of animal-source foods, fruits, or vegetables, which are rich in essential micronutrients.

Because of their economic circumstances, poor households are more responsive to changes in food prices than the wealthy, but there are variations across countries in the magnitude of this sensitivity. In Bangladesh rice accounts for 30 percent of total household expenditures and 48 percent of total food expenditures of the poor, which gives few options to adjust. In Vietnam the majority of the poor are found in rural areas, but because land holdings are relatively equitable, the adverse effects of higher rice prices in rural Vietnam are largely offset by the increased incomes these households receive for their rice production. By contrast, in Malawi,

[10] Chicago Board of Trade (CBOT). *A Global Trading Summary of Grain and Oilseed Markets* (Chicago: March 2008).

[11] In the past six months, the total number of long positions (that is, obligations to buy) by noncommercial traders as a fraction of the total reportable long positions by commercial and noncommercial traders for maize, wheat, soybeans, and rice has significantly increased, suggesting the possibility of a price bubble above what is justifiable by market fundamentals.

Zambia, and most Central American countries, higher maize prices adversely affect the poor in both urban and rural areas because even in rural areas, the poor tend to be net consumers of maize. In Nigeria poor or even lower-middle-income households are consuming less meat, rice, and maize and more cassava and yam as a response to the current food price increase. Overall, as prices continue to rise, the poor will experience a worsening of dietary quality and micronutrient intake, and the very poor will also experience decreased caloric intake.

Higher food prices not only lead to the deterioration of diets, but also significantly erode households' purchasing power. This loss affects the purchase of other goods and services essential for the health and welfare of household members, including heating, lighting, water, sanitation, education, and health care, all of which are important inputs into nutrition. The choices of coping mechanisms that poor households make will ultimately determine the severity of the impact of high food prices on their livelihoods and on the well-being of their members in the short, medium, and long term. Similarly, their access to social safety nets and other social protection schemes will also be a key determinant of the level of suffering they will experience. Productive safety nets that combine social transfers with production, such as public works, in many countries still reach only a small proportion of the poorest population. Ethiopia's safety net program, for example, which reaches 8 million people, covers approximately 25 percent of the poor. In Bangladesh—a country where 25 percent of the population is ultra poor—roughly 7 percent of the population has access to social protection or safety net programs.

People not only passively respond to food price inflation, but also increasingly turn to street protests and riots. The poorest suffer silently for a while, but the middle class typically has the ability to organize, lobby, and protest early on. Between early 2007 and May 2008, social unrest related to high food prices occurred in 30 countries.[12] Food price inflation has become a sensitive political and security issue.

IV. Proposed Policy Actions

The complex causes of the food and agriculture crisis require a comprehensive response. This situation calls for an international pact to achieve food and nutrition security with elements of global, regional, and national actions, all of which have shorter- and longer-term dimensions and need adequate sequencing. The actions proposed here are derived from the preceding analyses of the causes and consequences of the price increases and thus aim to address the acute human consequences of suffering among the poor and the current and past policy deficiencies that created and accelerated the crisis.

The obvious signals of the crisis are the drastic price increases and riots. That "information" is not enough, however, to point the way to sound policy actions. Governments and affected people need to be informed about the causes and implications of the current and emerging situation. The current developments have brought to the forefront the importance of food information systems. Appropriate monitoring mechanisms at the global, regional, and national levels will facilitate better responses. Such information must be available for decisionmakers on a regular basis and not only when a perceived problem has actually become acute. Although the urgency of the current food situation does not permit decisionmakers to wait for comprehensive information systems to be established before acting, coordinated information collection and sharing is needed to facilitate action.[13]

Although the current situation poses policy challenges on several fronts, there are effective and coherent actions that can be taken to help vulnerable people through humanitarian aid, trade, investment, and social protection policies. Some of these actions require international coordination, including the attention of the G8+5,[14] to work.

In view of the urgency of assisting people and countries in need, the policy actions suggested here are listed in two sets: an emergency package of actions to take immediately and a resilience package of actions to phase in now but whose impacts may take time. These actions do not mix general development policy agendas with the needed response to the current food price crisis, but actions that promise longer-term impact are nevertheless highly relevant. A focus on short-term crisis mitigation alone would fail to address the root problems and to bring the needed resilience into the food system.

This approach leads to eight major actions, all of which require immediate attention but whose impacts on the poor, on agriculture, and on the economy as a whole will differ

---

[12] Argentina, Bangladesh, Burkina Faso, Cameroon, China, Côte d'Ivoire, Egypt, Ethiopia, Guinea, Haiti, Honduras, India, Indonesia, Italy, Jordan, Madagascar, Malaysia, Mauritania, Mexico, Morocco, Mozambique, Pakistan, Philippines, Senegal, Somalia, South Africa, Trinidad and Tobago, United Kingdom, Uzbekistan, and Yemen.

[13] Such monitoring systems would include basic food consumption information, such as the prevalence of people forced to move from three meals a day to two or one; standardized household accounts (by rural and urban household groups and income classes) that can be used to assess price and income shocks; child weight-for-height information, which can indicate already acute problems; and expected crop production and changes in stocks.

[14] These are the Group of Eight countries (Canada, France, Germany, Italy, Japan, Russia, the United Kingdom, and the United States), plus the five leading emerging economies (Brazil, China, India, Mexico, and South Africa).

over time, ranging from immediate to future impacts. The first set of actions—the emergency package—will address immediate needs for food assistance and increased food availability. The second set of actions—the resilience package—will address the need to build a more resilient food system that can meet ongoing and future challenges.

The eight policy actions proposed are the following:

A. The emergency package

1. **Expand emergency responses and humanitarian assistance.** An urgent global response must include increased resources for humanitarian agencies. World preparedness to take action on food price crises must be improved. National emergency agencies typically respond to natural disasters and complex humanitarian emergencies but not to slow-onset disasters like this price crisis. This pattern must change. Emergency agencies need to adopt triggers that will activate them under crises like the current one. They need to invest more in preparedness and mobilize their often strong capabilities to monitor and assist the population groups that need to be targeted. National emergency agencies also need to collaborate with organizations that deal with chronic food, agriculture, and nutrition issues at the national level, similar to the effort now being pursued by the United Nations to improve global cooperation on food issues, with an important role for the World Food Programme (WFP). Given the nature of the price crisis, decisionmakers must give due attention to the urban poor. Food or cash transfers should be expanded and should target the poorest people, with a focus on early childhood nutrition, regions in distress, school feeding with take-home rations, and food and cash for work. Nongovernmental organizations (NGOs) and civil society organizations have an important role to play in the related actions.

   What could be expected from these measures? Targeted transfers will protect the food consumption levels of people served by existing programs. Increased funding would prevent further deterioration of food and nutrition security and increase emergency preparedness.

   Who would be the key actors? The UN, donors (for financing), humanitarian agencies, NGOs, and civil society organizations.

   Where is this action most relevant? Sub-Saharan Africa, Asia, and Central America and the Caribbean.

2. **Eliminate agricultural export bans.** The export bans among developing countries have created a new trade policy theater (see Section 2.4). Governments have a legitimate interest in caring for their citizens first. Hence there should be no illusion: the problem of export bans cannot be addressed country by country. Although the new wave of export restrictions requires urgent international attention, this issue should not be added to the WTO Doha Round. Instead, it should be addressed by an ad hoc forum of global players negotiating according to a code of conduct and in a spirit of mutual trust building. At the very least, export trade for humanitarian purposes should be reopened now even before a forum is convened.

   What could be expected from these measures? The elimination of export bans will stabilize grain price fluctuations, reduce price levels by as much as 30 percent,[15] and enhance the efficiency of agricultural production.

   Who would be the key actors? G8+5 and subregional organizations.

   Where is this action most relevant? Global impact; Asia, Sub-Saharan Africa, and Central America.

3. **Undertake fast-impact food production programs in key areas.** Short-term action to promote agricultural growth requires access to seeds, fertilizers, and credit for the small farm sector—in other words, the traditional "Green Revolution" package (see Section 2.3). Today, good seeds for rainfed agriculture, especially in Africa, are essential for expanding production. Also, small farmers should have access to procurement programs for their agricultural products at guaranteed minimum prices that reflect long-term international market prices.[16] Carefully subsidized programs for seeds, fertilizers, irrigation, electricity, and water should involve the private sector from the beginning and facilitate a transition from initial "crash programs" to market-based arrangements. Such subsidized programs should be focused on and limited to least-developed countries. The timing of these actions is crucial for

[15] These IFPRI modeling results from the MIRAGE model should be taken as a conservative estimate. IFPRI models factor in neither speculation over and above market fundamentals nor the increased price impacts of any quantity change in the much narrower international market.

[16] This procurement should not involve support pricing of a protectionist nature, but rather assurance of stable output prices.

achieving a rapid production stimulus for smallholder agriculture and the small business sector serving agriculture. Banking and finance are also critical for success. These short-term programs should have clearly defined and communicated exit strategies.

Even though the production response should be quick, it needs to be driven largely by higher yields rather than area expansion (see Section 2.3). Programs that set aside agricultural resources in industrialized countries, except in well-defined conservation areas, should be terminated where this has not already been done.

What could be expected from these measures? Fast-impact production programs would jump-start agricultural growth in the short term, create income-earning opportunities in the crisis, and lower prices.

Who would be the key actors? Donors, regional organizations such as the African Union and the New Partnership for Africa's Development (NEPAD), NGOs, and civil society organizations.

Where is this action most relevant? Sub-Saharan Africa and some selected Asian countries.

4. **Change biofuel policies.** A range of measures should be considered to make more grains and oilseeds currently used for fuel available for food and feed. These measures include freezing biofuel production at current levels, reducing it, or imposing a moratorium for biofuels based on grains and oilseeds (that is, temporarily suspending the use of grains and oilseeds for biofuel production) until prices come down to reasonable levels according to long-run supply and demand. Such a moratorium is not costless; it might require compensating investors that were led into this fast-expanding sector as a result of current policies. At the same time, more support should go toward developing bioenergy technologies that do not compete with food.

What could be expected from these measures? A grain-based biofuels moratorium would quickly unlock grains and oilseeds for food. This measure might bring maize prices down by about 20 percent and, as a consequence, decrease wheat prices by about 10 percent.[17] Price reductions could also be generated by removing blending mandates, import tariffs, and biofuel blending subsidies in the United States and Europe.

Who would be the key actors? Countries in the Organization for Economic Cooperation and Development (OECD) and others that have moved heavily into grain- and oilseed-based biofuels.

Where is this action most relevant? Global impact; Asia, Sub-Saharan Africa, and Central America.

B. The resilience package

5. **Calm markets with market-oriented regulation of speculation, shared public grain stocks, strengthened food import financing, and reliable food aid.** Speculation is mainly a consequence, not a cause, of the price crisis, so overregulation and market policing would be inappropriate responses. Surveillance and regulatory measures, however, such as monitoring speculative capital or limiting futures trading,[18] should be taken to curb excessive speculation in agricultural commodity markets.

Under the current tight market conditions, it is infeasible to accumulate a global stock of grain that would bring the desired calming effect into the markets. The needed incremental supply is missing. Agreements on joint pooling of fixed portions of national stocks at the regional or global level would seem feasible, however. A coordinated set of pledges for a modest grain reserve to be made by the main grain-producing countries (including coordinated releases from the reserve for regional emergencies when prices increase excessively over what market fundamentals indicate) should be established at global or regional levels. A global intelligence network should inform the management of these international coordinated reserves.

The Food Aid Convention should be renegotiated and reformed, while current grain delivery and cash commitments should be expanded. An accompanying option could be a finance facility, provided by the International Monetary Fund (IMF), for imports by countries in food emergencies.

What could be expected from this initiative? The pooling of global or regional public stocks, complemented by an import-financing facility, would allow countries with greater food deficits in a particular

[17] These are conservative estimates: in a tight market the price decrease will be greater.

[18] Policymakers could set maximum limits on trading positions, increasing the margin deposit requirements to minimize speculative capital.

region to gain access to food supplies at reasonable and stable prices in times of crisis. It would also help contain the speculative expectations that fuel further price rises during the upswing. But such reserves have costs, depending upon their size, which need to be carefully weighed against potential benefits.

Who are the key actors? The IMF, OECD countries, subregional organizations, and commodity exchanges.

Where is this action most relevant? Asia (for rice), Latin America, Sub-Saharan Africa, North Africa, and the Middle East.

6. **Invest in social protection.** Comprehensive social protection initiatives are required to address the risks facing the poor due to reduced access to food as a consequence of high prices (see Section III). A hierarchy of appropriate social protection interventions includes both protective actions to mitigate short-term risks and preventative actions to preclude long-term negative consequences. Introducing or scaling up these interventions is complex, associated with substantial costs, and dependent on knowledge base and capacity.

   At the core of the protective actions are conditional cash transfer programs, pension systems, and employment programs. These programs exist in many low-income countries and should be scaled up. Where such interventions do not exist, targeted cash transfer programs should be introduced in the short term. If food markets function poorly or are absent, however, providing food is a better option than providing cash.

   Microfinance, which includes both credit and savings, is also advisable to permit the poor to avoid drastic actions such as distress sales of productive assets that can permanently damage their future earning potential. The large global networks of microfinance institutions should consider responding to the price crisis by temporarily loosening repayment conditions, as the poor need access to food consumption credit and debt relief.

   Preventative health and nutrition programs targeted to vulnerable population groups (such as mothers, young children, and people living with HIV/AIDS) should be strengthened and scaled up to ensure universal coverage. This measure is essential to prevent the long-term consequences of malnutrition on lifelong health and economic productivity. In addition, school feeding programs can play an important role in increasing school enrollment, retaining children in school, and enhancing their academic achievement.

   Interventions should be coordinated with the emergency actions already mentioned (action 1). Many of these actions must take place at the national level, but many countries lack the resources to implement them. Donors should expand support for such programs in conjunction with sound public expenditure reviews.

   What could be expected from these measures? These steps can prevent the long-term adverse consequences of early childhood malnutrition, protect the assets of the poor, and maintain school participation rates.

   Who would be the key actors? The UN, national governments, donors, NGOs, and civil society organizations.

   Where is this action most relevant? Asia, Latin America, Sub-Saharan Africa, North Africa, and the Middle East.

7. **Scale up investments for sustained agricultural growth.** To transform the crisis into an opportunity for farmers and to build resilience to future food crises, a transition to viable long-term investments in support of sustained agricultural growth is urgently needed. Such investments are particularly needed in view of the emerging stress factors for agriculture from climate change that threaten to perpetuate the current crisis. Investments for sustained agricultural growth include expanded public spending for rural infrastructure, services, agricultural research, science, and technology.

   New and innovative crop insurance mechanisms should be introduced and tested at a larger scale. Information technology, improved weather data, and the expected high returns to insurance make innovation in this field now much more feasible.

   Developed countries should facilitate the sharing of agricultural innovation and research that are relevant to enhancing productivity and transforming small-farm agriculture. A scaled-up Consultative Group on International Research (CGIAR) has a key role to play in expanding global and national agricultural research systems geared to poor small-scale farmers.

   The recently expanded investments in agriculture in, for instance, China and India must be sustained at high levels. Also, African leaders must implement their commitment to allocate 10 percent of their budgets to agriculture as soon as possible in order to achieve much-needed agricultural growth to meet poverty and hunger reduction targets.

The needed supply response is not just a matter of the farm-level expansion of production, but must comprise the whole food value chain, with private sector actors in the food-processing and retail industries playing key roles. New—and much broader—concepts of corporate social responsibility are called for.

What could be expected from these measures? These investments would have high returns not only in terms of agricultural growth, but also in terms of poverty reduction in both rural and urban areas through increased production and employment and lower food prices.

Who would be the key actors? Donors, regional organizations, OECD countries, foundations, and the private sector.

Where is this action most relevant? Asia, Sub-Saharan Africa, and Latin America.

8. **Complete the WTO Doha Round.** The completion of the WTO Doha Round is even more relevant in times of high food prices in order to strengthen rule-based trade. A world short in supply and facing regional and country-specific fluctuations needs more options to trade, not less.

   It should be easier for countries to agree to lower agricultural tariffs when market prices, especially for sensitive commodities, are high. With high global food prices, there may be no need to provide large domestic support or export subsidies to farmers in developed countries. The EU has already eliminated its applied tariffs on cereals, but it has not yet decreased its bound tariffs, which means that there is no certainty about these levels in the long term. Similarly, U.S. farmers are holding tight to low loan rates and countercyclical payment programs despite the fact that they are projected to benefit little from them in the coming years. Policymakers in developed countries want to keep their options open in case prices fall. The current food situation should be viewed, however, as an opportunity to introduce major changes in the agriculture negotiations pertaining to market access, domestic support, and export subsidies.

What could be expected from these measures? If these opportunities are realized, they would lead to more fair and open trade, more efficient resource use, and higher welfare for people in developing countries. They would also have a stabilizing effect on agricultural prices and help prevent future crises.

Who would be the key actors? The WTO and OECD countries.

Where is this action most relevant? Global impact; Asia, Sub-Saharan Africa, and Latin America.

V. Resource Mobilization and Implementation

The humanitarian, economic, political, and security benefits of the proposed actions are huge and can hardly be calculated in monetary terms. This brief therefore makes no attempt to compile the costs of these needed actions. The pledges so far made by international agencies, however—as significant and important as they are—seem far below the needs, especially for the actions outlined under the "resilience package."

Investment in these actions calls for additional international resources and reallocation of resources at the national level. More international development assistance is needed to implement actions in low-income countries that lack both strong implementation capacity and resources for transfers to the poor and for investment. And where should these additional resources come from? Four domains should be considered for resource mobilization:

1. The countries that are large winners from the commodity boom should be confronted with the ethical call to share their new wealth with the poorest. Although such a step is partly a call for charity, it is also a sound use of capital for long run investment. These winners include not only oil- and mineral-rich countries, but also countries rich in agricultural export potential.

2. The community of wealthy donor countries—traditional and new—should expand their development assistance for agriculture, food, and nutrition along the action agenda described.

3. Within the affected countries—even low-income countries—budget reallocation and appropriate direct or indirect progressive taxation is needed to finance the mitigation of the impacts of the price crisis on the poor.

4. Most of the investment needs in agriculture will require mobilizing private sector finance, including through improved outreach of banking in rural areas, which requires additional support by public finance.

Implementation of the proposed actions requires global and regional cooperation. The ultimate responsibility for responding to high prices rests at the national level. Because of countries' diverse situations, the design of programs must be country driven and country owned, and accountability

for sound implementation must also rest with countries. Especially at the country level, prioritization and sequencing are crucial for successful implementation of these eight action points.

The current organizational setup for agriculture, food, and nutrition at the international level has failed to prevent the crisis. A new international architecture for governance of agriculture, food, and nutrition is needed in order to effectively implement these initiatives, and especially their international public goods components.[19] Such a new architecture needs to explicitly engage the new players in the global food system—the private sector and civil society, including large foundations—together with national governments and international organizations such as the UN agencies. One approach might be to establish a superstructure (for example, a panel appointed by the UN leadership) to guide changes across the existing specialized institutions and organizations and their partners.

Countries with leading roles in the global agricultural system—which now go beyond the United States and European countries to include Brazil, China, India, and others—must be involved. Indeed, leadership could well come from the developing countries, and not just the largest ones.

Within governments, more structured networks could be created between institutions. Such steps are beginning to be taken in some fields, such as public health, but not much yet in the areas of food, agriculture, and nutrition. There is scope to form innovative government networks and strengthen government-to-government systems for decisionmaking in agriculture, food, and nutrition.

Although governance reform for agriculture, food, and nutrition needs to be on the agenda as part of the described "resilience package," the acute situation does not permit decisionmakers to wait for such reform. Global and national action is needed now, through existing mechanisms, well-coordinated special initiatives, and possibly a special fund.

VI. Outlook

Continued population growth, expanding demand due to income growth, and emerging climate change point to the future challenges for agriculture production. Without deep action now, the current food price crisis merely foreshadows the events of coming decades. The high agricultural prices imply a fundamental revaluation of agricultural production and the natural resources it depends on, especially land and water. The challenge is to soundly manage the transition to the new economics of agriculture and the food system and to facilitate stable supplies and prices that offer long-term incentives for agricultural production and help protect the poor. Science plays a key role in this transition in the long run. Although long-term price trends should be allowed to govern resource allocation, steps should also be taken to reduce short-term cyclical volatility. All of these goals make up a complex long-term agenda. When the current crisis ends, policy must not return to business as usual. If it does, the next crisis will hit even harder.

[19] See Joachim von Braun and Nurul Islam, "Toward a New Global Governance System for Agriculture, Food, and Nutrition: What Are the Options?" in *IFPRI Forum*, March 2008.

Joachim von Braun is director general of IFPRI. **Akhter Ahmed** is a senior research fellow in the Food Consumption and Nutrition Division of IFPRI. **Kwadwo Asenso-Okyere** is director of the ISNAR Division. **Shenggen Fan** is director of the Development Strategy and Governance Division. **Ashok Gulati** is director in Asia of IFPRI (New Delhi). **John Hoddinott** is deputy director of the Food Consumption and Nutrition Division. **Rajul Pandya-Lorch** is head of IFPRI's 2020 Vision Initiative and chief of staff, Director General's Office. **Mark W. Rosegrant** is director of the Environment and Production Technology Division. **Marie Ruel** is director of the Food Consumption and Nutrition Division. **Maximo Torero** is director of the Markets, Trade, and Institutions Division. **Teunis van Rheenen** is IFPRI's coordinator for Partnerships and Impact Assessment. **Klaus von Grebmer** is director of the Communications Division.

Printed on alternative-fiber paper manufactured from agriculturally sustainable resources that are processed chlorine-free (PCF).

The Role of Biofuels and Other Factors in Increasing Farm and Food Prices

A Review of Recent Developments with a Focus on Feed Grain Markets and Market Prospects

Written by Keith Collins, Ph.D. (economic advisor, Keith J. Collins LLC) as supporting material for a review conducted by Kraft Foods Global, Inc. of the current situation in farm and food markets, June 19, 2008.

Contents

Executive Summary

Farm and Food Price Increases. Farm-level prices have increased sharply over the past two years. The index of prices received by farmers for all farm products increased by 34 percent over the period January 2006 through May 2008. The index of prices received for feed grains and hay, led by surging corn prices, increased by 144 percent over that period. High prices for farm products have led to significant retail food price increases, rising 4.9 percent during 2007, the highest increase in 17 years.

Factors Behind the Increases. Many factors are contributing to higher farm-level and retail food prices. They include: (1) strong global economic growth, thereby increasing demand for U.S. commodities; (2) the declining value of the dollar, although recent real trade-weighted exchange rates suggest that the weakened dollar has been less important to corn and other key crops; (3) reduced supplies of some crops, such as wheat and rice, due to adverse global weather; (4) higher energy prices that have increased farm production costs and food processing and distribution costs; (5) changing foreign agricultural policies that insulate countries from higher global prices; (6) increased investment by index funds and other managed investments that probably have increased price volatility but are not likely to have sustained effects; and (7) biofuels, particularly corn-based ethanol. Biofuels have been a major factor for feed grain and livestock markets, with corn used in ethanol rising from 2.1 billion bushels in 2006/07 to an expected 4.0 billion in 2008/09. This increase in corn for ethanol production exceeds the entire expected increase in total corn demand over this period.

Role of Ethanol. The expected increase in corn used as a feedstock in ethanol plants from 2006/07 to 2008/09 is equivalent to the production of corn on about 12 million acres. The increase in corn demand due to ethanol is rising faster than growth in corn yields per acre. So long as that situation continues, corn will have to attract acreage from other crops to meet its expanding demand. This shift will mean higher prices for all crops that compete, directly or indirectly, for acreage with corn. The market projects a continually tight corn supply and demand balance for the next several years, evidenced in current high cash prices and futures prices for the next several years.

This paper reviews various studies that have examined the relationship between corn used in ethanol production and corn prices. They suggest increased corn demand for ethanol could account for 25 to 50 percent of the corn price increase expected from 2006/07 to 2008/09. Another analysis presented in the paper suggests that ethanol could account for 60 percent of the expected increase in corn prices between 2006/07 and 2008/09 when market demand and supply are inelastic with respect to price—i.e., a period when stocks are very low, feed use is slow to respond, export demand is strong due to foreign agricultural policies, and acreage is very constrained.

Ethanol drivers. There are two important factors that have increased the price of ethanol. First, high crude oil prices and correspondingly-high gasoline prices have helped establish the current level of ethanol capacity. Second, Federal biofuels policies are encouraging continued ethanol production even with record-high and steadily rising corn prices. The ethanol tariff limits U.S. access of foreign supplies; the tax credit enables ethanol producers to pay the equivalent of up to $1.43 more per bushel for corn used as feedstock; and the Renewable Fuel Standard (RFS) mandates steady, undeviating annual increases in ethanol demand. These requirements must be met regardless of what happens to the prices of oil, ethanol, or corn. The RFS is likely to be an increasingly important factor in determining the direction that ethanol and corn prices will take over the next several years. The rate-of-return received by ethanol plants has been declining over the past year as corn prices have increased, and ethanol prices, excluding the tax credit, have declined to a level that reflects their energy (BTU) value relative to

gasoline prices. Without Federal biofuels incentive programs, it is increasingly likely that the RFS levels of ethanol production would not be realized with this year's expected decline in corn supplies.

Extraordinarily Low Feed Grain and Oilseed Stocks. With Federal biofuels programs assuring future expansion of corn for ethanol production, the corn and soybean supply/demand balance is expected to be very tight. Unless quantities demanded for exports, feed, seed, and food uses drop below the recent average levels and/or acreage expands beyond similar levels, corn and soybean inventories will fall to historic lows. These reserves provide the industry with a cushion to protect against low yields and adverse weather. Without sufficient reserves, any disruption will result in significant price increases, placing all users at substantial business risk, including livestock and poultry producers and many ethanol plants.

Food Price Effects. The increase in farm-level prices has contributed to higher retail food prices, which were up 6.9 percent at a seasonally-adjusted annual rate during the first 4 months of 2008. This increase compared with a 4.9 percent increase during 2007. Food price increases have exceeded forecasts, and many studies offer various conclusions about the causes for these increases and the prospect of future food prices. Higher energy prices, overall inflation, and biofuels are major contributors to recent food price increases. This latter factor – biofuels – is likely to have more of an impact over the next few years as meat production slows due to higher feed costs.

One way to gauge the potential increase in food prices due to biofuels is to estimate the increase in costs for livestock producers and other U.S. users of feed grains and oilseeds. If these costs are fully passed on through the food chain, they eventually will be reflected in higher retail food prices. For example, assume, as this paper suggests, that 60 percent (or $20 billion) of the expected increase in feed grain and oilseed product costs between 2006/07 and 2008/09 is accounted for by biofuels. These increases, in turn, translate into increased U.S. personal consumption expenditures on food, over a 2-3 year period, of 1.8 percent. While 1.8 percent may, on its face, appear small, it must be viewed in the context of the long-term annual average increase in food prices of about 2.5 percent per year. Thus, the increase in retail food prices due to biofuels is estimated to be 23-35 percent above the normal increase in food prices that would occur over 2-3 years. Accordingly, biofuels is now becoming a significant factor in higher food prices.

Policy Options. There are several global options for addressing extraordinarily low commodity stocks and higher farm and food prices. Governments could take actions to increase worldwide food production and increase investment in agricultural research and adoption of biotech seeds and other technologies. U.S. Federal biofuels policy could also be reconsidered.

As discussed, with ethanol plant margins declining over the past two years and corn prices soaring, tax credits and the RFS mandate will increasingly keep ethanol production capacity expanding, plant utilization high, corn prices rising, livestock producers under stress, and pressure on food price inflation. Government support for corn-based ethanol ensures a permanent, significant, and increasing demand for corn. These policies interfere with the normal price rationing function of markets when supplies are short. This is the situation today with production being reduced by flooding and excess moisture. In this "short-crop" environment, biofuels policy, including the RFS mandated use, causes even higher corn prices, eliminates the need for ethanol producers to adjust production based on market conditions, and shifts that burden to other users of corn (e.g., the livestock sector), and puts continuing pressure on retail food prices.

Therefore, the Federal Government should give serious consideration to whether (1) biofuels programs should be permitted to intervene significantly in corn and soybean markets, or (2) consumers, acting through market forces, should be the primary mechanism for allocating crops between food and fuel uses, with Government-supported biofuels programs functioning only as a safety net for biofuel producers.

The Role of Biofuels and Other Factors in Increasing Farm and Food Prices

A Review of Recent Developments with a Focus on Feed Grain Markets and Market Prospects

Introduction

Global grain market prices have increased sharply over the past two years. The increases have caused food protests and riots, threatening government stability in many developing countries. In the United States, the index of prices received by farmers for all products increased by 34 percent from January 2006 to May 2008 (U.S. Department of Agriculture (USDA), National Agricultural Statistics Service). The index of prices received for feed grains and hay, led by surging corn prices, increased 144 percent over that period. The large increases have raised questions about the causes, effects on market participants, impacts on food prices, and the likely direction of commodity and food prices for the future.

Many factors are contributing to higher farm-level and retail food prices. Rising demand for corn and vegetable oils for biofuel production have been identified as an important cause, generating controversy over the magnitude of the effects on farm and food prices. Expanding biofuel production increases the demand for corn and vegetable oils, increases prices of products that use them as ingredients, and increases prices of other crops that compete with corn and oilseeds for acreage. This paper reviews the factors affecting commodity and food price increases with a focus on biofuels and corn.

The search for more diversified U.S. energy supplies and stronger farm and rural incomes led to Federal programs to increase the production, distribution, and use of biofuels. Advances in corn and ethanol production technologies and improving technical and economic efficiencies of converting biomass into ethanol, have been a basis for increased Federal tax credits, loans, loan guarantees, grants, research, and tariffs for, and mandatory use of, biofuels. Rising oil prices, weather problems, and strong export demand for U.S. crops have combined with Federal biofuels programs to tighten the production/use balance of corn and increase corn prices well beyond recent projections of market analysts.

The surge in corn demand has been reducing the quantity of corn available in storage at the end of the marketing year to low levels. Carryover stocks are now expected to reach historically low levels, setting up the possibility of severe corn market imbalances in 2008/09 that will likely eliminate any disaster reserve and continue to push farm-level corn prices well beyond previous record highs. In such a tight market environment, the price effects of a sharp increase in demand for biofuels will be amplified, compared with a market that has more readily available supplies. These major market changes are occurring while corn ethanol use is just only slightly above one-half the level of use mandated for 2015 by the Renewable Fuel Standard (RFS) under the Energy Independence and Security Act of 2007 (EISA).

As farm-level prices have increased over the past two years, retail food prices have increased. During 2007, the Consumer Price Index (CPI) for food increased 4.9 percent (December 2007 over December 2006), compared with an increase of only 2.1 percent during 2006 (U.S. Department of Labor (DOL), p. 5). The 2007 increase was the highest in 17 years. And, food prices continue to increase, with the food CPI up 6.9 percent at a seasonally adjusted annual rate for the first 4 months of 2008. While a series of events have caused the recent increases in food prices, DOL notes, "Price increases for food can be attributed primarily to increases in ethanol production, exports, and energy prices" (DOL, p. 5). Because

biofuels affect prices for animal feeds, much of their impact on food prices has yet to be realized. As biofuel expansion continues, animal producers will reduce production and increasingly pass on higher feed costs to consumers in the form of higher prices for meats and other animal products.

The Road to Record-high Corn Prices

Prior to the 1970s, when the Former Soviet Union began importing large quantities of grain, farm-level corn prices were fairly stable and averaged between $1 and $1.50 per bushel annually. Since then, corn prices have been higher and more variable, typically setting new highs that last for one year and then pulling back as temporary demand surges pass, or, more usually, as production increases following weather-reduced production.

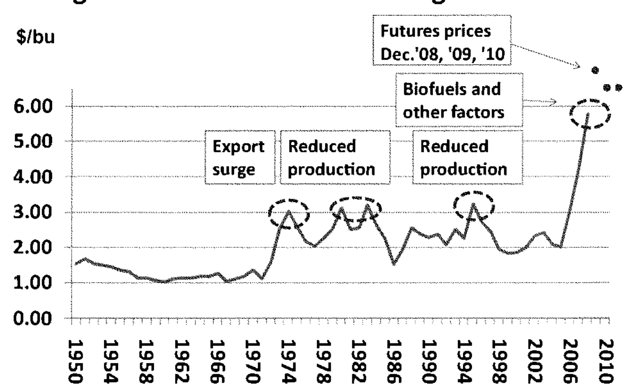
Figure 1 illustrates the price history and includes USDA projections and futures prices as of June 10, 2008 (USDA, WASDE). During the 1974 crop year as global grain demand increased sharply, season-average corn prices received by farmers set a then-record high of $3.02 per bushel. Two years later, however, prices averaged $2.15, a decline of nearly 30 percent.

In the 1980 crop year, the next record-high corn price was set at $3.11 per bushel when weather reduced corn yields. Again, two years later, corn prices averaged $2.55, nearly 20 percent lower.

In 1983, low yields again pushed corn prices to another record high at $3.21 per bushel. But prices declined 30 percent to $2.23 two years later.

In 1995, the next record-high corn price was reached at $3.24 per bushel, as weather again reduced production. This record prevailed until 2007. But three years after the 1995 record was achieved, corn prices had fallen 40 percent to $1.94 per bushel.

Fig. 1. U.S. Corn Season-Average Farm Price



This pattern of a sharp rise in corn prices followed by a rapid decline now appears to have ended. Corn farm prices reached a near-record high of $3.04 per bushel for the 2006 crop year and are estimated by USDA to average a new record-high of $4.35 per bushel for the 2007 crop year. During May 2008, the U.S. average farm-level corn price was $5.12 per bushel. In February 2008, USDA forecast that the U.S. average corn price for the 2008 crop year would set yet another record high of $4.60 per bushel (Ash). By June 2008, USDA had raised its 2008 crop year forecast of the U.S. average corn farm price to $5.80 per bushel.

Other forecasters also see continued high corn prices. The Food and Agriculture Policy Research Institute (FAPRI) projected in early March 2008 that the corn farm price for the 2008 crop year would average $3.90 per bushel (FAPRI). In April 2008, the ProExporter Network, a consultant to the grain and ethanol industry, issued a farm price forecast for the 2008 crop year of $6.00 per bushel (ProExporter Network), which incorporated the lower-than-expected 2008 planting intentions for corn reported in USDA's Planting Intentions survey released on March 31, 2008.

Key Factors Affecting Corn and Other Crop Prices

It is impossible to give precise estimates of the impacts of each of the many factors affecting corn or other major crop prices. Many recent studies have reviewed developments in markets and identified key factors (e.g., Trostle, Schnepf). This section identifies the major contributors to grain and oilseed price increases.

Expanding foreign incomes. Strong foreign economic growth has raised demand for U.S. exports and contributed to higher corn, other grain, and oilseed prices (von Braun, 2008a). During 2003-2007 global economic growth was unusually strong with the annual average real GDP rising 4.6 percent (IMF), compared with 3.2 percent in the prior 5 years. In emerging and developing economies, annual average real GDP increased 7.3 percent, compared with 4.1 percent in the prior 5 years. Emerging middle classes, changing diets, and high income elasticities of demand for food in emerging and developing economies all contributed to strong demand for food such as meats and grains.

The declining value of the dollar. A weaker U.S. dollar has contributed to higher corn, other grain, and oilseed prices by helping to maintain U.S. export demand in the face of higher commodity prices. For example, between 2001 and 2007, the nominal value of the dollar declined against the Euro by 35 percent (USDA Economic Research Service (ERS), 2008b). However, some discussions of the role of the weaker dollar have not taken account of all factors related to the dollar's depreciation.

A different picture emerges when the foreign exchange value of the dollar is adjusted for the relative rates of inflation in the United States and other countries that buy grain and oilseeds from the United States. For example, the ERS index that averages the inflation-adjusted currencies of countries that import U.S. corn (weighted by each country's share of U.S. corn exports) was down from over 113 in 2002 (the peak year in the 2000s) to about 107 in 2007, a depreciation of 5 percent. Between 2005 and 2007, the period of greatest corn price increases, the real corn export-weighted exchange rate actually increased 2.6 percent. The real corn exchange rate index, when weighted by the currencies of U.S. competitors in the global corn market, was down 19 percent between 2002 (the peak year in the 2000s) and 2007. But between 2005 and 2007, the real corn competitor-weighted real exchange rate was down 1.5 percent.

Thus, during a period when corn prices sharply increased, the real corn exchange rate changes were small in comparison. There is little doubt that over time the declining value of the dollar has increased export demand for corn and contributed to corn price increases, but the impact is not as large as suggested by the nominal depreciation against currencies such as the Euro.

Higher prices for other crops. The price of one grain or oilseed is affected by changes in the prices of other grains or oilseeds. For example, corn substitutes with sorghum, barley, and oats in feed rations. Prices of the four feed grains move closely together, but since corn dominates total feed grain supply and demand, changes in the markets for the other feed grains have only small effects on corn, but changes in the corn market have a large effect on the other feed grains. Oilseed meals can serve as a complement and substitute for corn and therefore affect corn prices. However, high oilseed prices were not the major cause of high corn prices. Reduced corn production in 2006 and stronger demand for corn increased corn prices, which led to a large shift from soybean acreage into corn acreage in 2007. That shift was a major factor which drove up soybean and soybean product prices. Demand for soybean oil for biodiesel also contributed importantly to the oilseed price increase.

Increased U.S. animal numbers. U.S. animals that consume grain have increased in recent years and have increased the demand for grain and oilseeds for feed use. The index of grain consuming animal units (U.S. animal numbers weighted by their share of grain consumption) was up 5.3 percent from 2005 to 2007. This suggests that, other things equal, feed and residual use of feed grains would be up 5.3 percent during this period, or about 325 million bushels for corn, which would have a fairly small price effect.

Weather effects. During the past several years, adverse weather has contributed to commodity price increases. The World Bank suggests that the price effects were not major noting, "Other developments, such as droughts in Australia and poor crops in the E.U. and Ukraine in 2006 and 2007, were largely offset by good crops and increased exports in other countries and would not, on their own, have had a significant impact on prices" (World Bank, p. 1). However, global weather effects on production appear most notable for wheat but less so for rice and minimal for corn. For corn, foreign production has increased from 415 million tons in 2005/06 to 446 million tons in 2006/07 to an estimated 458 million tons in 2007/08. U.S. corn yields have been close to trend levels during these years.

Changing foreign agricultural policies. Changing foreign agricultural policies have contributed to global commodity price increases. Numerous countries are reported to have taken actions to insulate their domestic markets from high commodity and food prices. For example, the International Food Policy Research Institute notes, ". . . China has banned rice and maize exports; India has banned milk powder exports; Bolivia has banned the export of soy oil to Chile, Colombia, Cuba, Ecuador, Peru, and Venezuela; and Ethiopia has banned exports of major cereals. Other countries are reducing restrictions on imports: Morocco, for instance, cut tariffs on wheat imports from 130 percent to 2.5 percent; Nigeria cut its rice import tax from 100 percent to just 2.7 percent" (von Braun, 2008b, p. 2). Generally, these actions include reducing import barriers, subsidizing domestic consumption, and halting or taxing exports. These actions prevent reductions in consumption that would otherwise be caused by higher prices, and they reduce supplies available to world buyers. The effect of the actions is to transmit increased prices and price volatility to countries that are not insulating their markets. For U.S. grain and oilseeds, the effect is primarily felt through U.S. exports being higher and less responsive to price changes than they would be otherwise.

Higher energy prices and U.S. farm production costs. Increases in farm production costs can raise commodity prices. U.S. average corn operating costs increased from $186.37 per acre in 2005 to $229.61 per acre in 2007, mainly due to higher energy costs (USDA ERS, 2008a). While higher production expenses, if sustained, are most likely to have longer term effects on commodity or food prices, several adjustments may partly offset their market price effects. First, higher costs reduce producer returns and the reduction may be reflected in lower farm land prices and rents. Second, producers may make production adjustments that lower input costs. Third, increases in productivity will also offset higher production costs per acre. For example, corn yield per planted acre increased slightly between 2005 and 2007, making the operating costs $1.25 per bushel in 2005 and $1.52 per bushel in 2007, an increase of 22 percent or $0.27 per bushel over two years. Fourth, higher energy prices can also contribute to lower farm-level prices by raising transportation costs to markets, such as ocean shipping costs. These distribution costs can be partly passed back to producers as wider basis or lower farm prices than would otherwise be the case.

Increased financial investment in commodity markets. Open interest in agricultural contracts on commodity exchanges has increased, but new futures market participants seem unlikely to be a major cause of persistently higher grain prices. Activity by money managers, such as index funds, has increased sharply. This has raised concerns that new players in the market have increased crop price levels and volatility. The Commodity Futures Trading Commission (CFTC) held an all-day hearing to examine the performance of futures markets in price discovery and hedging (CFTC). While there has been less efficient convergence between futures and cash markets for some contracts at some times, there is no clear indication that new investors are responsible for sustained higher corn prices. Futures and cash markets still generally converge and the hearing identified some actions that could improve convergence and basis predictability. CFTC is continuing to review this issue and accepted comments from the public through May 7, 2008.

A recent Government Accountability Office (GAO) review of increased managed-money investments in crude oil is instructive for crop markets. GAO notes that the views of market participants and other experts are mixed, with some arguing large speculative purchases could lead to higher prices, while others believe speculative activity does not have significant price impacts. GAO states, "Still others told us that while speculative trading in the futures market could contribute to short-term price movements in the physical markets, they did not believe it was possible to sustain a speculative "bubble" over time, because the two markets were linked and both responded to information about changes in supply and demand caused by such factors as the weather or geographical events." (GAO, 2007b, p. 13).

In agricultural as in energy markets, if new investors on the long side are bidding up prices well beyond the fundamentals of physical supply and demand, there is an opportunity for arbitrageurs to take short positions and physically deliver against futures contracts, which would move futures prices toward fundamentals of the market. The increased activity in futures markets is a reaction to tightening fundamentals and higher commodity prices and price volatility. Investors and traders are not creating the environment that is increasing farm prices; they are reacting to the opportunity presented by tight markets to invest funds to earn a return as prices move higher, due to the factors identified in this section.

Expectations of ever tighter markets. Expectations of even tighter markets in the future are likely being reflected in current prices, especially for corn and soybeans. The very sharp increases in corn cash and futures prices in late 2007 and early 2008 may also reflect expectations by market participants that there will not be quick relief from tightening supplies. While global wheat production is expected to be

much higher in 2008/09, and wheat prices likely lower with a return to global trend yields, the corn market is moving toward increased tightness in 2008/09 (USDA, WASDE). USDA expects that another large increase in corn use in ethanol and reduced corn acreage during 2008/09 will lead the second lowest level of stocks relative to consumption in 49 years. The average U.S. corn price received by farmers is forecast at $5.80 per bushel. Although soybean stocks are expected to increase in 2008/09 with higher production, soybean prices are forecast to increase yet again. It is likely that corn, soybeans, and wheat prices are all being affected by the expectation that corn and soybeans will compete intensely for limited acreage in 2009. In addition, expectations that stocks levels will be inadequate to deal with a moderate to severe drought may also add to current corn price increases by causing current supplies to be held back from the market in expectation of higher prices in the future.

Steady increases in biofuel production. Many media stories and other articles have cited biofuels as a major factor in commodity price increases. For example, one review concludes: "While biofuels have thus far had little impact on crude oil prices, they have already had large effects on prices of commodities used as feedstocks for biofuels, as well as for competing crops. For example, maize prices rose by about 60 percent from mid-2005 to mid-2006, largely because of the increased use of maize for ethanol production in the United States. This prompted a huge shift of land from wheat into maize in the following season, which contributed to a sharp increase in wheat prices. Vegetable oil prices have also increased because of their stepped-up use for biodiesel production in Europe and the United States, with palm oil prices up 48 percent in the last year and soybean oil prices up 25 percent" (World Bank, 2008).

One way to illustrate the importance of biofuels in the U.S. corn market relative to other global factors is to compare foreign corn consumption and production relative to U.S. corn used in ethanol production. Table 1 indicates that the corn deficit (domestic consumption minus production) in foreign countries has increased over the past two decades. The difference between foreign consumption and production signals the need to import corn from the United States and use up foreign corn stocks, or both. After a sharp rise in the early 2000s, this difference has been relatively steady in recent years. However, the increase in ethanol use (measured as 70 percent of the U.S. corn going to ethanol plants to account for coproducts used as feed) has grown much more sharply than the need for U.S. corn in foreign markets.

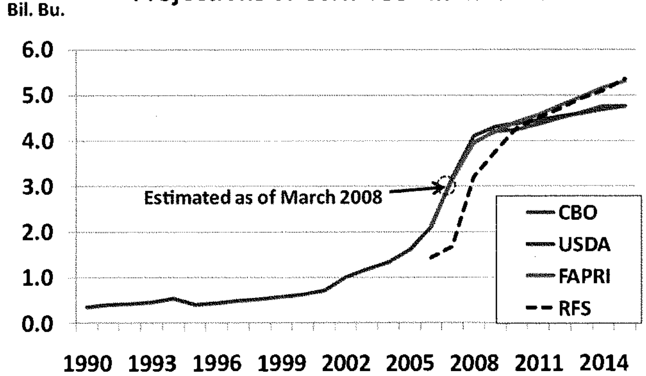
Table 1. Foreign Corn Production and Consumption and U.S. Corn Used in Ethanol (MMT)

	1989/90-1993/94	1994/95-1998/99	1999/00-2003/04	2004/05-2008/09	2006/07	2007/08	2008/09F 1/
Foreign production	292.7	337.8	362.6	437.6	445.5	457.7	477.2
Foreign domestic consumption	333.4	378.5	420.2	489.5	497.3	511.9	526.1
Difference	40.7	40.7	57.6	51.9	52.0	54.2	48.9
70% of U.S. corn demand for ethanol	6.9	8.4	14.4	42.8	37.6	53.3	71.1

1/ USDA, World Agricultural Outlook Board, 2008

Biofuel demand for corn is currently only a little more than half the RFS level for non-advanced biofuels mandated by EISA for 2015, thus assuring steady and large increases in corn demand for ethanol in coming years (Figure 2). The next section more closely examines biofuels, in particular ethanol.

Fig. 2. Current USDA, Congressional Budget Office and Food and Agricultural Policy Institute Baseline Projections of Corn Used in Ethanol



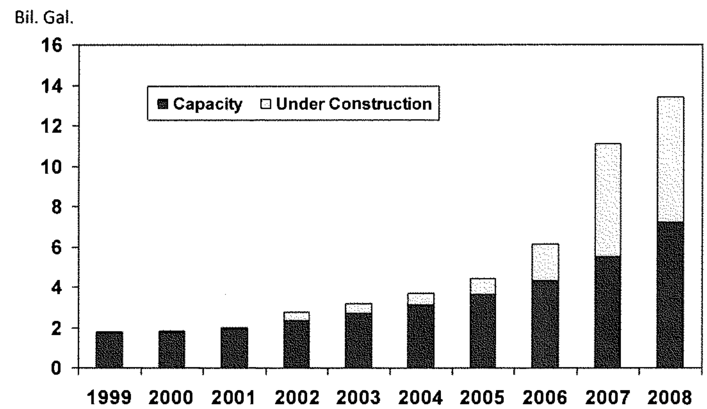
The Evolution of Ethanol as an Increasingly Important Factor in Farm Prices

Slow ethanol growth from 2000 to 2004. By 2004, corn used in ethanol had increased to a then record-high 1.323 billion bushels. This growth reflected the benefits of the $0.51 per gallon tax credit, steady gains in ethanol production efficiency, and higher oil prices. These factors spurred investment in ethanol plants. But the growth in corn use in ethanol between 2000 and 2004 could readily be accommodated by a market where annual increases in corn productivity were exceeding the increase in corn used in ethanol. Between 2000 and 2004, corn used in ethanol increased an average of 174 million bushels per year. However, corn production over the period, due entirely to increases in yields per acre, rose by an average of 473 million bushels per year. By the end of the 2004 crop year, corn carryover stocks amounted to over 2.1 billion bushels, consistent with long-term average carryover levels. However, the production increase included the unusually high yield in 2004. With a normal yield, production increases would have been slightly less than total demand, suggesting a small reduction in stocks and a small price increase due to corn demand increases due to ethanol and other factors.

Expansion quickens. The pace of ethanol expansion began to accelerate during the 2004-2005 period. While the tax credit for ethanol blending traces to 1978, the acceleration of corn ethanol production in the mid 2000s was also stimulated by increasing crude oil prices, which in 1999 began an advance to a new higher level. Refiner acquisition costs for crude oil rose from about $11 per barrel in early 1999 to over $31 by November 2000, focusing Federal policy attention on renewable fuels. The new President in early 2001 created the Energy Policy Development Group, chaired by the Vice President, which produced a report advocating increasing energy supplies including renewable energy. While there was no immediate legislative action on the President's energy policy report, the context for ethanol was defined: biofuels were going to be a part of any newly enacted national energy policy. However, the Energy Policy Act of 2005 initiated unprecedented mandates for ethanol consumption.

Ethanol emerges as major demand force. From 2006 to 2008, ethanol is the primary force behind the rise in corn prices and the reason corn prices are likely to remain at high and volatile levels for several years. The evidence for this conclusion is in the changing supply and demand balance sheet statistics for corn. By early 2005, crude oil prices exceeding $50 per barrel combined with existing and prospective new renewable energy programs to pull new investment steadily into ethanol plants (Figure 3). This raised ethanol production, increased corn used in ethanol production, and drove corn prices and the prices of related major crops to unexpectedly ever-higher levels. During the 2004 crop year, corn used in ethanol accounted for 12 percent of total use of corn; in 2005, 14 percent of total corn use; and by 2006, 19 percent of total corn use. USDA's current forecast for the 2007 crop year is that corn used in ethanol will account for 23 percent of total corn use, and USDA projects that in 2008 corn used in ethanol will rise to 32 percent of total corn use.

Fig. 3. Ethanol's Rapid Capacity Growth



Source: Renewable Fuels Association. January 1 of each year.

Productivity cannot meet demand growth; more acres needed. One implication of the rapid growth in corn use in ethanol is the need for substantially more corn acreage to support this new demand and still meet U.S. and global food and animal feed needs. This land requirement is illustrated by the implied acreage needed to satisfy this new corn demand. Between 2006/07 and 2008/09, corn use in ethanol is expected by USDA to increase from 2.1 to 4.0 billion bushels. This 1.9-billion-bushel increase is equivalent to the production on over 12 million harvested acres (with trend yields). Annual increases in corn use in ethanol are now rising more rapidly than the annual increases in corn productivity.

With corn used for ethanol expanding faster than corn productivity growth, ever more land is needed for corn ethanol. This pressure on land will continue until corn productivity is growing as fast as the growth in total corn demand, including corn used in ethanol. However, such a steady state appears to

be a few years away. EISA mandates the use of 12.0 billion gallons of biofuels by 2010 that, practically speaking, means crop-based biofuels like corn ethanol. If 95 percent of that is made from U.S. corn (a reasonable assumption), about 4.1 billion bushels would be needed. Corn was used in ethanol production in early 2008 at about a 2.8-billion-bushel annual rate (assuming 2.8 gallons of ethanol per bushel of corn). That means corn used in ethanol production must increase by 1.3 billion bushels over the next 2-3/4 years, or an average of 470 million bushels per year. Even assuming that 30 percent of the corn used in ethanol plants ends up as coproduct animal feeds, 330 million more bushels would be needed each year just for the ethanol produced. This increase is well beyond the normal annual increases in corn production due to trend increases in corn yields.

More corn acres raise the prices of other crops. As ethanol has expanded, corn stock levels have declined and corn prices have increased. Higher corn prices reflect lack of supplies, the need to ration short supplies among alternative users, and the need for more corn acres. In 2007, corn planted area reached nearly 94 million acres, the highest level in over 50 years. As the corn market has tightened, so too has the soybean market; soybean oil is used for biodiesel and soybean acres are pulled into corn production. Soybean prices have now increased sharply and are limiting the additional soybean acres that can be shifted to corn. Wheat acreage is expected to be up in 2008, but persistently high corn and soybean prices will limit future wheat expansion, holding wheat prices higher than otherwise.

Overall acreage is limited. In addition, there is only a limited acreage of cropland pasture that could be converted to soybean and corn production. While some crop acreage is expected to be released from the long-term Conservation Reserve Program (CRP) through the normal expiration of contracts and the 32 million acre cap put in the CRP by the 2008 Farm Bill, the quantity of acres that may return to crop production is still likely to be limited. In the fall of 2008 only 1.3 million acres under long-term contracts will expire and be available for 2009 production, and in the fall of 2009, 3.9 million acres will expire and be available for 2010 crop production. While the conversion of most of these acres to crop production would help augment tight supplies over a several year period, most of these acres are in areas that produce more wheat than corn or soybeans.

Quantifying the Importance of Ethanol in Determining Corn Prices

The effects on agricultural and food prices of all of the factors identified in the previous sections cannot be quantified with precision. Econometric models, simulation models, expert judgment and other approaches may be able to estimate the relative contribution of some of the factors on corn and other major crop prices, but results will vary. In this section, two approaches are used to illustrate the relative importance of ethanol in the recent increases corn prices.

Approach #1: Imputing price effects based on other studies. The first approach is to draw on the results from recent corn market projections that have examined exogenous shocks to the corn market and estimated the impacts on ethanol production, corn use, and corn price. For example, recent studies have estimated the impacts of eliminating the tax credit, eliminating the biofuel mandate under EISA, and increasing oil prices by $10 per barrel. Table 2 summarizes some recent studies and shows the effects on ethanol and corn.

Table 2. Corn Use and Corn Price Effects: Multipliers Derived from Several Studies						
Study	**Effect measured**	**Change in corn use in ethanol**	**Change in corn use in ethanol (1)**	**Change in corn price**	**Change in corn price (2)**	**Percentage increase in corn price per one percentage point increase in corn use in ethanol (2) ÷ (1)**
		mil bu	Percent	$/bu	Percent	Percent
USDA baseline, 2007	Tax credits and tariff v. credits and tariff expire; effect averaged over 2010-11	+488	+13.77	+0.25	+7.68	0.56
McPhail & Babcock	EISA v. no EISA for the 2008 crop year	+378	+14.63	+0.35	+7.04	0.48
Tokgoz et al., CARD, July 2007	Increase of $10 per bbl in crude oil price; long term effect	+5,806	+115.82	+1.27	+40.32	0.35
FAPRI Baseline	Tax credit v. no credit; effect averaged over 2011-17	+590	+13.14	+0.14	+3.68	0.28

The last column of the table shows for each study how much the corn farm price increases on average for each percentage point increase in corn used in ethanol. The impacts on price differ because the models and approaches differ, and the time periods over which the effects are measured differ. They suggest that a 10-percent increase in corn used in ethanol would increase corn prices by 2.8 percent to 5.6 percent over various time periods.

These multipliers may be used to make a rough estimate of the effect of expanded corn use in ethanol production. For example, corn used in ethanol was 2.1 billion bushels in 2006/07; and USDA forecasts an increase to 4.0 billion bushels in 2008/09, up 89 percent. Using the above table, the implied percentage changes in the price of corn due to the increase in corn use in ethanol would range from 25 percent to 50 percent. These multipliers, then, suggest an increase actual average corn farm price of $3.04 per bushel in the 2006/07 to a range of $3.80 to $4.55 in 2008/09.

If the price of corn averages $5.80 per bushel in 2008/09 (mid-point of the USDA forecast as of May 2008), these results suggest corn ethanol could be accounting for 28 to 55 percent of the price increase since 2006/07. Most of these analyses project lower prices for 2008/09 than currently being experienced, estimate market adjustments over a long period, or have stock levels that do not reflect current very markets. When stocks relative to use are extremely tight as they are today, a given increase in demand, such as one due to ethanol expansion, has a much larger price effect than during a period of high stocks relative to use. The current environment of high prices and low expected stocks

suggests the current ethanol-corn price relationship is more likely to be near or above the upper end of the range of these studies.

Approach #2: Using a simple analytical model. Another approach to illustrating the role of ethanol in affecting corn prices is to use a mathematical example based on elasticities of supply and demand (Table 3). The approach uses equations to represent the U.S. corn market. There are equations for U.S. corn feed demand, corn export demand, corn demanded for ethanol production, and corn supply. Each demand component is specified as a function of corn price and exogenous factors that shift demand. The supply of corn to the market is taken to be production plus the change in stocks and is also specified as a function of the price of corn. The equations can be mathematically expressed in terms of elasticities of supply and demand and the percentage change in the shift factors. See the Appendix for a more complete discussion of this approach.

The model could be used to simulate the percentage change in corn price from 2006/07 to 2008/09 due to shifts in each corn demand component and yield changes over that period. However, these shifts cannot be observed, and determining them irrespective of price changes is difficult. Part of this difficulty is knowing which supply and demand elasticity to use. This selection problem stems from the fact that the corn market is moving toward a historically tight supply and demand balance in 2008/09 with constraints on acreage, limited export response to price changes due to foreign policies, and an unusually limited supply of stocks available to meet demand. Thus, elasticities are likely moving toward smaller than historical average values, which magnifies the price effect of any demand or supply shift.

Instead, the approach used with this model is to start with the tight 2008/09 market and work back in time. The model is used by taking USDSA 2008/09 forecasts as the starting point and answering the question: what would corn price be in 2008/09 if corn used in ethanol had remained the same as quantity used in ethanol in 2006/07?

Table 3 shows the results of the calculations. Price elasticities of demand and supply are used that reflect the current tight markets and limited changes in demand that have occurred in the face of dramatic price increases.

Table 3. Effect of reducing ethanol corn use to 2006/07 level on 2008/09 corn price

Variable	2008/09 forecast value	Price elasticity	Percent change	Percent change in corn farm price due to change in variable
Supply	11,735	0.15		
Feed and residual use 1/	6,350	0.2		
Ethanol use 1/	2,800	0.15	-47	-29
Other food, seed & industry use	1,360	0		
Exports	2,000	0.5		
Average farm price ($/bu.)	5.80			4.13

1/ Ethanol use is reduced and feed and residual use is increased by 30 percent of the 2008/09 forecast of corn going to ethanol plants to account for coproducts of ethanol production being used as feed.

Had corn used in ethanol stayed at the 2006/07 level, the resulting demand and supply changes suggest 2008/09 corn prices 29 percent below the current expected price, or an average price of $4.13 per bushel. This means that the increase in corn used in ethanol since 2006/07 is estimated to increase corn

prices 40 percent, or from \$4.13 per bushel to an expected \$5.80 in 2008/09. Alternatively, the increase in corn used in ethanol since 2006/07 is estimated to account for about 60 percent of the \$2.76 increase in corn prices from \$3.04 per bushel in 2006/07 to \$5.80 in 2008/09. This approach does not identify the role of each factor in getting to a record high corn price but simply examines what might happen to prices if ethanol demand for corn was at a much reduced level.

No model however simple or complex can account for precisely what factors caused the increase in corn prices in the last couple of years. However, the projection models reviewed earlier and this simulation model indicate that biofuel demand for corn has been a significant factor in determining corn prices, particularly in an environment of tight supplies, and will continue to be so with the biofuel production increases mandated and expected over the next several years.

Factors Causing the Expansion in Ethanol Production

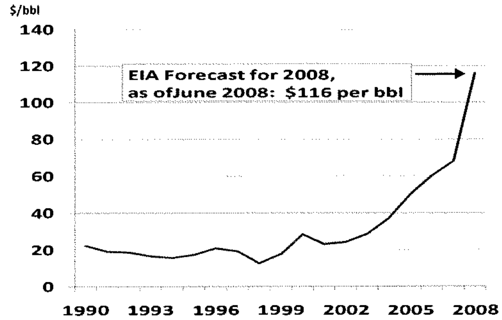
While it is difficult to explain quantitatively what each factor contributed to the increase in corn or other commodity prices, the reasons for the expansion of ethanol production are also hard to quantify. Factors include current and expected ethanol prices, corn prices, ethanol production costs, and government policy.

Oil prices. Oil prices have risen sharply during the 2000s (Figure 4), pulling up gasoline and ethanol prices. With ethanol prices rising faster than corn prices in the mid-2000s, the increase in ethanol plant margins spurred investment in production capacity. Higher oil prices generally enable ethanol plants to pay more for corn, which is illustrated by the following example.

If the price of crude oil increases by \$10 per barrel and 42 gallons of gasoline can be derived from it, then the marginal increase in the value of the gasoline in a barrel of oil would be \$0.24 per gallon (\$10/42 gallons per barrel). Because ethanol is worth two-thirds of gasoline based on energy value, ethanol would be worth \$0.16 per gallon more (0.67 times \$0.24). With 2.8 gallons of ethanol produced per bushel of corn, the value of corn in ethanol would be worth \$0.45 per bushel more (\$0.16 times 2.8 gallons per bushel). If 30 percent of corn can be sold as coproduct feeds at the same value as corn, then an ethanol plant can pay \$0.64 per bushel more for corn (\$0.45 divided by 0.7).

Consequently, a \$50 per barrel increase in crude oil prices, from \$80 to \$130 per barrel, could result in \$0.80 per gallon higher ethanol prices (\$0.16 times 5) and \$3.20 per bushel higher corn prices (\$0.64 times 5). While this example shows how crude oil prices have been an important incentive to produce ethanol, they are highly volatile and provide no guarantee that ethanol markets will be profitable in the future.

Fig. 4. Refiners Acquisition Cost of Crude Oil



Tax preferences and tariffs. Prior to 2005, current and expected oil prices and corn prices, along with Federal tax credits and state subsidies were the primary incentives to expand ethanol production. The $0.51 per gallon tax credit enabled blenders and refiners to pay $0.51 more for ethanol than they sell ethanol for in the retail market. Thus, the ethanol plant receiving up to 51 cents more per bushel than in the absence of the credit could pay up to $1.43 per bushel more for corn ($0.51 per gallon times 2.8 gallons per bushel and now after the recent reduction, $0.45 times 2.8, or $1.26) (Elam). The tax credit, combined with higher oil prices, enabled ethanol plants to cover operating and capital costs, and has been a powerful force on corn prices by spurring investment in ethanol production. FAPRI estimated that removal of the tax credit at the end of 2010 would reduce corn prices by $0.14 per bushel (3.6 percent) on average during 2011-2017. In an analysis of effects during 2008/09 alone, McPhail and Babcock (2008a) estimated that removal of the credit in 2008/09, in the absence of a mandate, would reduce corn prices by $0.82 per bushel (16.5 percent). In a later analysis, McPhail and Babcock (2008b) estimated that removal of the credit in the presence of the mandate and tariff in 2008/09 would reduce corn prices in that year by $0.21 cents per bushel (3.5 percent), and removal of the credit in the absence of the mandate and tariff would reduce corn prices by $0.85 per bushel (14.5 percent).

Renewable Fuel Standard (RFS). The Energy Policy Act of 2005 (EPACT), with its RFS mandate to use 7.5 billion gallons of renewable fuels by 2012, likely contributed in some limited way to establishing the current ethanol capacity, despite mandated use levels being below current and expected production at that time. EPACT was important because it provided a Federal government commitment to ensuring expanded biofuel consumption and reducing risk for ethanol firms by putting a floor under ethanol production. EPACT was also notable for eliminating the oxygenate requirement in reformulated gasoline markets and not providing liability protection for the controversial gasoline additive MTBE, which led to the replacement of MTBE by ethanol (Anderson et al.).

In contrast, EISA sharply increased the mandated levels of biofuel use such that the mandates are no longer floors but targets that can be achieved only through ethanol industry expansion (Appendix table). Several studies have attempted to estimate the effects on corn prices of the EISA mandate. Babcock and McPhail (2008b) estimated that removal of the RFS mandate in 2008/09 would decrease corn prices by $0.23 per bushel (3.9 percent) for 2008/09. In another approach, de Gorter and Just estimated that if

ethanol production in 2015 was 12 billion gallons, with no mandate in place, then a mandate that raised production to 15 billion gallons would increase corn prices by 15 percent in that year. Anderson et al. estimated that a one-quarter reduction in the mandate would reduce corn prices by about $0.30 per bushel and a one-half reduction in the mandate would reduce corn prices by $0.50 to $0.60 per bushel in a few years.

With current ethanol production running at slightly above half the mandated level for 2015, the effects of the mandate are now being built into current and out-year futures prices. Corn futures ranged from $5.50 to over $6 per bushel for corn delivered in late 2008, 2009, and 2010 even before the recent flooding in June. The EISA mandate raises expected ethanol prices because it ensures blenders and refiners will have to bid up ethanol prices if ethanol plants reduce output below the mandate in the face of higher corn costs or lower ethanol prices. Even if actual or expected ethanol production is above the mandated level in any year, the mandate raises expected future ethanol prices. It does this because it ensures higher corn demand for ethanol than might occur without the mandate in years when corn production or oil prices are low, assuming the mandate is not waived. This risk mitigation increases investment in ethanol production and hence ethanol output, even if ethanol production is above mandated level.

Federal biofuels programs taken together. The tax credit, tariffs, and RFS collectively lessen a number of risks facing ethanol producers, and as a result, generate ethanol investment, ethanol production, and higher corn and other agricultural commodity prices. Risks that are mitigated by biofuels programs include:

- Lower ethanol prices, caused by lower gasoline prices, caused by lower crude oil prices.
- High corn prices caused by unexpected demand, low corn production, or both.
- Low ethanol coproduct feed prices.
- High operating costs caused by increases in energy costs, labor costs, interest rate, or other raw material costs.
- Unexpectedly high plant construction and expansion costs.
- High transportation costs.
- Infrastructure problems creating ethanol distribution bottlenecks.

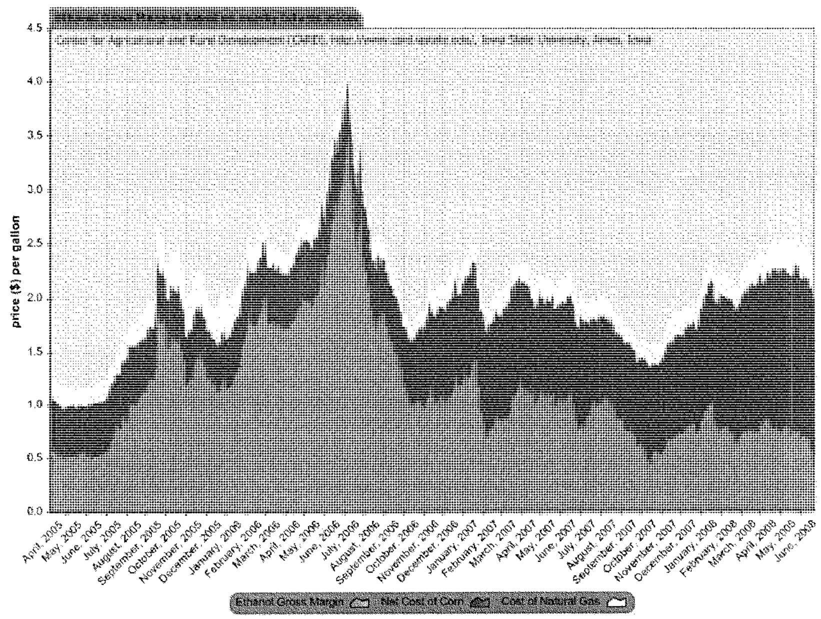
The tax credit raises ethanol prices and enables ethanol plants to pay more for corn. The tariff restricts ethanol competition from foreign sources and supports ethanol prices. The RFS mandate changes expectations about future corn demand and the ability of corn production to meet that demand. The once uncertain increase in corn demand due to biofuels, contingent primarily on strong, but highly volatile oil prices, is now a certain increase in demand due to the RFS, regardless of oil or corn prices. The mandate makes the demand for corn by ethanol plants highly inelastic with respect to price changes when corn prices are high and crude oil prices low. This feature reduces the normal ability of high corn prices to reduce demand and ration short supplies across users. In combination, these biofuels programs help ensure that corn stocks are reduced to historically low levels and kept low for several years, because of limited ability to expand corn production as fast as corn use in ethanol.

Current Ethanol Economics

There is no assurance RFS levels would be met without the mandate. In 2008, ethanol faces several challenges. Ethanol futures prices for August 2008 were in the range of $2.50 per gallon during mid

May, fell to about $2.30 in early June and then increased to about $2.80 in mid June. Corn prices have continued to increase, with cash market prices recently over $6.50 a bushel in Central Illinois and futures prices well over $7.00. Ethanol margins have been declining since 2006 (Figure 5 from Center for Agricultural and Rural Development, Iowa State University). Plant operating and expansion costs are rising and some plants have reportedly slowed or halted expansions. Distributing ethanol is now more costly because remaining blend markets are outside the Midwest, and ethanol must be transported longer distances, with transportation cost averaging 13 to 18 cents per gallon compared with 3 to 5 cents for petroleum fuels (GAO, 2007a). In this environment, the tax credit and the RFS mandate are helping to maintain investment in ethanol production capacity and production. Without these policies, ethanol prices would likely decline to their energy-equivalent value to gasoline, some ethanol plants would have negative margins and reduce capacity use or cease operating, and corn prices would decline.

Fig. 5. Ethanol Gross Margins



The Supply/Demand Challenge Facing Corn and Soybean Markets

This section examines the adjustments that corn and soybean markets likely face during the next 3 marketing years. Balance sheets for 2009/10 and 2010/11 are constructed based on the May 9, 2008 official USDA forecasts for production and carryin stocks for 2008/09 (Tables 4 and 5). Demand components are not forecast for each year; rather they are simply taken to be the most recent 3-year averages for feed, food, industrial, seed, and export demand for corn and crush, exports, and other for

soybeans. This is a "business as usual" case that provides no growth in demand, except for corn and soybeans used in biofuels. Ethanol demand for corn is assumed to expand as projected under the March 2008 FAPRI baseline, which incorporates EISA. Soybean crush for all years is assumed to be constant at the USDA forecast for 2008/09. Direct corn feed use is reduced in 2009/10 and 2010/11 to account for increased use of ethanol feed coproducts. Soybean and corn harvested acreage in 2009 and 2010 are assumed to be the average of 2007 and the USDA's 2008 forecast of harvested acreage. In addition, the 2009 corn and soybean acreage are each increased by one quarter of the acreage under Conservation Reserve contracts that expire in 2008, and the 2010 acreages are each increased by one quarter the acreage under Conservation Reserve contracts that expire in 2009. Corn and soybean yields are as projected in the USDA baseline.

Table 4. Implications for Corn Carryover Stocks with Average Use Levels

Item	2005/06-2007/08 Avg.	2008/09 1/	2009/10	2010/11
Harvested acreage (mil. ac.)	77.4	79	83	84
Yield (bu./ac.)	149.4	148.9	157.3	159.3
Production (mil. bu.)	11,574	11,735	13,056	13,381
Feed and residual use (mil. bu.)	5,968	5,150	5,440	5,370
Ethanol use (mil. bu.)	2,240	4,000	4,186	4,418
Exports (mil. bu.)	2,236	2,000	2,236	2,236
Other (mil. bu.)	1,370	1,360	1,370	1,370
Carryover stocks (mil. bu.)	1,568	673	497	484
Stocks-to-use (percent)	13.4	5.4	3.8	3.6
Avg. farm price ($/bu.)	3.13	5.80	--	--

1/ USDA, World Agricultural Outlook Board, 2008; midpoint of price forecast

Table 5. Implications for Soybean Carryover Stocks with Average Use Levels

Item	2005/06-2007/08 Avg.	2008/09 1/	2009/10	2010/11
Harvested acreage (mil. ac.)	69.6	73.8	69	70
Yield (bu./ac.)	42.3	42.1	42.6	43.0
Production (mil. bu.)	2,945	3,105	2,939	3,010
Crush (mil. bu.)	1,795	1,840	1,840	1,840
Exports (mil. bu.)	1,056	1,050	1,056	1,056
Other (mil. bu.)	145	172	145	145
Carryover stocks (mil. bu.)	383	175	73	42
Stocks-to-use (percent)	12.8	5.7	2.4	1.4
Avg. farm price ($/bu.)	7.36	11.75	--	--

1/ USDA, World Agricultural Outlook Board, 2008; midpoint of price forecast

The examples presented in Tables 4 and 5 indicate that even with no growth in demand for feed and exports above the most recent 3-year average levels, yields above recent levels, and acreage assumed to be above the average level of the past two years, corn and soybean carryover stocks as a percentage of use would fall steadily by 2010/11 to record low— impossibly low—percentages (Figure 6). Stock levels undoubtedly will be higher than in these examples, but much more production or rationing of use, or both, will be needed to bring them to an average level and to a level that could withstand adverse

weather in any of these 3 years. The current futures market corn and soybean prices reflect sustained tight markets as implied in these examples (Figure 7).

The importance of having adequate stocks. Evidence of increasing farm-level and retail food prices can be seen in "stocks-to-use ratios." In the agricultural industry, a prime indicator of price is the relationship of inventories of corn and other coarse grains (barley, sorghum, oats, and rye) to the use of those grains. The stocks-to-use ratio is the inventory that remains after harvest and sale of an annual crop, divided by the year's total use of the crop. During the period 1980 through 2004 (the year prior to enactment of the Energy Policy Act of 2005), the U.S. stocks-to-use ratio for corn averaged 24 percent. This number meant that there was sufficient inventory in the market that would provide a substantial cushion for the industry. The 24 percent represented approximately three months consumption of corn. Thus, if there was a drought or another adverse event, U.S. and foreign consumers had three months supply to draw upon, and price increases would be limited.

Fig. 6. U.S. Corn Ending Stocks: Share of Total Use

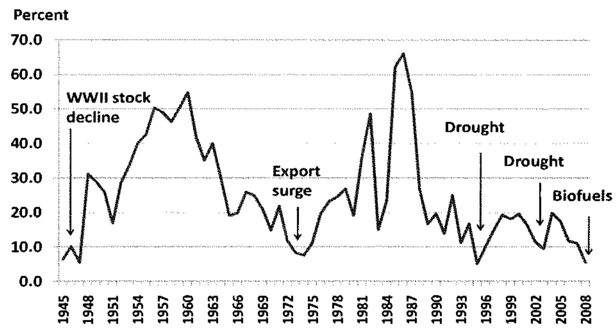
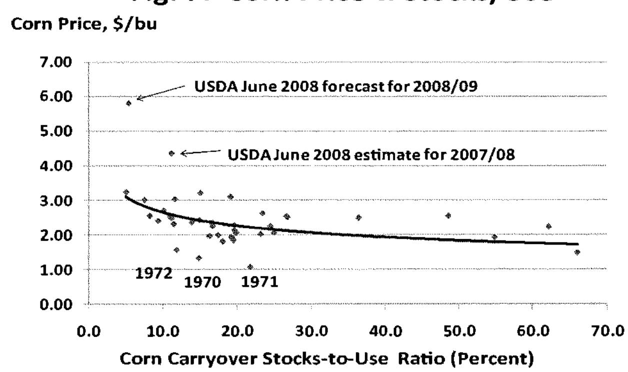


Fig. 7. Corn Price v. Stocks/Use



In contrast, today, the corn stocks-to-use ratio is expected to drop to 11.1 percent for 2007/08, or a little over one month's supply of this essential product. In 2008/09, it is expected to drop to 5.4 percent, only 20 days of supply and the second lowest level in 49 years of records. There is little prospect of a return to the historical ratio because demand for corn is increasing, and the market is tight. Simply stated, the U.S. and global grain economies are at risk. The delayed plantings and the excess precipitation this spring in the corn belt are proving that there no longer is any cushion or insurance, anywhere in the world, against disruptions in feed supplies due to production shortfalls in the United States. Prices are spiking significantly and if production prospects worsen, there would be further significant price increases for corn, which would have a devastating effect on the purchasers of that product.

Those less concerned about current high prices would argue that more acreage will be planted as land comes out of the CRP and that technology is likely to boost yields above these trends. That may work out over longer term but does not solve the problems of the next 2-3 years.

Over the next 2-3 years, biofuel use of commodities will continue to grow; added lands from CRP contract expirations will help but add only limited amounts to production; foreign economic growth and foreign policy decisions will likely cause continued strong demand for U.S. corn and soybeans; and weather may reduce corn yields in one or more of these years.

Biofuels and Food Prices

U.S. retail food and farm prices are related. In the United States, average annual changes in the Consumer Price Index (CPI) for food have generally reflected changes in prices received by U.S. farmers (Table 6). However, the relationship has weakened over time as the farm share of the retail dollar has declined from 32 percent in 1970 to about 20 percent before the recent increase in farm prices. In the 1970s, overall inflation averaged 7.1 percent per year, while the food CPI averaged 8.1 percent and the index of all farm prices averaged 9.1 percent. During the 1980s, smaller increases in farm prices aided in limiting food price increases. In the 1990s, farm prices actually declined 0.8 percent annually, while prices for all items and food increased 3.0 and 2.8 percent, respectively. Between 2000 and 2006, the average annual increases in the overall CPI, the CPI for food, and in farm prices were all similar, rising between 2.5 and 3.0 percent per year. In 2007, the index of all farm prices increased 18 percent and the CPI for food rose 4.0 percent.

Table 6. Average annual percent change in consumer prices and farm prices

	1970-1979	1980-1989	1990-1999	2000-2006	2007
CPI-All Items	7.1	5.6	3.0	2.8	2.8
CPI-All Food	8.1	4.6	2.8	2.5	4.0
Prices Received by Farmers for All Farm Products	9.1	1.2	-0.8	3.0	18.0

Sources: Bureau of Labor Statistics (CPI) and USDA NASS (farm prices).

Food prices are rising rapidly and the 4.0 percent year-over-year increase in the food CPI for 2007 masks a larger change within the year and larger increases in certain food groups. When food prices are accelerating, the change during the year will be larger than the year-over-year annual increases. For December 2007, the increase in the food CPI from the previous December was 4.9 percent. Food prices

during the first 4 months of 2008 increased at a seasonally adjusted annual rate of 6.9 percent, following the 4.9 percent increase during all of 2007. The food CPI increase during 2007 was the highest in 17 years.

Recent projections have been underestimating food price increases. Most forecasts of retail food price increases have been underestimated over the past two years. For example, USDA's initial forecast released in their 2007 baseline called for an increase in the food CPI of only 1.9 percent in 2007, compared with the actual increase of 4.0 percent. FAPRI's 2007 baseline forecast that the food CPI would rise 2.9 percent in 2007. Studies released in early 2008 increased forecast levels but, again, viewed food prices as generally low in 2008 and declining thereafter. USDA's baseline issued in February 2008 projects that the increase in the CPI for food would be 3.2 percent for 2008, and food price increases would decline to 2.2 percent by 2011. FAPRI also projects annual retail food price increases will decline over the long term, with food prices rising 3.7 percent in 2008 and increasing by only 1.9 percent by 2010. USDA's long term baseline has underestimated food price for each of the past 4 years in a row, and it appears that will happen again in 2008.

A challenge with forecasting food prices in the current environment is the sustained and pervasive increase in commodity prices that buyers are facing. Food pricing is a dynamic process. When crop price increases are modest and perceived to be temporary, livestock producers and other users may restrain from adjusting production or increasing their prices. However, when crop price increases are widespread, large, and perceived to be long-term, then larger and more rapid increases in meat and other food prices are likely to occur. These factors may lead to larger-than-expected increases in retail food prices over the next couple of years.

USDA has been increasing food inflation forecasts. USDA has been revising its forecasts monthly and now forecasts the year-over-year midpoint increase in the CPI for food for 2008 will be 5.0 percent above 2007, with a likely range of 4.5 to 5.5 percent. That would be up from the 4 percent increase in 2007 and the 2.4 percent increase in 2006. In explaining its CPI for food forecast for 2008, USDA notes several factors that are likely to pressure retail food prices in the future (Glauber). First, higher energy prices are increasing food processing, marketing, and retailing costs, and if maintained, these costs will be passed on in higher retail prices. Second, although USDA believes that food price inflation will moderate over the next few years, they caution that expansion of biofuels will keep corn and soybean prices at historically high levels and livestock producers will reduce production, leading to higher retail prices for beef and pork.

Studies show mixed effects of biofuels and corn prices on recent and prospective food price inflation. A number of studies have drawn various conclusions about increasing food prices and the major causes. These fall roughly into four groups.

First, some conclude that there is little evidence that food prices are being increased by ethanol-induced corn prices or that the effects are small relative to other factors, such as energy prices and labor costs (Informa Economics, Anderson et al., Urbanchuk). Second, others explain that the effect of higher feed grain prices are currently small but further increases may be realized in the market over time as livestock markets adjust and pass on their higher costs (Anderson et al., Glauber). Third, some make estimates regarding the effect on food prices, assuming that these higher feed costs are fully reflected in livestock product prices (Tokgoz et al., Leibtag, USDOE and USDA). Tokgoz compared the corn price of $1.90 a bushel (referred to as a no ethanol case) with $4.42 a bushel (ethanol production case) and concluded a 1.7 percent increase in retail food prices. Leibtag found food prices would increase less

than 1 percent per year. USDOE and USDA found that food prices could increase up to 0.85 percentage points as a result of farm-level price increases due to biofuels during April 2007 to April 2008. Fourth, others conclude that current analyses are likely to be significantly underestimating future food price increases (Lapp). Taking into account expected higher meat and dairy product prices, price increases for other inputs used in food production and distribution, and low grain stocks that will lead to much higher commodity prices should weather be adverse, Lapp now forecasts the CPI for food will average 9.0 percent per year during 2008-12, up from his earlier forecasts.

In addition, experts from international organizations have addressed the role of biofuels in higher food prices. The New York Times reported that the UN Food and Agriculture Organization (FAO) predicted biofuels would increase food costs by 10 to 15 percent (Martin). However, the UN FAO attributed to the World Bank the conclusion that 65 percent of the increase in world food prices is due to world biofuels (UN FAO). The World Bank itself points to biofuels as the primary reason for higher food prices over 2004-2007, indicating adverse weather and higher energy costs account for small shares (World Bank). The International Food Policy Research Institute indicates actual biofuel production compared with the 1990-2000 trend accounts for 30 percent of the increase in real grain prices and 39 percent of the increase in real corn prices (Rosegrant). Simon Johnson, Chief Economist at the IMF, stated that biofuels have "played quite a significant role," estimating that 20-30 percent of the price increases in the past two years are accounted for by biofuels (Open Europe, April 14, 2008). The IMF also indicated that 70 percent of the increase in corn prices and 40 percent of the increase in soybean prices has been due to increased biofuel production (Lipsky). In contrast, the Administration estimated that U.S. biofuels accounted for about a 30 percent increase in corn prices and a 10 percent of the increase in the IMF food commodity price index from April 2007 to April 2008 (calculated from data in the source, 40.6/45 times 100 percent)(U.S. Department of Energy and U.S. Department of Agriculture).

Potential Contribution of Biofuels to Food Price Increases

The wide range of conclusions about the main factors behind higher food prices reflects the different prices being measured (farm, wholesale, or retail), different models being used and different time periods for the data being analyzed, perspective of different analysts, and different forecast periods. For example, since corn is mainly used as a feed grain, higher corn prices in one year may not affect livestock prices for up to several years. That is the case today as U.S. meat production is expected to be record high in 2008 partly because high feed prices are causing increased slaughter of beef and dairy cows and sows. The consequence of this is more meat production today, but the reduction in breeding animals and herd sizes will mean lower meat production and higher meat prices over next several years.

Measuring the effect of biofuels through its effect on increased feed and ingredient costs to farmers, ranchers and food processors. Tokgoz et al., Leibtag, and US DOE and USDA all accounted for higher corn prices in food prices by estimating effects in different ways on livestock that have not yet been realized in retail meat prices. A similar approach is used here to approximate the effect of recent increases in biofuel production on food prices. The approach involves three steps: first, estimate the increase in expenditures by buyers of feed grains, oilseed meals, vegetable and animal fats and oils from 2006 to 2008; second, assume these costs will be passed on to retail consumers over a several year period; and third, attribute an appropriate portion of the increase in these costs to biofuels.

From 2006/07 to 2008/09, the increase in corn going to ethanol plants is expected to be greater than the entire increase in total U.S. corn use. However, that does not mean ethanol accounts for 100 percent of the increase in corn prices from 2006/07 to 2008/09. Other factors, such as foreign economic

growth and exchange rates are also increasing corn demand and yield is expected to be below trend. Earlier in this paper, a mathematical simulation was used to estimate that about 60 percent of the increase in corn prices from 2006 to 2008 may be due to the increase in corn used in ethanol from 2006 to the expected use in 2008. Oilseed prices and returns bear a consistent long-term relationship to corn prices and returns. This relationship is a powerful force causing oilseed markets to adjust prices and returns to maintain the relationships with corn. Since biodiesel and soybean acreage that is being bid away to corn production are major factors behind higher soybean price increases, it is reasonable to assume that 60 percent of the increase in soybean and soybean product prices between 2006 and the expected levels for 2008 are also due to biofuels. Then, these conclusions follow:

- Domestic livestock producers and food processors would pay an estimated $74 billion for feed grains, protein meals, vegetable oils, and animal fats and oils during 2008/09 (calculated using USDA projected 2008/09 domestic consumption levels if available, or 2007/08 levels, and USDA forecast prices for 2008/09). This level is $34 billion above costs using 2006/07 prices. No effects of biofuels are assumed on the prices for other crops such as hay, wheat, peas, dry beans, lentils, etc.
- If biofuels account for 60 percent of the increase in these prices, biofuels would account for $20.5 billion in increased feed and ingredient costs from 2006/07 levels to expected 2008/09 levels.
- Total U.S. personal consumption expenditures on food in 2007 were $1.109 trillion. Thus, a $20.5 billion increase in ingredient costs when passed on as higher meat and food prices would increase food spending by 1.8 percent, which could account for a substantial portion of food price inflation over the next several years.
- The annual average increase in food prices during 2000-2006 was 2.5 percent, thus a 1.8-percent increase in food costs may look small, but it is a substantial portion of the normal increase in food prices. It may take 2-3 years for this increase to be reflected in food prices. If the normal increase in annual food prices is 2.5 percent, food prices would normally rise 5.1 to 7.7 percent over a 2-3 year period. The 1.8-percent increase in food prices due to biofuels would be a 23-35 percent increase over the normal rate of food price inflation over a 2-3 year period.
- This approach does not take into account the effect of biofuels on the price increases in other commodities that may result from competition for land, and it does not take into account any markups in margins that processors, wholesalers, and retailers may take due to farm price increases. While it is clear biofuels have already had a major effect on increased feed costs, they are also likely to be a more important contributor to higher food prices over time as higher feed and other costs move through the food system.

Conclusions

U.S. farm prices have risen sharply since 2006.

- U.S. farm prices, particularly for crops and some animal products, have increased sharply over the past two years. The index of prices received by farmers for all farm products increased by 34 percent over the period January 2006 through May 2008. The index of prices received for feed grains and hay, led by surging corn prices, increased 144 percent over that period. Table 7 shows price increases for key major crops.

Table 7. Major crop prices received by farmers ($/bu)			
Crop year	Corn	Soybeans	Wheat
2005/06	2.00	5.66	3.42
2006/07	3.04	6.43	4.26
May 2008	5.12	12.30	8.80
Change from 2005/06	156% increase	117% increase	157% increase
Source: USDA, National Agricultural Statistics Service			

A number of factors are combining to drive up U.S. farm and food prices. They include:

- Expanding demand for U.S. commodity exports. This demand is the result of higher foreign incomes, changing diets, the declining value of the dollar, and production shortfalls in key countries the past two years. Foreign policies that are insulating some countries' agricultural markets from the world market are also transmitting higher and more volatile prices to countries not insulating their markets, such as the United States.
- Increasing animal numbers in the United States, which have increased the demand for feed the past two years.
- Increasing energy prices, which have increased production costs of agricultural commodities and added to the costs of processing and distributing food.
- Increasing investment and speculation in commodities, which mainly increases volatility.
- Expectations that markets will get increasingly tight over the next few years, increasing the prospect that adverse weather could lead to even higher prices and shortages.
- Expanding demand for crops from increased biofuel production, stimulated by higher oil prices, tax credits, tariff protection and mandates.

Nearly all of the increase in total use of corn over the past two years has been due to use of corn by ethanol plants, thus most of the corn price increase has likely been due to ethanol.

- A comparison of corn use during the 2005/06 corn marketing year, just prior to the acceleration of ethanol production, with corn use during the current 2007/08 marketing year reveals that ethanol, by far, dominated the increase in corn use. Based on current USDA estimates, 95 percent of the increase in total corn use over that period has been for corn ethanol plants.
- Corn use in ethanol is estimated to equal 23 percent of the record-large 2007 U.S. corn crop. Producers harvested more corn acres than in any year since 1933. With competition for land expected to intensify, and using the mandates in the RFS, the share of corn production used for ethanol is likely to exceed 35 percent by 2015.
- Between 2006/07 and 2008/09, USDA forecasts indicate the increase in corn going to ethanol plants is expected to exceed the increase in total U.S. corn use. Because corn stocks are expected to fall to such low levels relative to total corn use and expected corn prices are so high, any surge in corn demand has an amplified effect on corn prices. In this environment, if substantially less corn were to be used in ethanol production than now expected, corn prices would be much lower. A simplified analytical approach suggests that expected corn prices may be 40 percent higher than they would be had corn used in ethanol production remained at the 2006/07 level. Expressed in an alternative way, the increase in corn expected to be used in ethanol between 2006/07 and 2008/09 may account for up to 60 percent of the increase in corn prices between 2006/07 and 2008/09.

Corn prices are likely to remain high for several years and exceed current government long-term projections.

- The effect of ethanol on corn prices is demonstrated by the changes observed in cash and futures prices. The price of No. 2 yellow corn at country elevators in Central Illinois (a common benchmark market) averaged about $2.00 per bushel in 2005/06. By mid-November 2007, just prior to the increase in the RFS under EISA, corn prices had increased to about $3.60 per bushel. By the end of the second week in June 2008, corn prices had exceeded $6.60 per bushel, more than triple the 2005/06 level. Futures prices at the end of that week ranged from $7.65 to $6.93 per bushel for corn delivered in December 2008, 2009 and 2010. Such price levels are not reflected in either USDA's short-term forecasts for 2008/09 or their long-run commodity price projections released in 2008, or by other groups, such as the Food and Agricultural Policy Research Institute or the Congressional Budget Office.

Global grain economies are at risk due to extraordinarily low grain reserves.

- While global wheat production is expected to increase this year and raise wheat stock levels, the steadily increasing share of corn production going to ethanol is likely to reduce corn stocks to minimum levels and keep them low over the next several years. With very low corn stock levels, global consumers of corn, particularly producers of livestock and poultry and their products, will be put at a high economic risk from U.S. or foreign weather disruptions to feed grain production and will be vulnerable to much higher than normal price volatility. With this year's weather disruptions and prospective declining corn supplies, all users are facing rapidly escalating costs and the need to reduce corn use, and it is increasingly likely that RFS levels of ethanol use would not be realized without the mandate.

Increased corn production needed to meet demand increases the prices of other crops and foods made from those crops.

- The increase in corn prices due to ethanol has spread to other crop prices due to the competition for land to produce biofuels versus food. Moreover, biodiesel production has accounted for 52 percent of the increase in soybean oil use between 2005/06 and 2007/08. While wheat price increases are generally thought not to have been affected by higher corn prices, the higher corn prices, largely due to ethanol expansion, will keep wheat prices higher, longer because corn and soybeans will compete with wheat for land.

The increase in corn and other biofuels is raising retail food prices.

- Because of their dominant position in expanding demand and prices for feed grains and oilseeds over a sustained period, biofuels are expected to account for a significant portion of food price increases over the next several years. While some analyses conclude corn price increases have little effect on food prices, those analysis do not account for the time lags between increases in feed grain, oilseed meal, and other crop prices and their incorporation into retail animal product and other food prices. If the current increases in feed grain and other prices due to biofuels are fully reflected in meat, vegetable oil, and animal fats and oil prices and prices of other processed products over 2-3 years, the increases in retail food prices over that period are estimated to be 23-35 percent higher than the normal increase in food prices (which is 2.5 percent per year). Although energy price increases and other factors, such higher labor costs, will likely continue to

be major contributors to food price inflation, biofuels are now becoming a significant factor in increasing food prices.

Forecasters have been under estimating food price inflation.

- The December 2006 to December 2007 increase in the food CPI was the largest in 17 years. The risks to food price inflation are on the rise and many forecasters have been underestimating the increase in food prices. In fact, for the past 4 years, the annual USDA baseline forecasts have underestimated the increase in food prices, and it will do so again this year.

Policy actions that will affect farm and food prices.

- Food prices are going to be affected by several factors, including (1) high energy costs, (2) general inflation, (3) foreign income growth and the declining value of the dollar, (4) foreign governments closing their markets to exports, and (5) with very low stocks, even modest reductions in production due to bad weather.
- These factors are largely outside of the control of the U.S. government. However, the Federal Government has the ability to control certain factors.

U.S. biofuels policy could be reconsidered. Although high crude oil prices have been an important factor in the expansion of ethanol production to this point, they do not guarantee profitable ethanol production at high corn price levels for now or the future. With ethanol plant margins declining over the past two years, tax credits and the RFS mandate will increasingly keep ethanol production capacity expanding, capacity utilization high, corn prices high, livestock and poultry producers under stress, and pressure on food price inflation. Government support for corn-based ethanol ensures a permanent, significant, and increasing demand for corn. These policies interfere with the normal price rationing function of markets when supplies are short such as in 2008, with production being reduced by flooding and excess moisture. In this short-crop environment, biofuels policy, including mandated use of ethanol, causes even higher corn prices, shifts the demand adjustment burden to non-ethanol users of corn--particularly the livestock sector--and puts continuing pressure on food prices.

The Federal government should give serious consideration to whether (1) biofuels programs should be permitted to intervene significantly in corn and soybean markets or (2) whether consumers, acting through market forces, should be the primary mechanism for allocating crops between food and fuel use, with biofuels programs functioning as a safety net for biofuel producers.

References

Anderson, D.P, Outlaw, J.L., Bryant, H.L., Richardson, J.W., Ernstes, D.P., Raulston, M., Welch, J.M., Knapek, G., Herbst, B., and Allison, M. 2008. "The Effects of Ethanol on Texas Food and Feed," Agricultural and Food Policy Center, Texas A&M University, April 10.

Ash, Mark. 2008. USDA Grains and Oilseeds Outlook, USDA Outlook Forum, February 22. http://www.usda.gov/oce/forum/2008Speeches/Commodity/GrainsandOilseeds.pdf

Capehart, Tom and Richardson, Joe. 2008. "Food Price Inflation: Causes and Impacts," Congressional Research Service, April 10. http://www.schoolnutrition.org/uploadedFiles/ASFSA/childnutrition/govtaffairs/CRSFoodPriceInflation4-10-08.pdf

Commodities Future Trading Commission. 2008. Agricultural Forum, April 22. http://www.cftc.gov/newsroom/cftcevents/2008/oeaevent042208.html

de Gorter, Harry, and Just, David R. 2007. "The Economics of a Biofuel Consumption Mandate and Excise-tax Exemption: An Empirical Example of U.S. Ethanol Policy, Department of Applied Economics and Management Working Paper, WP 2007-20, Cornell University, October.

Elam, Thomas E. 2007. "Fuel Ethanol Subsidies: An Economic Perspective." Prepared for the National Turkey Federation. FarmEcon.com, September 27.

Food and Agricultural Policy Research Institute. 2008. "US Baseline Briefing Book, Projections for agricultural and biofuel markets," University of Missouri-Columbia, FAPRI-MU Report #03-08, March.

Glauber, Joseph. 2008. "Statement of Joseph Glauber, Chief Economist, U.S. Department of Agriculture, before the Joint Economic Committee, U.S. Congress, May 1.

Informa Economics. 2007. "Analysis of Potential Causes of Consumer Food Price Inflation." Prepared for the Renewable Fuels Association, November.

International Monetary Fund. World Economic Outlook Database. http://www.imf.org/external/pubs/ft/weo/2008/01/weodata/index.aspx

Lapp, William. 2007. "Back to the '70s? How Higher Commodity Prices Are Leading to the Return of Food Price Inflation," Advanced Economic Solutions, December.

Leibtag, Ehpraim. 2008. "Corn Prices Near Record High, But What About Food Costs?" *Amber Waves*, USDA, February 2008. http://www.ers.usda.gov/AmberWaves/February08/PDF/CornPrices.pdf

Lipsky, John. 2008. "Commodity Prices and Global Inflation," remarks at the Council on Foreign Relations, New York City, May 8.

von Braun, Joachim. "Rising Food Prices What Should Be Done?" International Food Policy Research Institute, IFPRI Policy Brief, April. http://www.ifpri.org/pubs/bp/bp001.asp

Martin, Andrew. 2008. "Fuel Choices, Food Crises and Finger-Pointing," New York Times, April 15.

McPhail, Lihong Lu, and Babcock, Bruce A. 2008a. "Ethanol, Mandates, and Drought: Insights from a Stochastic Equilibrium Model of the U.S. Corn Market," Center for Agricultural and Rural Development, Iowa State University, Working Paper 08-WP 464, March.

McPhail, Lihong Lu, and Babcock, Bruce A. 2008b. "Short-Run Price and Welfare Impacts of Federal Ethanol Policies," Center for Agricultural and Rural Development, Iowa State University, Working Paper 08-WP 468, June.

Open Europe. 2008. "France's response to food price crisis: resist farm subsidy cuts and return CAP to focus on food production." Press Summary Archive, April 14. http://www.openeurope.org.uk/media-centre/summary.aspx?id=570

ProExporter Network. 2008. PRX Annual Client Seminar and client updates. March 17-18 and follow-up email updates.

Rosegrant, Mark W. 2008. "Biofuels and Grain Prices: Impacts and Policy Responses," International Food Policy Research Institute, May 7.

Schnepf, Randy. 2008. "High Agricultural Commodity Prices: What Are the Issues?" Congressional Research Service, CRS Report for Congress. May 8.

Tokgoz, S., Elobeid, A., Fabiosa, J., Hayes, D., Babcock, B., Yu, T., Dong, F. Hart, C., and Beghin, J. 2007. "Emerging Biofuels: Outlook of Effects on U.S. Grain, Oilseed, and Livestock Markets," Center for Agricultural and Rural Development, Iowa State University, Staff Report 07-SR 101, July (Revised).

Trostle, Ronald. 2008. "Global Agricultural Supply and Demand: Factors Contributing to the Recent Increase in Food Commodity Prices," U.S. Department of Agriculture, Economic Research Service, WRS-0801, May. http://www.ers.usda.gov/Publications/WRS0801/

Urbanchuk, John M. 2007. "The Relative Impact of Corn and Energy Prices in the Grocery Aisle," LECG LLC, June 14. http://www.ethanolrfa.org/objects/documents/1157/food_price_analysis_-_urbanchuk.pdf

United Nations, Food and Agricultural Organization. 2008. Soaring Food Prices: Facts, Perspectives, Impacts and Actions Required. Prepared for the High-level Conference on World Food Security: The Challenges of Climate Change and Bioenergy, Rome, June 3-5.

U.S. Department of Agriculture, Economic Research Service. 2008a. Cost of Production Database.

U.S. Department of Agriculture, Economic Research Service. 2008b. Exchange Rate Database.

U.S. Department of Agriculture, National Agricultural Statistics Service. *Agricultural Prices*, various issues.

U.S. Department of Agriculture, Office of the Chief Economist. 2007. *USDA Agricultural Projections to 2016*, OCE-2007-1, February.

U.S. Department of Agriculture, Office of the Chief Economist. 2008. *USDA Agricultural Projections to 2017*, OCE-2008-1, February.

U.S. Department of Agriculture, World Agricultural Outlook Board. 2008. *World Agricultural Supply and Demand Estimates*, WASDE-457, June 10.

U.S. Department of Energy, Energy Information Administration. 2008. Short-term Energy Outlook, June 10. http://www.eia.doe.gov/emeu/steo/pub/contents.html

U.S. Department of Energy and U.S. Department of Agriculture. 2008. Letter to Senator Jeff Bingaman, Chairman, Committee on Energy and Natural Resources, United States Senate, June 11. http://www.usda.gov/documents/Chairman_Bingaman_Signed_w_Enclosure.pdf

U.S. Department of Labor, Bureau of Labor Statistics. 2008. CPI Detailed Report Data for March 2008. http://www.bls.gov/cpi/cpid0803.pdf

United States Government Accountability Office. 2007a. "BIOFUELS, DOE Lacks a Strategic Approach to Coordinate Increasing Production with Infrastructure Development and Vehicle Needs, Report to Congressional Requesters, GAO-07-713, June.

United States Government Accountability Office. 2007b. "COMMODITY FUTURES TRADING COMMISSION, Trends in Energy Derivatives Markets Raise Questions about CFTC's Oversight," Testimony of Orice M. Williams before the Subcommittee on General Farm Commodities and Risk Management, Committee on Agriculture, House of Representatives, October 24.

von Braun, Joachim. 2008a. "HIGH AND RISING FOOD PRICES, Why Are They Rising, Who Is Affected, How Are They Affected, and What Should Be Done?" International Food Policy Research Institute (IFPRI), presentation at a U.S. Agency for International Development (USAID) conference on *"Addressing the Challenges of a Changing World Food Situation: Preventing Crisis and Leveraging Opportunity,"* Washington, D.C., April 11.

von Braun, Joachim. 2008b. "Rising Food Prices What Should Be Done?" International Food Policy Research Institute (IFPRI), IFPRI Policy Brief, April.

World Bank. 2008. "Biofuels Global Economic Prospects 2008: Inflation and commodity markets, January 9.
http://web.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTDECPROSPECTS/EXTGBLPROSPECTS/0,,contentMDK:21540739~menuPK:4534774~pagePK:2904583~piPK:2904598~theSitePK:612501,00.html

World Bank, PREM, ARD and DEC. Undated. "Rising food prices: Policy options and World Bank response." Note distributed for information as background to the discussion of recent market developments at the Development Committee meeting.
http://siteresources.worldbank.org/NEWS/Resources/risingfoodprices_backgroundnote_apr08.pdf

Appendix

The mathematical simulation model of the corn market used in this paper to approximate the effects of demand and supply factors on the price of corn consists of demand equations that specify the quantity of corn used in animal feed, QF, the quantity of corn used in ethanol production, QE, and the quantity of corn exported, QX. Each demand equation is specified as a function of the price of corn, PC. Because other uses of corn, principally industrial, food, and seed uses, changed very little over the past few years, that demand is taken as a constant, QO. The supply of corn, Q, is taken to be production plus the change in stocks and is also specified as a function of the price of corn. Each equation (except supply) has a variable that shifts the equation and could be used to account for underlying economic changes, such as increased animal inventories, new ethanol plant construction, or foreign economic growth and exchange rates. The shift variables are denoted KF, KE, and KX and equal 1 during the reference period.

The model is:

$$QF = KF*F(PC);\ QE = KE*E(PC);\ QX = KX*X(PC);\ QS = S(PC);\ Q = Q(PC)$$
$$QF + QE + QX + QO = Q \text{ (market clearing condition: total use = supply)}$$

Substituting the demand and supply equations into the market clearing equation and taking total differentials yields the following equation:

$$dPC/PC = [QF_o*(dKF/KF) + QE_o*(dKE/KE) + QX_o*(dKX/KX)]/[Q_o*\varepsilon - QF_o*\eta_f - QE_o*\eta_E - QX_o*\eta_X]$$

This equation expresses the percentage change in the price of corn (dPC/PC) from the reference period (the 2008 crop year, denoted by the subscript zero) as a function of the percentage change in the shift in each demand component, weighted by the values of each demand component in the reference period, divided by the sum of the elasticities with respect to the price of corn for: supply, ε; corn demand for feed, η_f; corn demand for ethanol, η_E; and corn demand for exports, with each elasticity weighted by the values of each demand component in the reference period. Corn in ethanol is reduced by 30 percent of the official USDA estimate of corn used in ethanol for the 2008 and 2006 crop years to account for coproducts fed to animals. Feed use is increased by that amount. The data for the reference period, the elasticties used and the exogenous reduction in ethanol used to estimate the price effect are described in the text.

Appendix Table

Appendix Table 1. Energy Independence and Security Act of 2007, Renewable Fuel Standard Requirements, billion gallons

Year	Total renewable fuels 1/	Total renewable fuels less advanced biofuels	Advanced biofuels 2/		
			Cellulosic biofuel 3/	Biodiesel 2/	Other advanced biofuels 2/ 4/
2006	4.00	4.00			
2007	4.70	4.70			
2008	9.00	9.00			
2009	11.10	10.50		0.50	0.10
2010	12.95	12.00	0.10	0.65	0.20
2011	13.95	12.60	0.25	0.80	0.30
2012	15.20	13.20	0.50	1.00	0.50
2013	16.55	13.80	1.00	5/ 1.00	0.75
2014	18.15	14.40	1.75	1.00	1.00
2015	20.50	15.00	3.00	1.00	1.50
2016	22.25	15.00	4.25	1.00	2.00
2017	24.00	15.00	5.50	1.00	2.50
2018	26.00	15.00	7.00	1.00	3.00
2019	28.00	15.00	8.50	1.00	3.50
2020	30.00	15.00	10.50	1.00	3.50
2021	33.00	15.00	13.50	1.00	3.50
2022	36.00	15.00	16.00	1.00	4.00

1/ Requires a 20% LCA reduction in GHG compared with petroleum 1 year after enactment

2/ Requires a 50% LCA reduction in GHG compared with petroleum

3/ Requires a 60% LCA reduction in GHG compared with petroleum

4/ Other advanced biofuels could be cellulosic or biodiesel biofuels

5/ For 2013 and beyond, the level is determined by EPA, DOE and USDA

Order Code RL34474

CRS Report for Congress

High Agricultural Commodity Prices: What Are the Issues?

May 6, 2008

Randy Schnepf
Specialist in Agricultural Policy
Resources, Science, and Industry Division

Prepared for Members and Committees of Congress

Congressional Research Service

High Agricultural Commodity Prices: What Are the Issues?

Summary

Prices for nearly all major U.S. agricultural program crops — corn, barley, sorghum, oats, wheat, rice, and soybeans — have exhibited extreme price volatility since mid-2007, while rising to record or near-record levels in early 2008. Several international organizations have announced that the sharply rising commodity prices are likely to have dire consequences for the world's vulnerable populations, particularly in import-dependent, less developed nations. In the United States, high commodity prices have pushed farm income to successive annual records and have sharply lowered government farm program costs, but they have also stoked the flames of food price inflation and have raised costs for livestock producers and food processors. In addition, high, unexpectedly volatile prices have increased the risk and costs associated with grain merchandising. In particular, they have dramatically increased the cost of routine hedging activities (i.e., pricing commodities for purchase, delivery, or use at some future date) at commodity futures exchanges and, as a result, have diminished "forward contracting" opportunities for grain and oilseed producers who are eager to take advantage of record high market prices.

For some crops (particularly for wheat and rice), the price increases are likely to be relatively short-term in nature and are due to weather-related crop shortfalls in major producer and consumer countries, a weak U.S. dollar that has helped spark large increases in U.S. exports, a bidding war among major U.S. crops for land in the months leading up to spring planting in 2008, and the often perverse price effects resulting from international policy responses by several major exporting and importing nations to protect their domestic markets. Assuming a return to normal weather, these factors will likely self-correct within two growing seasons as global supplies are replenished and prices moderate. For coarse grains (corn, sorghum, barley, oats, and rye), oilseeds, and oilseed products (e.g., vegetable oil and meal), the price increases have also been due to strong, sustained demand deriving from two sources: robust income growth in developing countries (e.g., China and India), which has contributed to increased demand for meat products and the feed grains needed to produce that meat; and growing agricultural feedstock demand to meet large increases in government biofuel-usage mandates or goals in the United States, the European Union, and other countries.

Market analysts, including the United Nations' Food and Agricultural Organization (FAO), are predicting record global grain and oilseed production in 2008 in response to the high market prices. However, given the overall strength in demand growth, most market analysts predict that when commodity supplies eventually recover and prices moderate from current high levels, the new equilibrium prices will be significantly higher than has traditionally been observed during periods of market balance.

This report examines the causes, consequences, and outlook for prices of the major U.S. program crops, and provides references for more detailed information. It will be updated as events warrant.

Contents

List of Figures

List of Tables

High Agricultural Commodity Prices: What Are the Issues?

Introduction

U.S. and international markets for major grains and oilseeds are presently experiencing a period of tight supplies, strong demand, and high prices not seen since the mid-1990s (**Figures 1** and **2**). While agricultural commodity prices rose sharply during 2007, they have jumped precipitously in early 2008. For example, export prices for the world's two major food crops — wheat and rice, rose by 81% and 21%, respectively, during 2007, but have surged even higher in early 2008. Wheat prices (HRW No. 2, f.o.b., U.S. Gulf ports) rose 44% between November 2007 and March 2008 — rising from \$334.6 per ton to \$481.5 — before falling back slightly in April.[1] Rice export prices (100% Grade B, f.o.b. Bangkok) have more than doubled since November 2007, rising from \$358.3 per ton to \$873.25 in late April 2008 — an increase of nearly 144%.

This report identifies the predominant factors behind the current (2007/2008 crop year) market conditions for major agricultural commodities, with a focus on U.S. farm program crops. In addition, it briefly discusses how higher, more volatile commodity prices have impacted farm incomes, government farm programs, hedging activities, the livestock and food processing sectors, food prices, and the international food security situation. It reviews both the near- and longer-term commodity price outlook, and finally, it discusses various viewpoints and policy options that have been suggested as possible responses to the perceived causes and consequences of the unusually high commodity prices.

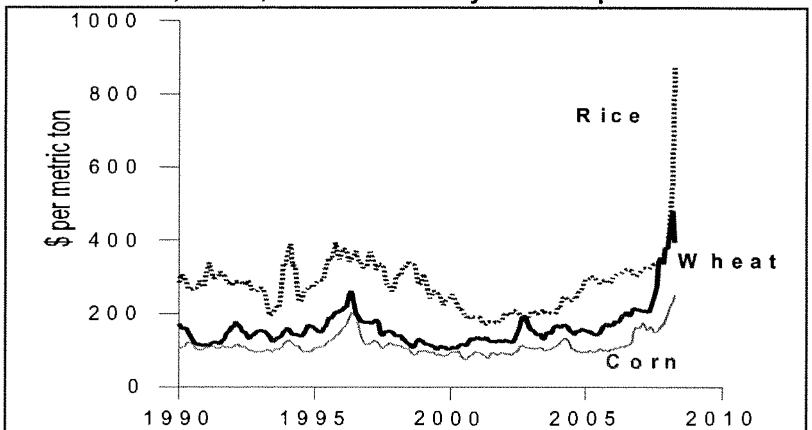
Because supply and demand circumstances vary widely across these crops — particularly in terms of their seasonality, their price elasticity, and the derived nature of their end products — readers are encouraged to review the brief commodity overviews provided in CRS Report RL33204, *Price Determination in Agricultural Commodity Markets: A Primer*, for background information on the underlying nature of the different commodity markets.[2]

---

[1] Note that all data are in metric tons unless otherwise stated. These prices are from "World Food Situation website," Food and Agricultural Organization (FAO), United Nations, at [http://www.fao.org/es/esc/en/index.html].

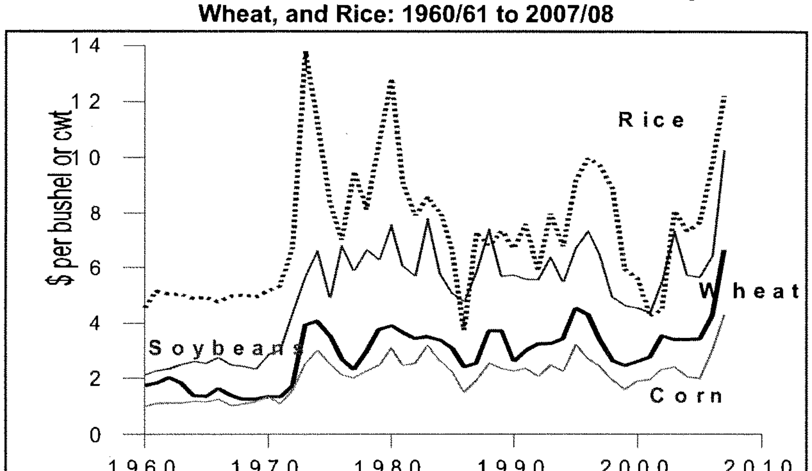
[2] An additional source for more detailed market and policy information for major program crops may be found at the online briefing rooms maintained by the Economic Research Service (ERS) of USDA, available at [http://www.ers.usda.gov/briefing].

Figure 1. Monthly International Export Prices for Corn, Wheat, and Rice: January 1990 to April 2008



Source: U.N. FAO, International Commodity Prices. Rice: Thai 100% Grade B, f.o.b. Bangkok; Wheat: U.S. No.2, Hard Red Winter, Gulf; Corn: U.S. No. 2 Yellow, Gulf.

Figure 2. U.S. Season Average Farm Prices for Corn, Soybeans, Wheat, and Rice: 1960/61 to 2007/08



Source: National Agricultural Statistics Service, USDA.

Global Food Crises Declared by United Nations

While the high market prices have been a boon for producers and owners of agricultural commodities, they represent a drastically worsening food security outlook for low-income households, particularly those in poor, import-dependent countries. A global crisis was signaled when, on March 20, 2008, Josette Sheeran,

the executive director of the United Nations' World Food Program (WFP), issued an appeal for $500 million from donor countries to close an immediate gap in the WFP's normal food distribution commitments resulting from rising commodity prices.[3] This was followed on April 14, 2008, by a warning from U.N. Secretary General Ban Ki-moon that a rapidly escalating global food crisis had reached emergency proportions and threatened to wipe out seven years of progress in the fight against poverty.[4] World Bank president Robert B. Zoellick announced that the surge in food prices could push 100 million people living in low-income countries into deeper poverty.[5] That same month the U.N.'s Food and Agricultural Organization (FAO) identified 37 countries in food crisis requiring external assistance — 21 of them in Africa.[6] Then, on April 22, 2008, barely a month after her first announcement, executive director Sheeran announced that the WFP's operation funding gap had now risen to $755 million, up from the earlier estimate of $500 million, due to continuing increases in commodity prices since mid-March.[7]

In addition to global food security concerns, higher commodity prices have stoked the flames of food price inflation and its potentially deleterious effect on lower-income households while raising costs for livestock feeders and food processors. Because the rising prices have been associated with unexpectedly large price volatility, they also have increased the risk and costs of grain merchandising all along the marketing chain. Finally, the high, volatile commodity prices have dramatically increased the cost of routine hedging activities (i.e., pricing commodities for purchase, delivery, or use at some future date) at commodity futures exchanges and thereby diminished "forward contracting" opportunities for grain and oilseed producers who are eager to take advantage of record high market prices.

Not All Commodities Are Equal

The specific circumstances leading to high market prices — e.g., weather-related supply shortfalls, unexpected surges in demand, market-distorting government policies — vary in important ways for each of the major U.S. program crops. For wheat, a combination of international weather-related crop failures over the past two years that has resulted in historically low U.S. and global stock levels is the primary impetus behind high prices. Government policies by several key foreign producers to limit exports in favor of domestic markets also have contributed to higher prices. For coarse grains and oilseeds, a combination of growing demand bolstered by rapid income growth in developing markets and government biofuels

[3] "WFP letter of appeal to Government donors to address critical funding gap," WFP News Room, March 20, 2008, at [http://www.wfp.org/].

[4] "UN chief: Food crisis in now emergency," by Edith M. Lederer, *Breitbart.com*, April 14, 2008, at [http://www.breitbart.com/article.php?id=D901PT181&show_article=1].

[5] "Food Price Crisis Imperils 100 Million in Poor Countries, Zoellick Says," The World Bank, News Release, April 14, 2008, at [http://www.worldbank.org/html/extdr/foodprices/].

[6] *Crop Prospects and Food Situation* report, No. 2, April, 2008, FAO, U.N., at [http://www.fao.org/giews/english/cpfs/index.htm].

[7] "Food Crisis Is Depicted as 'Silent Tsunami'," by Kevin Sullivan, *Washington Post*, April 23, 2008.

mandates are the key drivers. For rice, the combination of population-driven demand growth outpacing crop yields over several years, and recent government policies by several major rice exporting countries to limit exports, are the primary catalysts. For cotton, where global supplies remain relatively abundant, the general "bull market" mentality that currently dominates global markets for nearly all commodities has likely been a major contributor to what are otherwise unusually high prices given cotton's current supply and demand balance.

Of course, no single event or circumstance fully explains high prices for any single commodity. Global economic growth, in general, reinforces demand for all agricultural commodities. Lack of sustained investment in the agricultural sector diminishes long-term productivity potential, dampens producer incentives, and contributes to the slow erosion of food supply availability. High prices for one crop spill over into markets for other crops that compete for the same agricultural land. A ban on rice or wheat exports by one country ripples through all commodity markets that compete for the consumer's food budget. And, as a backdrop, record oil prices have raised costs all along the various commodity marketing chains from field to kitchen table.

High Prices: A Case of Deja Vu

The last period of similarly high commodity prices occurred in the 1995-1996 period, when several years of government stock reductions were followed by an unusual combination of global supply-reducing weather events and strong international demand.[8] However, current commodity market conditions for major U.S. farm program crops — which have occurred simultaneously with dramatic price rises in coffee, cocoa, and tea markets, as well as in non-agricultural markets (e.g, petroleum, gold, silver, platinum, copper, aluminum, iron ore, and coal) — appear more reminiscent of the 1972-1974 period, when increasing inflation, gasoline shortages, and fears of widespread resource depletion appeared to place constraints on economic growth and food production.

In the current farm commodity bull market, global stocks-relative-to-use ratios for vegetable oils and several grain crops are projected to reach historic lows by mid-2008 (**Table 1**). As a result, commodity prices in both cash and futures markets have approached or surpassed historic highs (**Tables 2** and **3**) while exhibiting heightened sensitivity to crop prospects across the globe this year. This sensitivity has translated into record price volatility in agricultural markets. The full consequences of historically high, but unpredictably volatile, commodity prices are only beginning to emerge, but clearly they have raised the cost of doing business and such costs have not been spread evenly among market participants.

On the positive side, high commodity prices have contributed to record U.S. farm income in 2007 and the outlook for even higher returns in 2008, while dramatically reducing government outlays for price-contingent commodity

---

[8] For a brief description of these earlier periods, see "Global Grain Markets in 1996: Shades of 1972-74?" by Pete Riley, *Agricultural Outlook*, September 1996, pp. 2-6.

programs.[9] On the other hand, the outlook for sustained high commodity prices has contributed to the concerns of the U.S. livestock sector and food processors about the continued timely availability of grain and oilseed supplies, and the impact such high input prices have had on their profitability. Historic high price levels and volatility have sharply increased the costs of routine hedging activities of commercial elevators, grain merchandisers, and food processors. In addition, as commodity prices have risen in tandem with food prices, consumers from low-income households and import-dependent nations have expressed concerns, often in the form of riots, about food price inflation, domestic and international food aid, and the ability of agricultural producers to meet projections for continued strong demand growth.

U.S. and Global Stocks Near Historic Lows for Several Crops

U.S. and global stocks for several major U.S. program commodities are expected to be at or near historically low levels — particularly when measured as a share of total usage — prior to the next harvest this coming summer and fall of 2008 (**Table 1** and **Figures 3-8**). For example, global end-of-year stocks for coarse grains and wheat are projected to drop by mid-2008 to the lowest levels since 1977, while ending stocks of total grains fall to the lowest level since 1981. More importantly, their respective stocks-to-use ratios are all projected to reach record lows. Similarly, the stocks-to-use ratios for global corn and vegetable oils are projected to be the tightest since the early 1970s. Global rice stocks, as well as the stocks-to-use ratio, are projected up slightly from the previous year at 77.2 million tons and 18.2% in 2007/2008. However, the previous year's stocks-to-use ratio of 18.1% was the lowest since 1976. Current rice stock levels represent a halving of available supplies from the year 2000, when global ending stocks peaked at 147.1 million tons.

A certain amount of stocks at the end of the marketing year are necessary to provide a continuous flow of grain to processors and exporters before the new crop is harvested — such stocks are referred to as pipeline supplies. Although there is no hard and fast rule on what volume of stocks represents desirable pipeline levels for the major grain and oilseed crops, whenever stocks approach historically low levels market analysts speculate about what pipeline-stock levels might be. For wheat, U.S. pipeline stocks are estimated to be in a range of 9.5 to 11 million tons (350 to 400 million bushels); for corn, 10 to 12 million tons (400 to 500 million bushels); and for soybeans, about 4 to 5.5 million tons (150 to 200 million bushels).[10] Whenever USDA ending stock projections approach these levels, market prices become very sensitive to unexpected market news and prices tend to be more volatile than during periods of abundant stocks.

[9] For more information, see CRS Report RS21970, *The U.S. Farm Economy*.

[10] Pipeline ranges are derived by CRS from various sources.

Table 1. Summary of Global and U.S. 2007/2008 Ending Stocks

	Ending Stocks			Stock-to-Use Ratio	
Commodity	Million tons	Lowest since	Change from 2006/07	%	Lowest since
Global[a]					
Total Grains[c]	317.2	1981	-6%	13%	on record
Coarse Grains[d]	127.5	1977	-7%	11%	on record
Wheat	112.5	1977	-10%	16%	on record
Corn	103.0	1983	-5%	12%	1973
Rice	77.2	2006	1%	17%	2006[e]
Soybeans	49.3	2004	0%	16%	2003
Cotton	13.0	2004	-3%	36%	2003
Vegetable Oil	8.9	2003	-3%	5%	1972
United States[b]					
Total Grains[c]	43.1	1996	-13%	10%	1995
Coarse Grains	35.9	1996	-1%	10%	1995
Wheat	6.6	1947	-47%	10%	1946
Corn	32.6	2003	-2%	10%	2003
Rice	0.7	1980	-45%	9%	1974
Soybeans	4.4	2003	-72%	5%	2003
Cotton	2.1	2006	2%	51%	2005
Vegetable Oil	1.5	2004	-7%	13%	2004

Source: USDA, PSD data base, April 9, 2008.

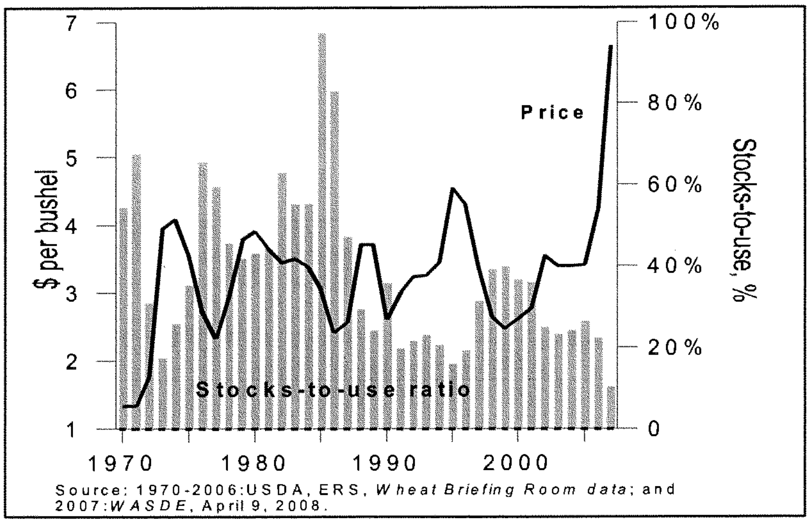
Note: The 2007 crop year covers the period from the start of the 2007 harvest to the start of the 2008 harvest. Thus, ending stocks for the 2007 crop represent supplies available in 2008 just prior to the harvest for the 2008 crop. Similarly, the stocks-to-use ratio for the 2007 crop is a measure of available supplies relative to use just prior to the harvest of the 2008 crop.

[a] USDA's PSD database for global commodities extends back to 1960; thus, "lowest on record" means the lowest data point" since 1960.
[b] USDA domestic data extends back prior to 1900 for most commodities.
[c] Total grains include coarse grains, wheat, and rice.
[d] Coarse grains include corn, sorghum, barley, oats, and rye.
[e] Rice stocks in 2006 were the lowest since 1976.

U.S. wheat ending stocks for 2007/2008 are projected to fall to their lowest level (242 million bushels or 6.6 million tons) since 1947 — well below their pipeline range. U.S. soybean stocks of 4.4 million tons are projected at the lower end of their pipeline range. U.S. corn ending stocks, although projected at what would appear to be an ample level, are low in historical global supply-to-use terms. Furthermore, the multi-year outlook for corn supplies is strongly impacted by the biofuels usage mandate in the Energy Independence and Security Act of 2007 (P.L. 110-140), which suggests that corn supplies will continue to tighten through 2015. Among the major program crops, cotton is the principal exception, with global and U.S. ending stocks projected at relatively abundant levels.

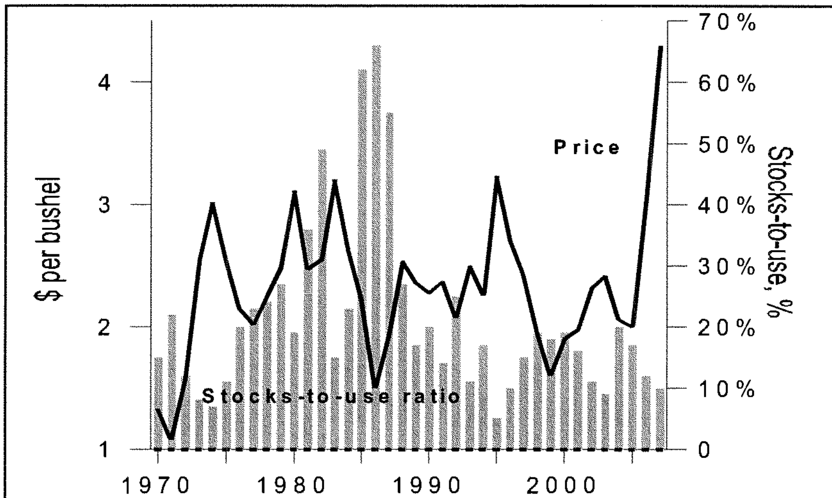
Ending stocks are calculated as the difference between total supplies (beginning stocks plus production plus imports) and total disappearance (all domestic uses plus exports). As such, season-ending stocks of an annually produced commodity summarize the effects of both supply and demand factors during the marketing year. Expected ending stocks — expressed as a ratio over expected total use — are frequently used as an indicator of a commodity's expected price outcome by USDA and other market observers.[11] For most seasonal commodities, annual prices tend to have a strong negative correlation with their ending stocks-to-use ratio (**Figures 3-8**). As a result, expectations for high stocks relative to use typically result in lower prices, while expectations for low stocks relative to use tend to raise prices.

Figure 3. All Wheat: U.S. Season-Average Farm Price vs. Stocks-to-Use Ratio



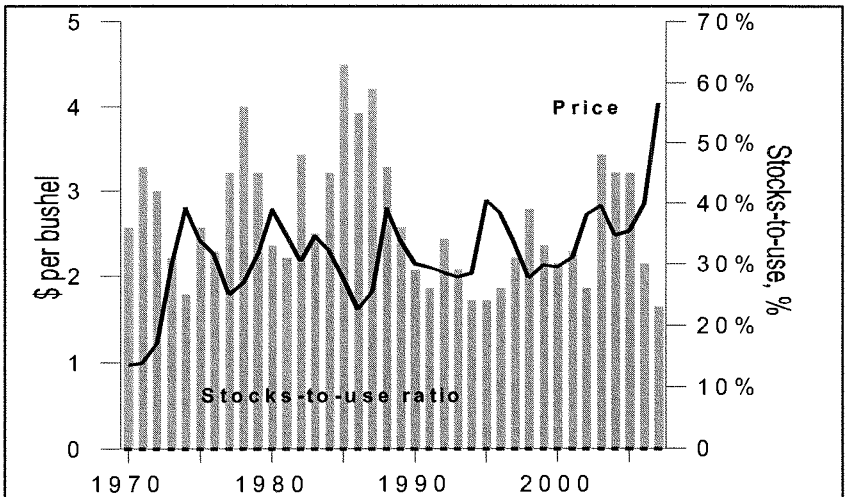
[11] For more information, see CRS Report RL33204, *Price Determination in Agricultural Commodity Markets: A Primer* by Randy Schnepf.

Figure 4. Corn: U.S. Season-Average Farm Price vs. Stocks-to-Use Ratio



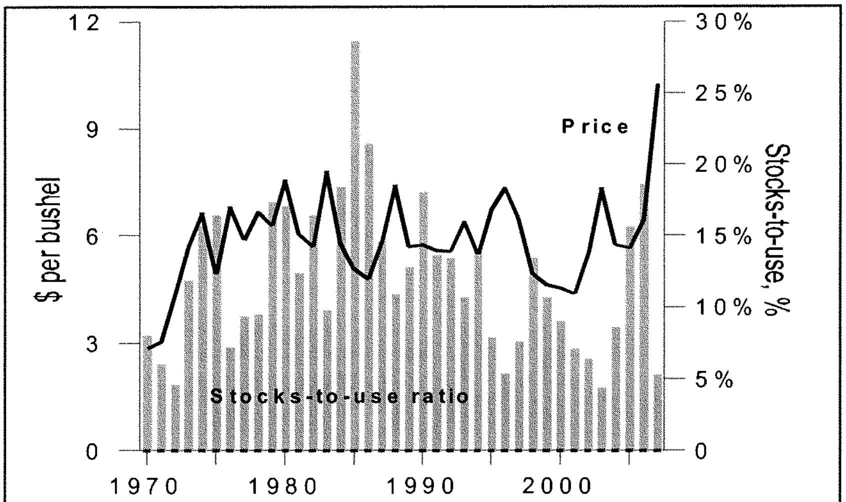
Source: 1970-2006:USDA, ERS, *CornBriefing Room data*; and 2007:*WASDE*, April 9, 2008.

Figure 5. Barley: U.S. Season-Average Farm Price vs. Stocks-to-Use Ratio



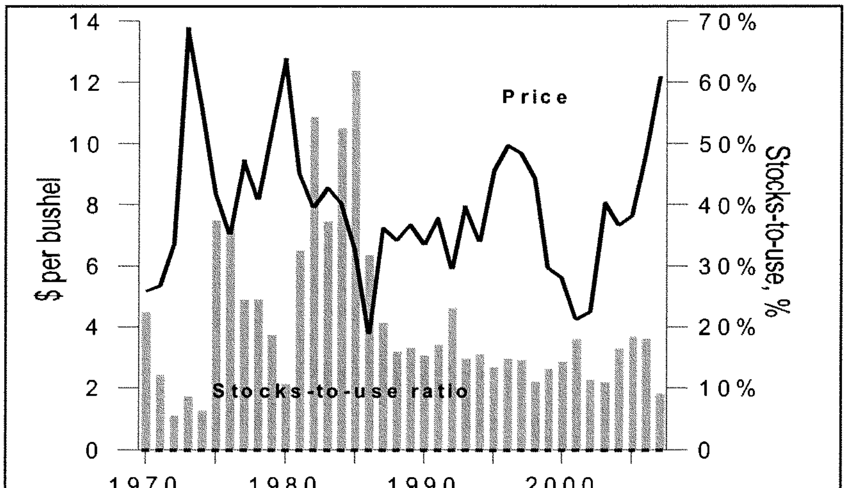
Source: 1970-2006:USDA, ERS, *Corn Briefing Room data*; and 2007:*WASDE*, April 9, 2008.

Figure 6. Soybeans: U.S. Season-Average Farm Price vs. Stocks-to-Use Ratio



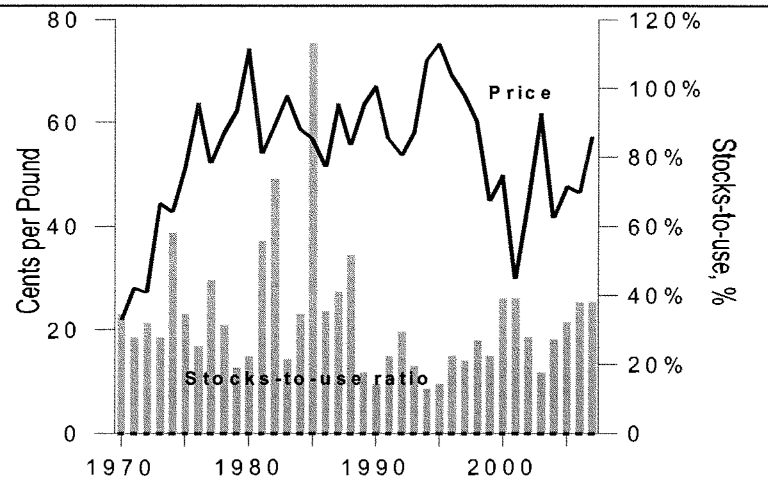
Source: 1970-2006:USDA, ERS, *Soybeans and Oil Crops Briefing Room*; and 2007:*WASDE*, April 9, 2008.

Figure 7. Rice: U.S. Season-Average Farm Price vs. Stocks-to-Use Ratio



Source: 1970-2006:USDA, ERS, *Rice Briefing Room data*; and 2007:*WASDE*, April 9, 2008.

Figure 8. Cotton: U.S. Season-Average Farm Price vs. Stocks-to-Use Ratio



Source: 1970-2006:USDA, ERS, *Cotton Briefing Room data*; and 2007: FAPRI 2008 baseline.; data are for upland cotton.

Many Commodity Price Records Established in 2008

The tight supply situation for many agricultural commodities has sparked higher commodity prices throughout the global marketing chain — farm gate, futures markets, major international ports of call, wholesale distribution points, and finally to retail prices.

International Index of Export Prices Record High

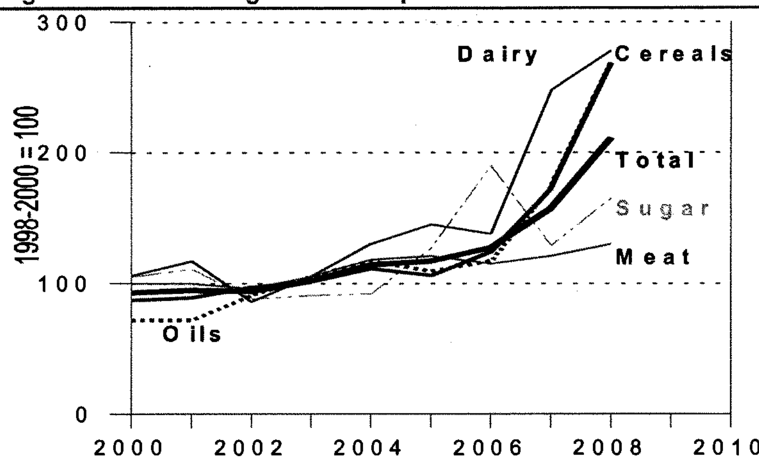
According to the United Nations' Food and Agricultural Organization (FAO), export prices for major agricultural commodities rose 23% during 2007 following a 34% rise in 2006 (**Figure 9**).[12] Furthermore, the FAO's food price index indicates that food prices in the international marketplace have jumped nearly 18% during the first three months of 2008, driven largely by price rises in cereals (up 27%) and oils (up 26%). This rapid price rise is evidenced by the direction of major export prices for wheat, corn, and rice in **Figure 1**. FAO predicts that the cereal import bill for the world's poorest countries will rise by 56% in 2007/08, following a 37% increase in 2006/2007.[13]

---

[12] *World Food Situation*, Food Price Indices, FAO, April 2008, at [http://www.fao.org/worldfoodsituation/FoodPricesIndex].

[13] "Poorest countries' cereal bill continues to soar, governments try to limit impact," FAO Newsroom, FAO, April 11, 2008.

Figure 9. U.N. FAO Agricultural Export Price Index: 1990 to 2008



Source: U.N. FAO, 2008 is based on data through mid-April.

U.S. Farm Prices Projected Record High for Several Crops

In light of the commodity price increases of the past several months, USDA is projecting record high season-average farm prices for wheat, corn, sorghum, barley, soybeans, and soybean products (soybean oil and soybean meal) for the current 2007/2008 crop year, while farm prices for rice are expected to be the highest since 1973 (**Table 2**). Prices for minor oilseeds (e.g., sunflower and rapeseed), oats, and hay crops also are projected to approach or surpass previous record highs.

USDA's farm price estimates are weighted by monthly marketings. Since a large portion of each crop is marketed within two to three months of harvest when seasonal prices are generally at their lowest level, the season average farm price (SAFP) is weighted downward by a large volume of lower-priced early marketings. Also, USDA reports farm prices on a monthly basis, not daily like the major commodity futures exchanges. As a result, the monthly farm prices reported by USDA do not exhibit the same degree of volatility as that of the futures prices reported in the news media. For examples, see the discussion in the next section on futures contract prices and compare the record futures contract prices for the major program crops as reported in **Table 3** with the farm prices reported in **Table 2**.

While the establishment of record highs for grain and oilseed program crops is noteworthy, the extent to which the 2007/2008 prices deviate from both the average prices of the preceding five-year period and the previous record SAFPs has evoked concern and even alarm from consumer and hunger advocates. For example, the 2007/2008 corn SAFP of $4.30 per bushel is projected to be nearly 94% above the previous five-year average farm price of $2.22 and about 33% above the previous record high $3.24 achieved in 1995/1996. Most grains and oilseeds are projected at least 56% to 94% above the previous five-year average price. Soybean oil is projected 121% above its five-year average. Even cotton, a relatively abundant commodity, is projected 25% above its previous five-year average price.

Table 2. U.S. Farm (or Wholesale) Prices: Projected versus the Previous Five-Year Average and Prior Record

		Prior record		5-Year Avg.	Proj. 2007/08[c]		Proj. 2007/08 to 2017/18[e]	
Crop	Units	Price[a]	Crop Year	(5YA) Price[b]	Price[a]	% of 5YA	Avg. Price	% of 5YA
All Wheat	$/ bu.	$4.55	95/96	$3.56	$6.65	187%	$5.51	155%
Corn	$/ bu.	$3.24	95/96	$2.22	$4.30	194%	$3.93	177%
Sorghum	$/ bu.	$3.29	06/07	$2.18	$4.15	191%	$3.70	170%
Barley	$/ bu.	$2.89	95/96	$2.60	$4.05	156%	$3.96	152%
Soybeans	$/ bu.	$7.83	83/84	$6.03	$10.25	170%	$10.24	170%
Soy Oil	¢ /lb.	31.6¢	73/74	23.6¢	52.0¢	221%	54.6¢	232%
Soy Meal	$/s.t.	$270.7	96/97	$193.61	$325.0	168%	$237.3	123%
Rice	$/cwt	$13.80	73/74	$6.81	$12.20	179%	$11.54	169%
Upl. Cotton	¢ /lb.	76.5¢	95/96	46.0¢	57.3¢[d]	125%	62.0¢	135%

Notes: s.t. = short ton; cwt = hundred pounds.

[a] Season average farm price received (SAFP) for all wheat, corn, sorghum, barely, soybeans, rice, and upland cotton, National Agricultural Statistics Service (NASS), USDA; season average annual wholesale prices for soybean oil and soybean meal, Decatur, Illinois, Agricultural Marketing Service (AMS), USDA.

[b] Simple average of SAFPs or wholesale prices for the 2002/03 to 2006/07 period.

[c] Mid-point of projected price range; *WASDE Report*, April 9, 2008, WAOB, USDA.

[d] Projection from *U.S. Baseline Briefing Book*, FAPRI-MU Report #03-08, March 2008.

[e] Avg. for the 10-year projection period, 2007/08 to 2017/18, FAPRI-MU Report #03-08, Mar 2008.

Recent (March 2008) long-run commodity price projections from the Food and Agricultural Policy Research Institute (FAPRI) suggest that, when commodity markets return to equilibrium, the long-run average price for major program crops will settle at levels that are 23% to 132% above the recent five-year average.

Several Futures Prices Set All-Time Highs

Unlike cash markets which deal with the immediate transfer of goods, a futures exchange provides the facilities for buyers and sellers to trade commodity futures contracts — that is, contracts to buy (or sell) a specified volume of a commodity, subject to detailed quality conditions, at a fixed price for potential physical delivery (or acquisition) at some future date. Commodity futures exchanges are important barometers of commodity price movements — both the general level as well as the volatility — because they function as a central exchange for domestic and international market information. Market participants are able to respond with buy or sell orders within seconds upon receiving new information. As a result, futures contract prices react almost instantaneously to new information regarding commodity supply and demand expectations. This futures market activity (e.g., price, volume, open interest) is then reported electronically by the major exchanges through their

own news media, as well as through national and international news media.[14] As a result of this transparency, futures exchanges have served two critical roles — price discovery and risk management — in facilitating the marketing of agricultural commodities.

The market circumstances of the first few months in 2008 have clearly manifested themselves in the commodity futures exchanges, where prices for many commodities have hit historic all-time highs (**Table 3**). For example, at the Chicago Board of Trade (CBOT), prices for nearby futures contracts for corn, wheat, soybeans, soybean oil, and rice reached all-time highs in early March 2008.[15] Corn and rice contracts have remained particularly active, pushing to new contract highs on almost a daily basis during April (**Figures 10** and **11**). Finally, the July 2009 futures contract for corn set a new all-time high of $6.584 per bushel on May 2, 2008.[16]

Heightened Commodity Price Volatility Since 2005. As commodity price levels have moved higher over the past two years in response to the gradual tightening of global supplies, they also have exhibited unprecedented volatility in the range of daily price movements, swinging rapidly up and down in response to the arrival of new market information. For example, according to a CBOT volatility index (of day-to-day price movements converted to an annual basis), corn and wheat futures contract price volatility have averaged 19.7% and 22.2% since 1980 (**Figure 12**).[17] However, in 2006 and 2007 both corn and wheat price movements have produced successive record annual volatility measures of 28.8% and 31.4% for corn, respectively, and 30.4% and 32.7% for wheat.[18]

Both the price level and volatility for most agricultural commodities have continued to rise in 2008. During March 2008, CBOT's monthly average price volatility (expressed on an annualized basis) for wheat was 73%, corn 41%, soybeans 54%, soybean oil 57%, soybean meal 65%, and rough rice 35%.

---

[14] For more information on agricultural futures exchanges see pp. 7-10 of CRS Report RL33204, *Price Determination in Agricultural Commodity Markets: A Primer.*

[15] CBOT daily futures contract price quotes are available at [http://www.cbot.com].

[16] As of May 5, 2008.

[17] The price volatility index is a measurement of the day-day change in price. It is expressed as a percentage and computed as the annualized standard deviation of the percentage change in daily price.

[18] Chicago Mercantile Exchange (CME) Group, Datamine, Historical Volatility Measures, [http://www.cmegroup.com/].

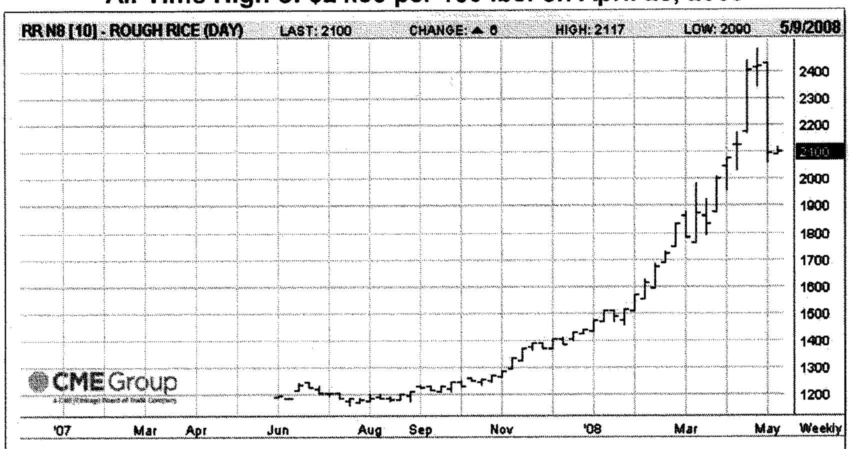
Table 3. Futures Contract Price Highs, Selected Commodities and Months, versus the Recent Five-Year Average Farm Price (AFP)

Commodity	Futures Exchanges[a]	Unit	Contract: Month / YR	Date	Intra-day High Price[b]	5-Year AFP[d]
Wheat: HRS	MGEX	bushels	March 08	2/25/08	$25.00[c]	$3.70
			May 08	2/27/08	$19.00	
	Previous high		*May 96*	*5/10/96*	*$7.32*	
Wheat: HRW	KCBOT	bushels	March 08	2/27/08	$13.70[c]	$3.54
			May 08	2/27/08	$13.70	
	Previous high		*May 96*	*4/26/96*	*$7.44*	
Wheat: SRW	CBOT	bushels	March 08	2/27/08	$13.35	$3.28
			May 08	2/27/08	$13.50[c]	
	Previous high		*July 96*	*3/20/96*	*$7.50*	
Corn	CBOT	bushels	March 08	3/11/08	$5.72	$2.22
			May 08	4/9/08	$6.16	
			July 09	5/2/08	$6.584[c]	
	Previous high		*July 96*	*7/12/96*	*$5.55*	
Soybeans	CBOT	bushels	March 08	3/3/08	$15.71	$6.03
			May 08	3/3/08	$15.86	
			July 08	3/3/08	$15.95[c]	
	Previous high		*July 73*	*6/5/73*	*$12.90*	
Soybean oil	CBOT	pounds	March 08	3/3/08	$0.708	$0.236[e]
			May 08	3/3/08	$0.708	
			March 09	3/3/08	$0.721[c]	
	Previous high		*October 74*	*10/1/74*	*$0.510*	
Soybean meal	CBOT	short	March 08	3/3/08	$385.70	$193.6[e]
			May 08	3/3/08	$392.90	
			July 08	3/3/08	$393.00	
	Previous high		*July 73*	*6/5/73*	*$451.00*	
Rice	CBOT	cwt	March 08	3/13/08	$19.55	$6.81
			May 08	4/23/08	$24.46	
			July 08	4/23/08	$24.85[c]	
	Previous high		*March 97*	*1/31/97*	*$12.45*	

Source: Futures contract prices are reported daily by the various futures exchanges and reprinted in the *Wall Street Journal*; farm prices are from NASS, USDA; and cash prices are from AMS, USDA.

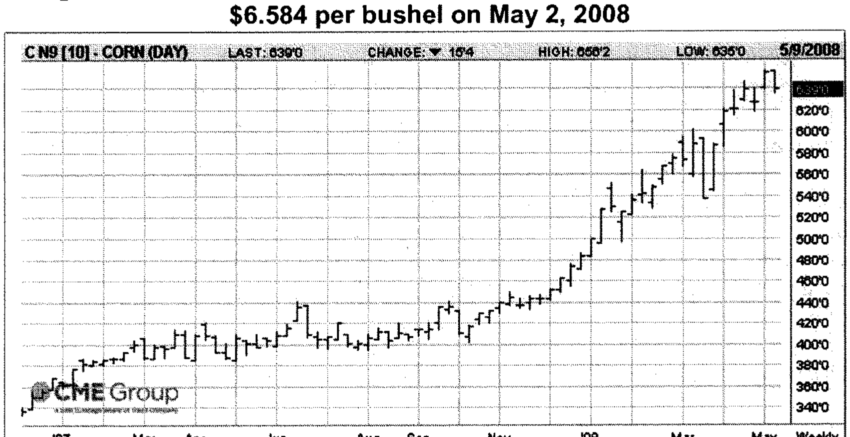
[a] MGEX = Minneapolis Grain Exchange; KCBOT=Kansas City Board of Trade; and CBOT=Chicago Board of Trade; cwt = hundredweight (i.e., 100 lbs.).
[b] Record price for each contract month with the exception of the July soybean meal futures contract.
[c] Record price for any futures contract month for this commodity at this exchange as of May 5, 2008.
[d] Simple average of monthly farm prices received for the five-year period 2002/03 through 2006/07.
[e] Simple average of monthly cash prices; Decatur, Illinois.

Figure 10. Rough Rice July 2008 Futures Contract Sets All-Time High of $24.85 per 100 lbs. on April 23, 2008



Source: Chicago Board of Trade, as of May 5, 2008.

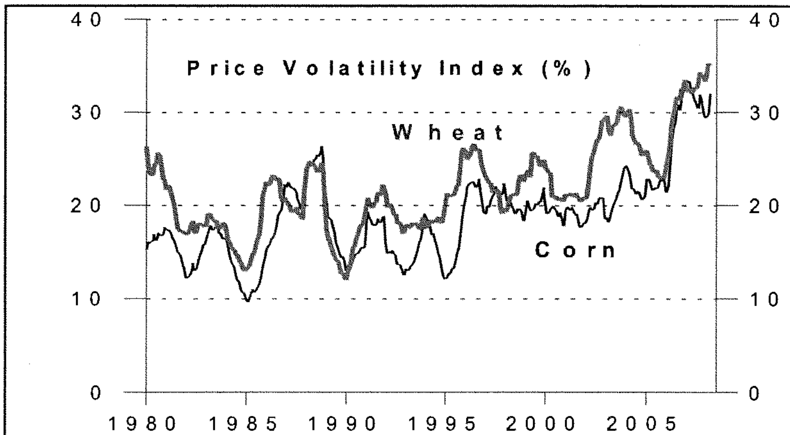
Figure 11. Corn July 2009 Futures Contract Sets All-Time High of $6.584 per bushel on May 2, 2008



Source: Chicago Board of Trade, as of May 5, 2008.

Note: Futures market price data is presented as weekly price ranges with the left tick representing the week's opening price and the right tick representing the week's final settlement price.

Figure 12. Eleven-Month Moving Average of Price Volatility Index for Corn and Wheat Futures Prices Since 1980



Source: Chicago Mercantile Exchange (CME) Group, datamine, Historical Price Volatility; [www.cmegroup.com/].

Factors Behind the High Prices

Rising food prices, which are affecting millions of people, are rooted in what Josette Sheeran, Executive Director of the WFP, has described as a "perfect storm" of increasing demand for food from emerging economies, competition between biofuels and food production, high fuel prices, and increasing climatic shocks such as droughts and floods.[19] Further contributing to high commodity prices have been a series of international government policies to limit domestic export supplies that have heightened fears of shortage and a weak U.S. dollar that has made U.S. exports more competitive in international markets. The market effects of these factors have been particularly acute for agricultural commodities because of the inelastic nature of both supply and demand.[20]

Widespread Weather-Related Crop Shortfalls

Global grain production declined in both 2005 and 2006 — primarily due to declining global productivity — cutting into existing stocks and reducing exportable supplies. A major tipping point occurred in 2007 when Australia — traditionally a major wheat and barley exporter — suffered a second consecutive year of sharply lower grain production due to drought. With stocks already low, Australia's 2007 grain exports were dramatically curtailed for a second year. Meanwhile, grain crops

[19] Statement given at the "Inaugural Ceremony: 30th Anniversary Session of IFAD's Governing Council," by Josette Sheeran, Executive Director, WFP, February 13, 2008.

[20] For more information, see CRS Report RL33204, *Price Determination in Agricultural Commodity Markets: A Primer*, "Price-Inelastic Demand and Supply," p. 23.

in the United States, Canada, European Union (EU), Eastern Europe, and some countries of the former Soviet Union were also reduced by weather conditions. In the EU, declining grain supplies forced livestock producers to import substantial volumes of wheat and other feed grains for feed rations. As a result, the EU switched from its traditional status as a major net exporter of grains into a net importer in 2007. The cumulation of these events severely drew down global grain supplies (**Table 1**).

Strong Economic Growth in Developing Countries

A steadily increasing world population, boosted by robust growth in purchasing power, especially in developing countries such as China and India, has contributed to a permanent increase in global demand for more and different kinds of food.[21] As households improve their incomes and food purchasing power, they shift their demand away from traditional staples and toward higher-value foods like meat and dairy products.[22] This dietary shift is leading to increased demand for grains used to feed livestock.

Weak U.S. Dollar Lowers Cost of U.S. Exports

When the U.S. dollar declines in value in international exchange markets relative to the currency of our export competitors (e.g., Canada, Australia, or the EU) or importing nations (e.g., Japan, Taiwan, etc.), it makes U.S. export products cheaper and, therefore, more competitive. Since January 2002, the U.S. dollar has lost over 44% of its value against the EU's euro and the Australian dollar, and nearly 37% against the Canadian dollar (**Figure 13**).[23]

A key result of the declining value of the U.S. dollar has been a dramatic surge in U.S. exports of agricultural products, particularly of bulk commodities. Record exports in the face of historically high commodity prices seems somewhat counterintuitive. However, the decline in the foreign exchange value of the U.S. dollar has been so dramatic that, in some cases, it has completely offset the rise in commodity prices, thereby making U.S. grains and oilseed very attractive.

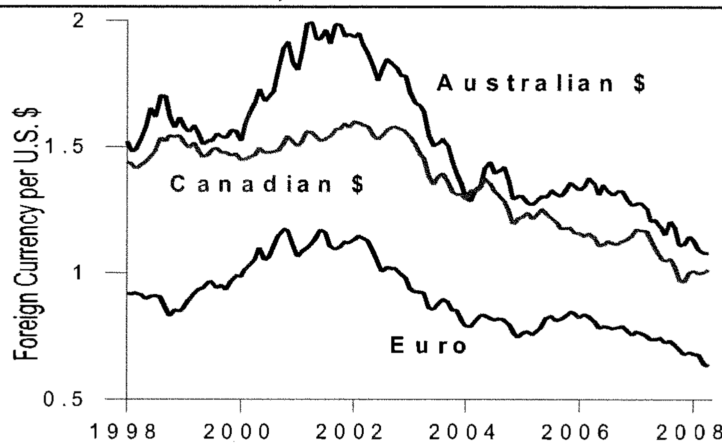
---

[21] For more information on GDP and population growth in the developing world, see *USDA Agricultural Projections to 2017*, OCE-2008-1, USDA, pp. 12-13.

[22] *Rising Food Prices: What Should Be Done?*, Joachim von Braun, International Food Policy Research Institute Policy Brief, April 2008.

[23] For more information, see CRS Report RL31985, *Weak Dollar, Strong Dollar: Causes and Consequences* by Craig K. Elwell.

Figure 13. The U.S. Dollar Has Steadily Weakened Against the Euro, the Canadian Dollar, and the Australian Dollar Since 2001



Source: Monthly exchange rates, Pacifica Exchange Rate Service.

Total U.S. agricultural exports in FY2008 are estimated at a record $101 billion, including record bulk shipments of $44.7 billion and 135.8 million tons.[24] In terms of year-to-year export volumes, U.S. corn exports are projected up nearly 18% to a record 2.5 billion bushels (63.5 million tons) in the 2007/2008 marketing year, wheat exports are projected up 40%, sorghum exports 82%, and rice exports 23%. These record shipments of grains and oilseeds have helped to draw down U.S. stocks and fuel higher commodity prices.

Government Biofuels Policy

Concerns over high oil prices, energy security and climate change have prompted governments to take a more proactive stance towards encouraging the production and use of agriculture-based biofuels.[25] Several countries have set standards or targets for use of biofuels. The largest biofuels programs are in the United States, Brazil, and the EU. Brazil requires a minimum use of 20%-25% of sugar-cane-based ethanol (E20-E25) in its national gasoline supply, and has subsidized the establishment of a national distribution network that includes pumps for 100% ethanol in addition to the E20-E25 blend. In addition, Brazil requires that all diesel oil contain a 2% blend of biodiesel by 2008 rising to a 5% blend by 2013. The EU has established a goal of 5.75% of motor fuel use from biofuels by 2010, rising to 10% by 2020. The EU's program is primarily focused on vegetable-oil-based biodiesel production. As a result of its biofuels policy, EU farm policy

---

[24] *Outlook for U.S. Agricultural Trade*, AES-57, February 21, 2008, at [http://usda.mannlib.cornell.edu/usda/current/AES/AES-02-21-2008.pdf]. Bulk shipments include wheat, rice, feed grains, soybeans (and other oilseeds), cotton and linters, and tobacco.

[25] For more information, see CRS Report RL32712, *Agriculture-Based Renewable Energy Production*.

incentives have generally favored the expansion of rapeseed production at the expense of wheat, barley, and other grain crops. Thailand, India, and China also have established biofuel mandates that hinge on the expansion of agriculture-based biofuels. However, these three countries have at least temporarily suspended their biofuels programs in light of the current high commodity prices and global food crisis.

U.S. Biofuels Mandate. In the United States, the Energy Independence and Security Act of 2007 (EISA; P.L. 110-140) extended and substantially expanded the existing Renewable Fuel Standards (RFS).[26] The RFS is a usage requirement mandating that an increasing volume of biofuels be blended with conventional fuels. Under EISA, the RFS mandates the use of at least 9 billion gallons of biofuel in U.S. fuel supplies in 2008, but grows quickly to 20.5 billion gallons by 2015 and to 36 billion gallons by 2022. The U.S. biofuels sector is also supported by a tax credit (TC) of $0.51 for every gallon of ethanol blended in the U.S. fuel supply ($1.00 per gallon of virgin-oil-based biodiesel), and an import tariff of $0.54 per gallon of imported ethanol.[27] In addition, several federally-subsidized grant and loan programs assist biofuels research and infrastructure development.

Current U.S. biofuel production is almost entirely corn-based ethanol — nearly 6.5 billion gallons of corn-ethanol were produced in 2007, compared with an estimated 450 million gallons of biodiesel. The RFS for corn-based ethanol is capped at 15 billion gallons in 2015. However, additional mandates for biodiesel and for cellulosic and other non-corn ethanol continue to expand to a total RFS of 36 billion gallons by 2022. This mandate places tremendous pressures on U.S. and global crop production systems. This crop year (2007/2008), USDA estimates that about 24% of the U.S. corn crop will be used to produce ethanol; however, this share is projected to grow to 33% next year. This rapid, "permanent" increase in corn demand has directly sparked substantially higher corn prices to bid available supplies away from other uses — primarily livestock feed. Higher corn prices, in turn, have forced soybean, wheat, and other grain prices higher in a bidding war for available crop land.

This bidding war is being played out in global markets as traditional corn users search for alternative feed grain supplies. According to the World Bank, increased biofuel production has been one of the principal causes of the dramatic rise in food prices — almost all of the increase in global corn production from 2004 to 2007 (the period when grain prices rose sharply) went for biofuels production in the United States.[28]

---

[26] For more information, see CRS Report RL32712, *Agriculture-Based Renewable Fuels*, and CRS Report RL34265, *Selected Issues Related to an Expansion of the Renewable Fuel Standard (RFS)*.

[27] An exception to the tariff exists under the Caribbean Basin Initiative; see CRS Report RS21930, *Ethanol Imports and the Caribbean Basin Initiative*.

[28] "Rising Food Prices: Policy Options and World Bank Response," World Bank, undated mimeo, at [http://www.worldbank.org/].

Economic Analysis of U.S. Biofuels Mandate. A recent study by the Food and Agricultural Policy Research Institute (FAPRI) attempts to measure the pure and joint price effects of the U.S. biofuels RFS and the tax credits (TC) (**Table 4**).[29] FAPRI's study suggests that implementation of EISA's RFS (in the absence of the TC) will raise corn price by about 19% once the new long-run equilibrium has been established. The FAPRI study also estimates that the ethanol tax credit (TC) of $0.51 per gallon (in the absence of the RFS) supports corn prices by a slightly smaller 11%. Because of interactions between the two subsidies, it is estimated that joint implementation of both the RFS and TC supports corn prices by about 20%.

Strong effects were also observed by FAPRI for other commodities, particularly soybean oil whose wholesale price is projected 73% higher under the joint RFS-TC scenario (**Table 4**). A substantial portion of corn price effects are likely transmitted to the soybean market via competition for land, primarily in the Corn Belt where soybeans and corn are both widely grown. The biofuels price effects would also transmit to regions outside of the Corn Belt (where wheat, cotton, and other major grain and oilseeds are produced) as farmers reconfigure their planting decisions and opt for greater soybean and corn production to maximize returns.

A similar study by the Center for Agricultural Research and Development (CARD) found that, jointly, the RFS and TC supported the price of corn by a slightly smaller 16%.[30] Both of these studies found the results to be highly dependent on the price of petroleum (or gasoline). Higher petroleum prices substitute for government incentives and diminish the relative impact of such incentives on corn prices. Neither study evaluated the effect of the U.S. import tariff of $0.54 per gallon on imported ethanol from Brazil, although the CARD study pointed out that the corn price impacts would be greater if the tariff on Brazilian ethanol were eliminated. Nor did either study include the effects of the various grants and subsidized loans that have been made available to the U.S. biofuels sector for research and infrastructure development.

The CARD study also investigated the potential combined impact of the biofuels mandate with a major drought in the Corn Belt. The study replicated the 1988 drought when corn yields fell almost 25% below trend levels. Study results suggest that weather-reduced corn supplies confronted by a biofuels blending mandate would place severe pressures on the U.S. and global corn market — with the mandate in place, corn prices would increase to an eye-popping $8.62 per bushel compared with $7.28 without the mandate. Thus, the study projects that corn prices would be over 18% higher with the mandate in place if a severe 1988-like drought occurred.

---

[29] "The Energy Independence and Security Act of 2007: Preliminary Evaluation of Selected Provisions," FAPRI-MU #01-08, Jan. 2008.

[30] "The Outlook for Corn Prices in the 2008 Marketing Year," *Iowa Ag Review*, Spring 2008, Vol. 14, No. 2, pp. 4-5; and "Ethanol, Mandates, and Drought: Insights from a Stochastic Equilibrium Model of the U.S. Corn Market," by Lihong Lu McPhail and Bruce A. Babcock, Working Paper 08-WP 464, CARD, Iowa State University, March 2008.

Table 4. FAPRI Projections of U.S. Biofuel Policy Impacts

	Units	No RFS No TC	No RFS TC		RFS No TC		RFS TC	
		Scenario: Projections and % Change						
Production								
Ethanol	Bil. gal.	8.11	11.7	44%	14.1	74%	14.5	79%
Biodiesel	Bil. gal.	0.23	0.51	122%	0.96	317%	0.96	317%
Price								
Corn	$/bu.	2.81	3.11	11%	3.33	19%	3.37	20%
Soybeans	$/bu.	6.15	6.64	8%	7.21	17%	7.25	18%
Wheat	$/bu.	4.03	4.19	4%	4.31	7%	4.33	7%
Soy Meal	$/s.t.	179.99	166.23	-8%	138.29	-23%	137.98	-23%
Soy Oil	$/lb.	26.89	34.34	28%	46.29	72%	46.64	73%

Source: "The Energy Independence and Security Act of 2007: Preliminary Evaluation of Selected Provisions," FAPRI-MU #01-08, Jan. 2008.

Note: The numbers presented in this table are the averages of the scenario projections for the 2011 to 2016 period, thus, they are an estimate of the long-run equilibrium values. The "No RFS; TC extended" scenario represents FAPRI's December 2007 baseline projections.

Foreign Government Policies to Limit Exports

Foreign government policy responses to the high commodity prices have, for the most part, had the perverse effect of reinforcing higher prices thereby contributing to, rather than alleviating, the current market supply-and-demand conditions.

Since late 2007, several traditional wheat and rice exporting countries — in an effort to ensure domestic food availability and temper rising internal inflation — have instituted policies designed to limit exports of domestic supplies. These policies, albeit implemented to dampen internal prices for domestic consumers, have had exactly the opposite effect on international market prices, pushing them higher than supply and demand conditions would otherwise dictate by limiting access to available supplies by international buyers. On April 24, 2008, the WFP claimed that more than 40 food-exporting countries had placed some kind of restriction or outright ban on many crop exports in an attempt to stabilize prices within their borders.[31]

For example, in the international rice market, the traditional exporters including Vietnam, India, China, and Egypt, (the world's second-, fourth-, sixth-, and eighth-leading rice exporters last year), along with minor exporter Cambodia, have all set in place policies to limit exports. The combined effect of these bans is to remove over a third of available export supplies from world markets and to drive

[31] Nathanial Gronewold, "Food prices hampering U.N. agency's ability to head off 'new face of hunger,'" *E&E News PM*, April 24, 2008, at [http://www.eenews.net].

international rice prices sharply higher. Similar action in the international wheat market includes both Ukraine and Argentina which, in the spring of 2007, initiated wheat export restrictions in efforts to control food price inflation. Pakistan placed taxes on wheat exports. By late February 2008, Kazakhstan officials set in place policies to slow their country's wheat export pace (via higher custom duties), also due to declining supplies.[32] By mid-April, Kazakhstan had converted its export slowdown into an outright ban.

Argentina's government policy of banning wheat and beef exports, slowing corn exports through procedural barriers at customs, and heavily taxing exports of soybeans[33] (both to limit exports and to raise government revenues) is particularly noteworthy for three reasons. First, the export controls resulted in a nationwide farmers' strike whereby producers refused to bring to market any agricultural products. Second, although the strike (after lasting three weeks) was temporarily suspended for 30 days starting on April 3, 2008,[34] in an agreement between farmers and government that essentially left the export controls in place, the uncertainty surrounding Argentina as a reliable export supplier resulted in a substantial amount of purchase contracts being diverted to U.S. suppliers. Thus, already huge U.S. export numbers were further bolstered by the shift in demand from Argentinean to U.S. commodities. Third, Argentina's strict export controls have had a major impact on that country's agricultural prospects, at least in the short run, as most market analysts are now predicting a significant decline in Argentina's planted area for wheat (and possibly corn and soybeans) in 2008.[35]

Alternately, on the demand side, several countries that either depend on imports to meet an important share of their domestic food needs, or have large groups of nutritionally vulnerable people, began to remove long-standing barriers to imports.[36] For example, in late March 2008, India authorized duty-free imports of rice. Several other Asian, African, Latin American, and Caribbean nations have also lowered or eliminated tariffs on a range of imported foodstuffs. In addition, many countries froze internal commodity prices at below market levels and issued temporary income subsidies to help consumers meet their food needs. While these consumer-oriented actions may be laudable, they have had the effect of increasing international demand at the same time that international supplies are being restricted.

---

[32] "Wheat Jumps on Supply Concerns," Stevenson Jacobs, *Washingtonpost.com*, Feb. 25, 2008.

[33] "Argentina suspends wheat exports indefinitely," *Commodity Online*, April 22, 2008.

[34] "Farmers' Strike in Argentina Is Suspended for Negotiations," by Vinod Sreeharsha and Alexei Barrionuevo, New York Times, April 3, 2008.

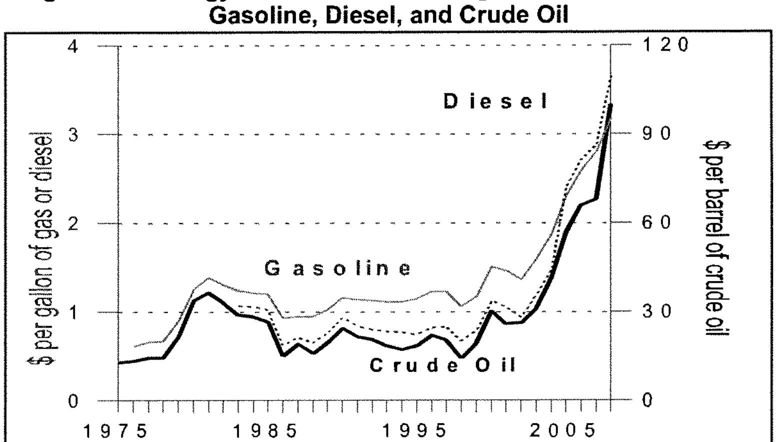
[35] "Argentine Soybean Output May Slip; Protests May Pause,"by Heather Walsh and Eliana Raszewski, *Bloomberg News*, March 19, 2008.

[36] *Crop Prospects and Food Situation*, No. 2, April 2008, FAO, U.N., at [http://www.fao.org/worldfoodsituation].

High Energy Costs

Petroleum prices have doubled since January 2007 when the monthly spot market price for West Texas Intermediate (WTI) at Cushing, Oklahoma, averaged $53.70 per barrel (**Figure 14**). On April 22, 2008, the price for WTI exceeded a record $119 per barrel and have since surpassed $120. Since gasoline, diesel fuel, and other energy products are either directly or indirectly derived from petroleum, high petroleum price have increased operating costs all along the marketing chain for agricultural inputs and outputs, thus inflating prices everywhere. Energy-driven higher marketing costs accumulate at the retail outlet where they translate directly into higher consumer food prices.

Figure 14. Energy Costs: Annual Average Prices Since 1975 for Gasoline, Diesel, and Crude Oil



Source: Gasoline, Unleaded Regular, U.S. City Average; Diesel:, No. 2, Retail Sales; Crude Oil, West Texas Intermediate, Cushing, OK ;Energy Information Agency, Dept of Energy.

High petroleum prices and strong demand for ocean shipping drove ocean rates for shipping bulk commodities to record levels in 2007, nearly doubling the previous record set in 2004, and adding to the imported cost of internationally traded products.[37] WFP executive director Sheeran has suggested that high oil prices may be the single most important factor in driving up food costs because, in addition to its effect on raising energy costs throughout the marketing chain, it has boosted the popularity of biofuels.[38]

---

[37] *Grain Transportation Report*, Agricultural Marketing Service, USDA, April 17, 2008.

[38] Nathanial Gronewold, "Food prices hampering U.N. agency's ability to head off 'new face of hunger'," *E&E News PM*, April 24, 2008, at [http://www.eenews.net].

Macroeconomic Linkages Reinforce Price Rises

Several economists have stated that U.S. fiscal policies intended to stave off economic recession have contributed indirectly to the U.S. and global "food crises" by resulting in a weaker U.S. dollar. Between September 2007 and April 2008, the U.S. Federal Reserve's Open Market Committee cut a key interest rate (the federal funds rate) by 3.25 percentage points to 2%, primarily due the escalating financial crisis related to the rise in defaults on subprime mortgages and the overall weak U.S. economy.[39] Lower U.S. interest rates contribute to a decline in the value of the dollar relative to other currencies which, in turn, contributes to higher U.S. commodity exports and higher oil prices.

Since oil is priced in U.S. dollars in international markets, a weakening dollar is generally perceived as contributing to higher oil prices via two mechanisms. First, oil exporters must raise the dollar price per barrel to retain the same level of purchase power against appreciating non-U.S. currencies. Second, oil importers — whose currencies have generally strengthened against the dollar — drive the dollar price of oil higher when they bid the same price per barrel in their own currency. Since the United States is the world's largest oil importer, surging oil import costs pressure the U.S. trade deficit and ripple through the U.S. economy further slowing economic activity. The weakening U.S. economy has impacted capital and stock market prices. As a result, the bullish commodity markets have become an attractive market for mutual funds and investors seeking more profitable investment opportunities. This "speculative" investment money — valued in the hundreds of billions of dollars — has been accused of reinforcing rising prices.[40] Some analysts suggest that agricultural commodity markets are now playing a role traditionally reserved for gold and other precious metals — a safe haven for investors.[41]

Implications of High Commodity Prices

U.S. Farm Income Record High

The past six years are the six highest farm income years on record, but the past two years have seen significant gains from previous records.[42] According to USDA's Economic Research Service (ERS), national net cash income — a key indicator of U.S. farm well-being — is expected to rise to a record $96.6 billion in 2008, over 10% above the previous year's record ($87.6 billion) and 26% above the four-year

---

[39] "Open Market Operations," Federal Open Market Committee, U.S. Federal Reserve Board, at [http://www.federalreserve.gov/fomc/fundsrate.htm]; see also CRS Report 98-856, *Federal Reserve Interest Rate Changes: 2000-2008*, by Marc Labonte and Gail E. Makinen.

[40] "Some blame speculators for worsening global food crisis," RB, *Greenwire*, April 24, 2008.

[41] Nathanial Gronewold, "Commodity 'feedback loop' fueling price surge," *Greenwire*, March 11, 2008, at [http://www.eenews.net/Greenwire/].

[42] For more information, see CRS Report RS21970, *The U.S. Farm Economy*, by Randy Schnepf.

average of $76.5 billion for 2003 through 2006, all on the strength of higher commodity prices. Farm revenue gains are expected to easily outpace rising input expenses (up 34% versus 29%, respectively, from the 2000-2006 period average), leaving many farm communities flush with cash.

Lower Government Farm Program Outlays

In February, USDA forecast government direct payments at $13.4 billion in 2008, up slightly from $12.0 billion in 2007 but well below the four-year (2003-2006) average of $17.4 billion.[43] Government direct payments peaked at $24.4 billion in 2005. Higher projected market prices are expected to limit payments under the two major price-triggered programs — counter-cyclical payments (CCP), and marketing loan benefits (loan deficiency payments, marketing loan gains, and certificate exchange gains).[44] Fixed direct payments, whose payment rates are fixed in legislation and are not affected by the level of program crop prices, are estimated up slightly at $5.3 billion.

USDA's farm income and government program outlay forecasts, which were released in February 2008, were based on prices that persisted in late 2007. However, commodity prices have increased unexpectedly since then. In March, FAPRI released more current estimates of government direct payments for 2008/2009 at $5.8 billion, down slightly from a revised forecast of $6.0 billion in 2007/2008.[45] Under FAPRI's projections, price contingent outlays on CCP and LDP are about $0.5 billion, while fixed direct payments of $5.2 billion comprise the majority of government subsidy expenditures.

Crop Insurance Premiums Costs Surge in 2008

Commodity prices are a key ingredient in the formula for calculating crop insurance premiums.[46] Higher, more volatile prices lead to higher insurance premiums, but they also provide the opportunity for producers to lock in unusually high per-acre returns. Both volatility and absolute prices levels are substantially higher in 2008 than in 2007 for all major program crops.

For example, the base price for corn was $4.06 per bushel in 2007 compared with $5.25 in 2008 — an increase of $1.19 or 29%.[47] The higher price level plus this

---

[43] Ibid. Note, these farm income and government outlay projections were made in early February 2008, and are likely to be revised downward due to significant price rises since then. The next USDA farm income update is scheduled for August 28, 2008.

[44] For more information on commodity programs, see CRS Report RL33271, *Farm Commodity Programs: Direct Payments, Counter-Cyclical Payments, and Marketing Loans.*

[45] "Selected direct government payments," *U.S. Baseline Briefing Book*, FAPRI-MU Report #03-08, FAPRI, March 2008, p. 59.

[46] Gary Schnitkey, "Crop Insurance Decisions: Why Not the Same as Last Year?" *Illinois AgriNews*, Dept of Agriculture and Consumer Economics, University of Illinois, Feb. 2008.

[47] The base price for corn is equal to the average price during the first half of February, of (continued...)

year's higher volatility (**Figure 12**) translate into higher crop insurance premiums. Premiums vary by crop and location, as well as the farm's production history. However, a higher base price also means that the per acre returns being insured are substantially higher in 2008, especially since most crop insurance policies sold are revenue products that allow farmers to insure a target level of revenue rather than just yields.[48] Many farmers on traditionally high-yielding farms in the Corn Belt will be able to guarantee corn revenues in the $500 per acre range for a 75% coverage level. Guarantees over $600 are possible with higher coverage levels. Similar high insurance premiums and revenue guarantees will be available for most major program crops in most major producing areas.

Unlike government commodity program outlays, which decline when prices rise, government support for federal crop insurance rises with higher prices. This is because the federal government subsidizes the premiums by an average of 50% to 60% of the total premium, depending on the coverage level. In addition, the government reimburses the insurance companies for a share of their administrative and operating expenses incurred in delivering the crop insurance policies. The reimbursement share of administrative and operating expenses is based on a percentage of total premiums; thus, it also rises with rising crop prices. FAPRI projects net federal outlays (including premium subsidies, excess indemnity payments, and administrative and delivery costs) at $4.71 billion in 2008 and at $7.1 billion in 2009.[49] These net outlays compare with an estimated $3.6 billion in 2007.

Sharply Higher Feed Costs

In February, ERS projected U.S. livestock feed costs for 2008 at a record $45 billion, up nearly $7 billion or over 18% from the previous year's record.[50] Meanwhile, USDA projects that wholesale prices for nearly all livestock product categories (with the exception of poultry and eggs) will decline in 2008.[51] Rising feed costs (primarily grains and protein meals) have cut into profit margins of all livestock sectors (beef, dairy, pork, and poultry) and, in the case of hogs have rendered many operations unprofitable. For example, on April 28, 2008, Tyson Food — a major producer, distributor, and marketer chicken, beef, and pork products — reported its first loss in six quarters and said that its corn and soybean costs would

---

[47] (...continued)
the harvest-time (i.e., December) futures contract at the Chicago Board of Trade.

[48] For more information on crop insurance programs, see CRS Report RL34207, *Crop Insurance and Disaster Assistance: 2007 Farm Bill Issues*, by Ralph Chite.

[49] "Crop Insurance," *U.S. Baseline Briefing Book*, FAPRI-MU Report #03-08, FAPRI, March 2008, p. 59.

[50] "Farm Income and Costs: 2008 Farm Sector Income Forecast" briefing room, ERS, USDA updated March 7, 2008; at [http://www.ers.usda.gov/Briefing/FarmIncome/].

[51] *World Agricultural Supply and Demand Estimates*, World Agricultural Outlook Board, USDA, April 9, 2008.

increase by $600 million in 2008.[52] Texas Governor Rick Perry — whose state is the U.S. leader in beef production and ranks in the top 10 for production of poultry, eggs, and dairy — has stated that rising corn prices have been particularly harmful to Texas livestock producers. According to Governor Perry, every one-cent rise in corn prices costs his state's livestock sector over $6 million.[53]

The U.S. livestock sector will have to work through many issues related to the changing nature of feed supplies as feedstock demand from biofuels production lowers grain supplies and replaces them in part with higher protein supplies. Feed supply logistics and feed ration composition are likely to remain unsettled for several years if the biofuels industry continues to expand.

Futures Market Dilemma

Because of their transparency and their traditionally strong relationship with cash markets, futures contract prices are often the primary basis for price determination in many wholesale and cash markets, as well as for managing the risk associated with the ownership (current or anticipated) of a large volume of an agricultural commodity that is actively traded on a futures exchange. However, the rapid, volatile escalation in agricultural futures prices that has evolved since 2005 appears to be diminishing the effectiveness of the futures market as a device for both price discovery and risk management. The financial demands associated with routine hedging operations (primarily in the form of increased margin requirements) have risen in tandem with commodity prices, thereby placing severe strains on market participants. In addition, increasing evidence of lack of convergence between cash and futures contract prices for some commodities in some markets (observed primarily for corn, soybeans, and wheat contracts at the CBOT) is increasing the risk of futures-price-based forward contracts for the grain buyers that offer them.

These developments are of particular concern to traditional commercial interests — such as grain and oilseed elevators, food processors, grain merchandisers, and other participants in the marketing chain for agricultural products — who are likely to see their costs of operations rise with any decline in the efficiency of the futures market. Agricultural producers are equally concerned because, as grain and oilseed buyers refrain from offering forward contracts, producers are increasingly unable to take advantage of the current high prices. Forward contracting has traditionally been one of the primary risk management strategies employed by U.S. producers.[54] It is not clear to what extent, if any, high commodity prices have had on the perceived lack of convergence.

---

[52] Steven Mueson, "A Costly Link Between Food and Fuel," *Washington Post*, April 30, 2008.

[53] Letter to EPA Administrator Stephen Johnson, by Texas Governor Perry, April 25, 2008, at [http://www.governor.state.tx.us/].

[54] For more information on farm risk management strategies, see "Risk Management Strategies" at the ERS Farm Risk Management Briefing Room, at [http://www.ers.usda.gov/Briefing/RiskManagement/Strategies.htm].

The Commodity Futures Trading Commission (CFTC) — the government agency responsible for oversight and regulation of U.S. futures exchanges — has said that an examination of futures trading data has yet to show any visible evidence that hedging operations are declining as a result of the rising financial obligations associated with hedging.[55] In addition, economists have studied the emerging lack of convergence between cash and futures prices and have yet to identify any significant causal factor.[56] Despite any current lack of evidence, some agricultural interests affected by these issues have accused the growing pool of speculative money that has been invested in agricultural futures markets in recent years of artificially increasing prices and their volatility, and sharply raising the costs of standard hedging operations. As a result, these parties have called for greater federal regulation and monitoring over speculative participation in futures markets, as well as for more stringent trading limits on speculative funds. As a general rule, this type of speculative investment in futures markets is considered to add necessary liquidity to commodity markets.

Several other issues related to the efficient functioning of futures markets that have emerged in recent years — for example, electronic trading and the standard practice of raising limits on the daily movement of contract prices when prices settle at their limits — have been accused (rightly or wrongly) of aggravating the dilemma surrounding the rising cost and declining viability of routine hedging operations in agricultural futures markets. On April 22, 2008, the CFTC held a special public "Round Table" to publicly discuss the issues confronting commodity futures exchanges and to hear from market participants.[57] While no policy positions were recommended or adopted from the session, the Round Table represents an awareness of the importance of the efficient functioning of agricultural futures markets to the U.S. agricultural sector and a willingness to heighten monitoring by the CFTC of these emerging issues.

Expanded, More Intensive Agricultural Production

Since most of the increase in demand is considered permanent, commodity prices will likely return to lower levels only through an expansion in aggregate supply (from either domestic or foreign sources) that outpaces demand growth. This, in turn, may be accomplished by increases in either yields or cultivated area. The strong market price signals received by the world's farmers during the past six months are expected to engender a response in both planted area and yield per unit of planted area.

---

[55] "Overview of Agricultural Futures Markets For Congressional Staff ," by John Fenton, Deputy Director for Market Surveillance, Div. of Market Oversight, CFTC, April 2, 2008.

[56] For example, see "The Performance of Chicago Board of Trade Corn, Soybean, and Wheat Futures Contracts After Recent Changes in Speculative Limits," by Scott H. Irwin, Philip Garcia, and Darrel L. Good, Dept. of Ag and Consumer Economics, Univ. of ILL, Urbana-Champaign, IL, May 2007, at [http://www.farmdoc.uiuc.edu/irwin/research/CBOT FuturesPerformance.pdf].

[57] For more information, visit the CFTC website at [http://www.cftc.gov].

Agricultural Productivity. Yield increases generally accumulate slowly over time via more intensive use of fertilizers, pesticides, improved seeds, and adoption of better farming practices (which themselves are generally the product of investments in research, extension, and infrastructure). The availability and cost of fertilizers and chemicals can be a limiting factor on short-term yield gains. Furthermore, adoption of more intensive cultivation practices may contribute to potentially harmful environmental consequences such as possible water quality degradation from fertilizer and chemical runoff, and increased soil erosion.

Expanded Cropped Area. Area increases for a given crop can occur more quickly than yield increases by shifting land use among different crops, by altering rotational tillage-fallow cultivation practices, or by bringing marginal, less-productive soils into cultivation. Land-use shifts imply winners and losers among crops, while altering rotational patterns and farming marginal lands all imply potentially harmful environmental consequences such as reduced wildlife habitat, lower soil fertility, increased erosion, possible water quality degradation from nutrient and sediment loads in rural waterways, and lost carbon sequestration. Most analysts agree that the current high commodity prices are likely to entice some marginal land back into production in 2008.[58]

In 2007, about 321 million acres were planted to the principal crops in the United States, of which 315 million acres were for the major program crops.[59] In addition, 62 million acres of hay were harvested in 2007. In 2008, USDA estimates that about 4 million additional acres will be planted to principal crops (up 1.2%), while program crop area will expand by 6.2 million acres (up 2%). Thus, more than a 2-million-acre shift from minor crops to program crops is anticipated. In addition, nearly 1 million acres is expected to shift from hay to program crop area.

Converting Conservation Acres to Production

In the United States, the Conservation Reserve Program (CRP) represents the most visible bank of potential crop land available for re-entry into agricultural production.[60] The CRP provides payments to farmers to take highly erodible or environmentally sensitive cropland out of production for ten years or more to conserve soil and water resources. In February 2008, national enrollment in the CRP was 34.6 million acres. Each year, a portion of enrolled CRP acres is eligible for renewal or removal depending on the owner's preferences which, in turn, are likely influenced by market conditions. Farmers also have the option of paying a penalty for early withdrawal, but the penalty (which includes full repayment of all benefits received) is generally prohibitive except in the case of recently enrolled land which

---

[58] "Crops winning out over conservation for some landowners," James MacPherson, Associated Press, *WashingtonPost.com*, April 30, 2008.

[59] *Acreage*, National Agricultural Statistics Service (NASS), USDA, June 29, 2007. Major program crops include corn, sorghum, oats, barley, winter wheat, rye, durum wheat, other spring wheat, rice, soybeans, peanuts, sunflower, cotton, dry edible beans, potatoes, sugarbeets, canola, proso millet, hay, tobacco, and sugarcane.

[60] For more information on the CRP, see CRS Report RS21613, *Conservation Reserve Program: Status and Current Issues*, by Tadlock Cowan.

has yet to accumulate many benefits. In March 2007, then-Secretary of Agriculture Mike Johanns announced that there would be no penalty-free release of acreage from the CRP in 2007. USDA estimates that, in 2007, about 130,000 acres of CRP that were under contract were withdrawn early and were subject to penalty. Secretary Schafer has reiterated the no-penalty-free-release-of-CRP position for FY2008, but has said that USDA will make a decision concerning FY2009 in August or September 2008.

CRP is perceived as providing multiple environmental services — for example, critical wildlife habitat, wind and soil erosion control, wetlands protection, forestry restoration, carbon sequestration, and water quality gains via filter strips and buffer acreage. As a result, the public interest in seeing lower crop prices via expanded cropland must be weighed against the public interest in maintaining the substantial environmental benefits of land in CRP.[61]

Between September 2007 and February 2008, 2.1 million acres opted out of the CRP as their contracts expired. Another 27.8 million acres under CRP contracts will expire by 2010. Contracts for approximately 23 million (83%) of these acres have been renewed or extended. High commodity prices, however, may discourage future re-enrollments and contract extensions. Environmental and wildlife organizations are major advocates for maintenance and/or expansion of current CRP levels. Livestock groups, the milling and baking industry, and other food processors favor reducing or eliminating early-out penalties for CRP to maximize the amount of land that is cropped.[62] The Alliance for Agriculture Growth and Competitiveness (AAGC) — a group representing the beef, poultry, pork, and grain and feed industries — has been lobbying USDA since 2005 to allow landowners to pull out of CRP contracts without penalty.[63] According to the Center for Agricultural Research and Development (CARD), if CRP policy is unchanged, than as much as 2 million acres of CRP land per year will be brought back into crop production over the next 10 years.

CRP Policy Options. USDA's March *Planting Intentions* report estimates about a 2% increase in program crop planted acreage in 2008 in response to the high commodity prices. Given that USDA's projected year-to-year farm price increases for 2007/2008 range from 20% to 60% for the major program crops, economists at CARD suggest that such a low area response, if realized, implies that U.S. farmers' ability to respond to high commodity prices is constrained by a lack of viable cropland.[64] As a result of this land constraint, CARD suggest that USDA consider "re-optimizing" CRP through a combination of penalty elimination and aggressive

---

[61] "Options for the Conservation Reserve Program," by Bruce A. Babcock and Chad Hart, *Iowa Ag Review*, Spring 2008, Vol. 14, No. 2, pp. 6-7.

[62] Ibid.

[63] For example, see the AAGC mission statement and its letter of policy recommendations for USDA at [http://www.cmcmarkets.org/files/18_mission_&_prin.pdf] and [http://www.nopa.org/content/newsroom/2005/aug/081205_lettertochuckconnor_CRP.pdf].

[64] "Options for the Conservation Reserve Program," by Bruce A. Babcock and Chad Hart, *Iowa Ag Review*, Spring 2008, Vol. 14, No. 2, pp. 6-7.

rebidding of its entire CRP holdings. By eliminating penalties on CRP contracts that expire in the next three years, more productive land could return to production earlier, while the freed up CRP payment funds could be used to offer further protection to the more environmentally sensitive land that offers the greatest environmental benefits. Similarly, CARD suggests that USDA, by rebidding its entire CRP land portfolio, could ensure that the most vulnerable land is retained while allowing less vulnerable land to return to production.

Rising Food Price Inflation Impacts Consumer Budgets

The rise in agricultural prices, combined with high energy costs, have contributed to higher food inflation in the United States and around the world. In general, higher food price inflation impacts consumers' dietary choices as relative prices vary across foods that compete for food expenditure dollars.[65] The overall impact to consumers from higher food prices depends on the proportion of income that is spent on food — households that spend a much greater proportion of their income on food have less flexibility to adjust expenditures in other budget areas to accommodate increasing food costs.

International comparisons of household budgetary expenditures indicate that rich industrial nations spend 6% to 20% of their annual budgets on food compared with 20% to 30% for middle income countries, and 30% to nearly 80% for low income countries.[66] These differences suggests that food price increases represent a potentially far more serious hardship for households in low income countries, particularly those nations that depend on imports for an increasing share of their domestic food needs.

U.S. Food Price Inflation. In the United States, food prices increased by 4.2% during 2007, the highest one-year rise since 1989. USDA predicts that food price inflation for 2008 will be in the range of 4% to 5%.[67] During the first three months of 2008, the U.S. Bureau of Labor Statistics (BLS) reports that food prices have climbed by 1.3% for an annual rate of 5.2%.[68] **Figure 15** displays the monthly rate of change in the BLS food price index compared with its more stable 11-month moving average. Since 2005, the general trend has been upward and in June 2007, the 11-month moving average reached its highest point (0.43%) since June 1990.

---

[65] *Changing Structure of Global Food Consumption and Trade*, Anita Regmi, Editor, WRS-01-1, ERS, USDA, May 2001.

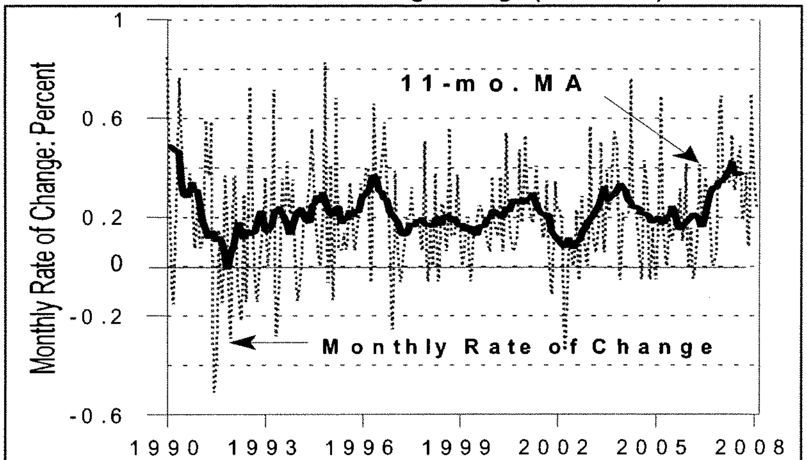
[66] "Table 97 — Expenditures on Food, by Selected Countries, 2002," Briefing Room: Food CPI, Prices and Expenditures, ERS, USDA, at [http://www.ers.usda.gov/Briefing/CPIFoodAndExpenditures/].

[67] "Food Price Outlook, 2008," Briefing Room: Food CPI, Prices, and Expenditures, ERS, USDA, March 21, 2008. See also CRS Report RS22859, *Food Price Inflation: What are the Issues?* by Tom Capehart and Joe Richardson.

[68] "Table 1. Consumer Price Index for All Urban Consumers (CPI-U): U.S. city average, by expenditure category and commodity and service group," U.S. Dept. of Labor, BLS; as observed on April 22, 2008.

Despite the sharp increases in commodity prices in 2007, most economists agree that energy costs, particularly fuel prices, have played a larger role in food price inflation than have commodity prices.[69] In general, retail food prices are much less volatile than farm-level prices and tend to rise by a fraction of the change in farm prices. This is because the actual farm product represents only a small share of the eventual retail price (20% on average), whereas transportation, processing, packaging, advertising, handling, and other costs — all vulnerable to higher fuel prices — comprise the majority of the final sales price.[70]

Figure 15. Food Price Index: Month-to-Month Change versus 11-Month Moving Average (11-mo MA)



Source: CRS calculations based on data from the U.S. Dept. Of Labor, Bureau of Labor Statistics.

Because food expenditures represent a relatively small share of consumer spending for most U.S. households, food price increases are absorbed relatively easily in the short run. On average, in 2006 U.S. households spend about 6% of their total disposable personal income on food consumed at home and another 4% on food consumed away from home for a total food outlay of about 10.5%. [71] However, even in a wealthy nation such as the United States, household income variations suggest that the impact of food price inflation can vary widely and can result in painful

---

[69] For example, see "The Relative Impact of Corn and Energy Prices in the Grocery Aisle," John M. Urbanchuk, Director, LECG LLC, June 14, 2007.

[70] "Price Spreads from Farm to Consumer," Briefing Room: Food Marketing System in the U.S., ERS, USDA, at [http://www.ers.usda.gov/Data/FarmToConsumer/marketingbill.htm].

[71] Statement by Joseph Glauber, Chief Economist of USDA, at a Hearing entitled "How Are High Food Prices Impacting American Families?" before the Joint Economic Committee U.S. Congress, May 1, 2008, p.15, at [http://www.jec.senate.gov/].

spending choices at the household level. In 2006, U.S. families with less than $20,000 in income spent over 20% of their after-tax income on food.[72]

The United States has several food assistance programs that are designed to assist households in meeting their minimum food needs.[73] The two largest programs, Food Stamps and child nutrition programs, operate as entitlement programs that make specified payments to all qualifying beneficiaries. However, in the case of Food Stamps the burden is upon the eligible individuals to seek out the benefits. In general, rising food prices result in higher federal spending on Food Stamps and child nutrition programs because participation expands and because the benefits under most federal food assistance programs are indexed to some type of consumer food basket. In 2007, $33.2 billion was spent on the Food Stamp program while the average food stamp recipient received $95.63 per month in benefits and the average participating household received $214.69 per month.

International Price Rises Dim Food Security Prospects. Due to market and trade linkages, high commodity prices ripple through international markets where impacts vary widely based on a country's grain import dependence and its financial ability to respond to higher commodity prices. For example, both Japan and Mauritania are dependent on imports for a substantial portion of domestic food needs; however, Japan has the financial means to better accommodate rising food import prices.

Import-dependent developing country markets are put at greater food security risk due to the higher cost of imported commodities. Lower-income households in many foreign markets where food imports are an important share of national consumption, and where food expenses represent a larger portion of the household budget, may be affected quite severely by higher food prices.[74] Humanitarian groups have expressed concern for the potential difficulties that higher grain prices imply for developing countries that are net food importers.[75] According to the U.N.'s Food and Agricultural Organization (FAO), the grain import bill for Low-Income Food-Deficit Countries (LIFDCs) — those nations identified as the most vulnerable to international food price changes — is forecast to increase by 56% in 2007/2008 following a 37% rise the previous year.[76] For low-income food-deficit countries in

---

[72] Ibid.

[73] For more information on U.S. food assistance programs, see "Federal Spending for Domestic Assistance Programs," in CRS Report RS22859, *Food Price Inflation: What are the Issues?* by Tom Capehart and Joe Richardson.

[74] Shahla Shapouri and Stacey Rosen, "Energy Price Implications for Food Security in Developing Countries," *Food Security Assessment, 2006*, GFA-18, ERS, USDA.

[75] International Monetary Fund, *World Economic Outlook: Globalization and Inequality.* October 2007. Washington.

[76] "Poorest Countries' cereal bill continues to soar, governments try to limit impact," FAO Newsroom, FAO, U.N., April 11, 2008. For detailed information on international food supply and demand projections see *Crop Prospects and Food Situation*, No. 2, April 2008, FAO, U.N., at [http://www.fao.org/worldfoodsituation].

Africa, the cereal bill is projected to increase by 74% due to the sharp rise in international cereal prices, freight rates, and oil prices.

The cost of food imports is compounded by bulk ocean freight rates which were record high in 2007.[77] Ocean freight rates are expected to retreat slightly in 2008 as the supply of ships expands, however, the continual rise of crude oil prices to new highs in early 2008 suggest that shipping costs are unlikely to experience a significant decline, and could possibly rise with higher fuel costs.

The political consequences of food shortages can be severe. Since January 2008, the emerging food crisis has sparked reports of hoarding and theft.[78] Civil unrest over food prices have been reported around the globe including Egypt, Indonesia, the Philippines, and much of Africa (Burkina Faso, Cameroon, Ivory Coast, Mauritania, Mozambique, Senegal, and South Africa).[79] In Haiti, two days of food-price rioting toppled the prime minister.[80]

Shortages, High Prices Hurt International Food Aid Prospects

Higher commodity and food prices reduce the international community's ability to provide food aid to other countries without additional appropriations. This is because most international food aid activities (the United States included) are fixed in value by annual appropriations; thus, the amount of commodities that can be purchased declines with rising food prices.

In 2007, the U.N.'s World Food Program (WFP) — the world's leading source for international food aid — estimated it would need $2.9 billion to cover its 2008 approved project needs which included feeding 73 million people in 78 countries. However, on March 20, the WFP made an emergency appeal for an additional US$500 million to twenty heads of government to offset the increased price of food commodities which had since raised its operating needs to $3.4 billion. Then, barely a month later on April 22, 2008, Josette Sheeran, the executive director of WFP, announced that the WFP needs $755 million in additional funding to meet its current operating needs due to continued rises in commodity prices since mid-March.[81] One of the difficulties facing the WFP, according to Sheeran, is that rice suppliers that had signed earlier grain delivery contracts with the U.N. when prices were lower are now

---

[77] *Grain Transportation Report* Agricultural Marketing Service, USDA, April 10, 2008.

[78] For an example, see "Rice dealers hoard lucrative crop, intensifying shortage," by RB, *Greenwire*, April 18, 2008.

[79] "Food price anger sparks protests," *Reuters News*, April 21, 2008.

[80] U.N. food agency facing worst crisis, director says," Nathanial Gronewold, *E&E News PM*, April 22, 2008, at [http://www.eenews.net].

[81] "Food Crisis Is Depicted As 'Silent Tsunami'," by Kevin Sullivan, *Washington Post*, April 23, 2008.

finding it more profitable to pay a 5% penalty to break the contract, and then sell their rice at the current higher market price.[82]

International food aid is the United States' major response to reducing global hunger.[83] In 2006, the United States provided $2.1 billion of such assistance, which paid for the delivery and distribution of more than 3 million tons of U.S. agricultural commodities. The United States provided food aid to 65 countries in 2006, more than half of them in sub-Saharan Africa. The U.S. Agency for International Development (USAID) indicated that rising food and fuel prices would result in a significant reduction in emergency food aid in 2008. According to press reports in March 2008, USAID expects a $200 million shortfall in funding to meet emergency food aid needs. For FY2008, Congress appropriated $1.2 billion for P.L. 480 food aid, the same as FY2007.[84] For FY2009, the President's budget again requested $1.2 billion. However, in six out of ten years since 1999, supplemental funding for P.L. 480 Title II food aid has been appropriated.

Since February, President Bush has been under increasing pressure from international hunger advocacy groups, as well as the U.S. milling and baking industry and other food industry groups, to open grain supplies held in the Bill Emerson Humanitarian Trust (BEHT) — which was estimated to hold $177 million in cash and about 33 million bushels of wheat in early 2008 — as a short-term means of dampening grain prices while augmenting international supplies. On April 14, 2008, President Bush directed the Secretary of Agriculture to access grain supplies from the BEHT valued at $200 million to meet emergency food aid needs abroad.[85]

Farm Commodity Market Outlook

Positive Short-Run Outlook, Especially for Food Crops

For some crops (particularly for wheat and rice), the price increases are likely to be relatively short-term in nature and are due to weather-related crop shortfalls in major producer and consumer countries, a weak U.S. dollar which has helped spark large increases in U.S. exports, a bidding war among major U.S. crops for land in the months leading up to spring planting in 2008, and the often perverse price effects resulting from international policy responses by several major exporting and importing nations to protect their domestic markets.

---

[82] Food prices hampering U.N. agency's ability to head off 'new face of hunger'," Nathanial Gronewold, *E&E News PM*, April 24, 2008, at [http://www.eenews.net].

[83] For more information, see CRS Report RL33553, *Agricultural Export and Food Aid Programs* by Charles Hanrahan.

[84] P.L. 480 is the principal U.S. food aid program. It is administered by USAID.

[85] White House News Release, Office of the Press Secretary, April 14, 2008. For more information on the Bill Emerson Humanitarian Trust, see CRS Report RS21234, *The Bill Emerson Humanitarian Trust: Background and Current Issues*, by Charles Hanrahan.

Substantial recovery is expected to occur by late 2008, especially in wheat and rice markets, as global supplies rebuild. FAO forecasts that world cereal production will expand 2.6% to a record 2.164 billion tons in 2008.[86] Most of the increase is expected to come from wheat with rice and coarse grains showing modest gains. If realized, FAO predicts that the expanded production will help to ease the current tight global cereal supply situation. However, any recovery remains weather-dependent and commodity prices are likely to remain highly volatile until the 2008 harvests are "in the bin." More immediate price moderation can be achieved if government policies to limit or ban exports of available grain and oilseed supplies are repealed. Such export-prohibiting policies distort international market prices in the short-run by limiting access to export supplies, while dampening long-run productivity gains by artificially curtailing demand and thereby discouraging investments in domestic agriculture.

Biofuel feedstock demand has bid up the price of corn, soybeans, and other crops that compete for acres, especially in the United States. Both USDA's and FAPRI's outlook projections for 2008 include expanded acreage in the United States and worldwide, as high prices bring marginal land back into crop production. In the U.S., expectations for increased double cropping of winter wheat and soybeans in the Delta and Southeast, along with a return to crop production of a substantial portion of pasture land as well as nearly 2 million acres of former CRP, are expected to boost planted area for corn, soybeans, and wheat by nearly 7 million acres to 224.6 million acres.

Similar area expansion is expected to occur worldwide in response to strong price incentives and, in some countries, to government policy. For example, *StatsCanada* recently forecast Canadian wheat plantings to be up over 16% in 2008.[87] In the EU, in September 2007 agriculture ministers suspended a 10% set-aside requirement that paid farmers to idle nearly 3.8 million hectares (9.4 million acres) of cropland annually. Mariann Fischer Boel, EU Agriculture Commissioner, expects the additional land re-entering crop production to bolster EU grain output by up to 17 million tons in 2008.[88]

Despite projections for record world grain production in 2008, only marginal global stock building is projected to occur. Relatively low stocks are expected to persist through 2008 as global production will be hard pressed to keep up with continued growth in demand (even with a return to normal weather and yields). This will leave commodity markets particularly vulnerable to news of poor harvests or demand shocks, and will very likely mean continued high price volatility.

---

[86] *Crop Prospects and Food Situation*, No. 2, Global Information and Early Warning System on Food and Agriculture (GIEWS), FAO, U.N., April 2008.

[87] "Field and specialty crops: Seeded area," *Statistics Canada*, April 21, 2008.

[88] "Set aside suspended by European Union," by Bruno Waterfield and Charles Clover, ©Telegraph Media Group Limited 2008, September 26, 2007; [http://www.telegraph.co.uk].

Long-Term Outlook Hinges on Productivity Gains

Projections for a steady rise in global population, accompanied by sustained income growth in the world's developing economies, are expected to sustain growth in demand for livestock products and the feedstuffs — e.g., coarse grains and protein meals — needed to produce those products. In addition, the outlook for increased demand for agricultural feedstocks to meet large increases in government biofuel-usage policies, particularly in the United States and the European Union (EU), suggest that demand will increase strongly over the coming decade for corn (the primary feedstock for U.S. ethanol production), and vegetable oils (the primary feedstock for biodiesel production in the United States and the EU).

As a result, even with a return to normal crop growing conditions and successful harvests, commodity prices are expected to remain at significantly higher levels than experienced during the 1998-2006 period. FAPRI's long-term 10-year projections suggest that prices for major U.S. program crops and products — corn, barley, sorghum, soybeans, soybean oil, soybean meal, wheat, and rice — will remain well above average prices of the recent five-year period 2002/2003 to 2006/2007 (**Table 2**).

A sustained period of agricultural output growth that surpasses the projected rise in demand is needed to produce a return to abundant supplies and moderate prices. Increased agricultural production implies some combination of increased land dedicated crop production and/or increased output per acre of planted land. For most countries, only marginal expansion of cropped area is possible and often this involves less-productive, more environmentally sensitive land. Agricultural productivity gains, on the other hand, require sustained long-term investment in agricultural research, extension, and marketing infrastructure. How commodity markets actually evolve will depend greatly on the policy choices that the U.S. and international community make concerning agricultural productivity and renewable energy.

U.S. and International Policy Response

Because the current U.S. and global commodity market dynamic affects so many aspects of agricultural markets including short-term consumer needs, as well as issues related to intermediate and longer-term agricultural productivity, the nature of the U.S. and international response will necessarily vary by targeted beneficiary as well as the relevant time period. It is unlikely that any single policy response will be able to address all issues simultaneously. This section briefly reviews some of the more salient policy responses being suggested or implemented by major players in the U.S. and international agricultural arena.

U.S. Industry Groups Decry Rising Costs of Grain as an Input

Interests from livestock and poultry sectors, food processors and retailers, and hunger advocacy groups, have advocated for changes in current U.S. agricultural and food policy. Many interests from within these sectors have advocated for the reversal

of U.S. biofuels policy, while some have also advocated for a reduction in crop land retirement under the CRP program.

The U.S. milling and baking industry, led by the American Bakers Association (ABA), held a march in Washington, D.C. in March, 2008, to highlight their concerns about the short grain supplies and sharp price rises in U.S. commodity markets. As part of their campaign, the ABA put forward a three-point congressional action plan.[89]

- First, the ABA claims that as much as one-third of CRP land could be returned to agricultural production without environmental harm. They urge Congress to accept House Agriculture Committee Chairman, Colin Peterson's proposal to decrease the CRP by 7 million acres; they encourage Congress and the USDA to support early out-of-contract provisions within the CRP; and they request that USDA and the Administration undertake an evaluation to identify viable cropland within the CRP to facilitate its return to production.
- Second, the ABA recommends that EPA use its waiver authority to waive the RFS annual requirements, and to drop all tariffs on imported ethanol.[90]
- Third, the ABA recommends that Congress and USDA consider the needs of the domestic food industry ahead of export markets whenever U.S. wheat stocks drop below a three-month-usage supply.

In April 2008, a spokesperson for the U.S. Grocery Manufacturers Association called on Congress, the EPA, and states to freeze and rollback the biofuels mandates due to their effect on food prices.[91] In addition to interests from the food processing and grocery retail sectors, the U.S. livestock sector has expressed long-standing concerns about diverting feed crops away from commercial animal feeders and into biofuels production. The National Cattlemen's Beef Association (NCBA) explicitly opposes the national biofuels RFS.[92] NCBA members have called for a market-based approach for the production and usage of ethanol produced from livestock feedstuffs, and the NCBA supports sun-setting the existing biofuels tax credits and the ethanol import tariff as scheduled and not allowing for renewal in their current form. In April, a major international agriculture research group, the International Food Policy Research Institute (IFPRI), announced that a moratorium on global grain- and

---

[89] For more information see the American Bakers Association, Press Releases, at [http://www.americanbakers.org/].

[90] For more information, see CRS Report RS22870, *Waiver Authority Under the Renewable Fuel Standard (RFS)*, by Brent Yacobucci.

[91] Transcript from interview with Scott Faber, vice president of government affairs, Grocery Manufacturer Association, *E&ENews OnPoint*, April 9, 2008, at [http://www.eenews.net/].

[92] "Renewable Fuels and Ethanol Production," policy news, NCBA, at [http://www.beefusa.org/goveRenewableFuelsandEthanolProduction.aspx].

oilseed-based biofuels would help ease corn prices by up to 20% and wheat prices by 10% in the next few years.[93]

On April 25, 2008, Texas Governor Rick Perry, in a letter to Stephen Johnson, Administrator of the Environmental Protection Agency (EPA) — the federal agency responsible for administering the RFS — to request that EPA waive 50% of the RFS' ethanol requirements to alleviate their impact on corn prices.[94] Section 211(o) of the Federal Clean Air Act (as amended by EISA of 2007) provides the EPA Administrator, in consultation with the Secretary of Agriculture and the Secretary of Energy, with the authority to suspend for one year all or part of the RFS. EPA has 90 days to respond to Governor Perry's petition for a waiver. The National Chicken Council's President, George Watts, publicly commended Governor Perry's action stating that ethanol has been a factor behind rising food costs.[95]

On May 2, 2008, 23 Republican senators sent a letter to EPA administrator Johnson to inquire about the status of regulations for states applying for an ethanol mandate waiver and urged that EPA take into consideration food inflation concerns related to the biofuels mandate.[96] However, not all quarters agree with the blame being targeted on the biofuels sector. The Renewable Fuels Association, the National Corn Growers Association, and other interest groups that have benefitted from U.S. biofuels policy suggest that high oil prices, global production shortfalls, and foreign export controls are the main culprits and that it is unfair and incorrect to place the entire blame on the biofuels sector.[97]

U.S. Congressional Action

On April 29, 2008, Congressman Jeff Flake introduced a bill, H.R. 5911, that would repeal the RFS biofuels usage mandate, as well as the biofuels tax credit incentive and the ethanol import tariff — all to take effect immediately upon enactment of the bill. Senator Kay Bailey Hutchinson has also announced her intentions to introduce legislation that would freeze the RFS at its current level rather than allowing it to increase through 2022.[98]

---

[93] "Biofuels halt would ease food prices — ag group," Missy Ryan, *Guardian*, April 29, 2008.

[94] "Letter to EPA Administrator Stephen Johnson," by Texas Governor Perry, April 25, 2008, at [http://www.governor.state.tx.us/].

[95] "National Chicken Council Commends Texas Governor for Filing First Request for Waiver of National Renewable Fuel Standard," NCC Press Release, April 25, 2008.

[96] "Sens. Hutchinson, McCain Urge Ethanol Mandate Relief from EPA," news release, Sen. Hutchinson's office, May 2, 2008, at [http://hutchinson.senate.gov/pr050208b.thml].

[97] For example, see the articles "Flat out Wrong About Food Prices," and "RFA Opposes Waiver Request by Texas Governor," at the RFA website at [http://www.ethanolrfa.org/]; or "Recipe for a Food and Fuel Smear Campaign," Rick Tolman, Chief Executive Officer, National Corn Growers Association, at [http://www.ncga.com/].

[98] "Citing food costs, Texas Governor seeks waiver of fuel mandate," Ben Geman, *Greenwire*, April 28, 2008, [http://www.eenews.net].

Two additional legislative proposals currently being negotiated in Congress could contribute directly or indirectly to the U.S. response to the current global food crisis. These are a renewal of U.S. farm legislation, and a possible emergency supplemental appropriations bill.

The U.S. farm bill legislative process has been ongoing for nearly a year with considerable uncertainty surrounding a final outcome as of May 1, 2008. However, the eventual outcome has important implications for the level and timing of funding for several areas related to the U.S.' ability to respond to domestic and international food concerns. For example, these include U.S. domestic nutrition programs, U.S. foreign food aid and agricultural assistance, the on-going debate over food versus fuel, agricultural land use incentives, and agricultural productivity issues. Different versions of new farm legislation (H.R. 2419) have been passed by both the House and the Senate. Both the House and Senate farm bills seek many of the same types of changes to existing legislation and programs, but there are numerous differences, particularly in the nutrition and energy titles. These differences will have to be worked out in conference.[99] However, the Administration has objected to new restrictions on its management of emergency food aid funding that is being proposed within farm legislation.[100] The President asserts that much of U.S. emergency assistance in the bill actually is earmarked for non-emergency situations, and that the bill prohibits use of U.S. funds to purchase foods in regions near a food emergency.[101]

Congress is presently considering supplemental appropriations for the Iraq war which could include some as-yet-undetermined funding for emergency response to the international food crisis.[102] President Bush has requested $350 million in additional food aid as part of this emergency supplemental bill.

On May 1, 2008, President Bush announced a new, additional funding request of $770 million for emergency response to the international food crisis in FY2009.[103] This funding is separate from the $350 million that he proposed for the current FY2008. According to White House officials, the $770 million would include about $395 million for direct food assistance; $150 million for agricultural development; and $225 million for local crop purchases, vouchers, and other special programs.

Immediate International Food Crises Response

On April 29, 2008, U.N. Secretary-General Ban Ki-moon announced that he will lead a task force to coordinate the efforts of the U.N. system in addressing the global crisis arising from the surge in food prices. The Task Force on the Global Food

---

[99] See CRS Report RL33934, *Farm Bill Legislative Action in the 110th Congress.*

[100] "De-railing the Farm Bill," *Washington Trade Daily*, Vol. 17, No. 87, April 30, 2008.

[101] See CRS Report RL34145, *International Food Aid and the 2007 Farm Bill.*

[102] For more information see CRS Report RL34451, *Second FY2008 Supplemental Appropriations for Military Operations, International Affairs, and Other Purposes*

[103] "Bush Seeks $770 Million More in World Food Aid," Dan Eggen, *Washington Post*, May 2, 2008.

Crisis will bring together the heads of U.N. agencies, funds and programs, and the World Bank and International Monetary Fund, as well as experts within the UN and leading authorities from the international community.

The two principal agencies within the United Nations (U.N.) responsible for international agricultural development and food aid are the Food and Agricultural Organization (FAO) and the World Food Program (WFP). WFP is the U.N.'s front-line agency in the fight against global hunger via emergency operations in response to natural and man-made disasters, relief and rehabilitation projects, development projects where food aid is used for social and economic development, and special operations involving logistics to speed up the movement of food aid.[104] In contrast, FAO has a longer-term focus. FAO is mandated to raise levels of nutrition, improve agricultural productivity, better the lives of rural populations and contribute to the growth of the world economy. FAO accomplishes this through in-country agricultural research and extension support, information dissemination, international workshops and conferences, etc. in order to help developing countries modernize and improve their agriculture, forestry and fisheries practices and ensure good nutrition for all.[105]

On December 17, 2007, the U.N.'s FAO launched its Initiative on Soaring Food Prices (ISFP) as a focal point for technical and policy assistance to those countries identified as the hardest hit by the sharp increase in food prices — referred to as Low-Income Food-Deficit Countries (LIFDCs).[106] The international community is seeking to coordinate on-going work by the World Bank, the International Fund for Agriculture Development (IFAD), WFP, Regional Development Banks (e.g., the Asian Development Bank and the African Development Bank), and private foundations to integrate new projects and interventions. First, the WFP, FAO, and IFAD are scheduled to present their strategies for coping with the food-price crisis at a U.N. executive board meeting in Geneva.[107] Then, the WFP and other international agencies will hear directly from governments on what they believe policy responses need to be at a gathering at U.N. headquarters in New York. These policy meetings are a prelude to the FAO's "Summit on Food Security" in Rome scheduled for June 3-5, 2008. It is expected that the Rome summit will provide a forum for coordinating the global response to the current food crises. The list of current proposals by the U.N. and its agencies includes:[108]

- Establishment of a U.N. task force on food crisis.
- WFP request for $755 million of emergency food aid (above normal program funds) to world's poorest.

---

[104] For more information on the WFP, see [http://www.wfp.org/].

[105] For more information on the FAO, see [http://www.fao.org/].

[106] "Information Note," FAO's Initiative on Soaring Food Prices, FAO, U.N., at [http://www.fao.org/newsroom/common/ecg/1000826/en/ISFP.pdf].

[107] Food prices hampering U.N. agency's ability to head off 'new face of hunger'," Nathanial Gronewold, *E&E News PM*, April 24, 2008, at [http://www.eenews.net].

[108] "U.N. taskforce to tackle global food crisis," Harvey Morris, *Financial Times*, April 30, 2008.

- Emergency $1.7 billion initiative to provide poor food importers with seed and fertilizer.
- The World Bank is to explore a rapid financing facility for poor countries.
- The International Monetary Fund (IMF) proposes aid to countries facing balance of payments gaps.
- The U.N. calls for the lifting of food export restrictions.

Long-Term Agricultural Productivity Response

While the international donor community is responding to short-term food needs, other interest groups are encouraging both greater investment in international agricultural productivity and the phasing out or elimination of government policies that distort market signals and diminish agricultural producer's incentives to respond to price signals. For each country, the appropriate policy response depends on the specific policy goal.[109] Many suggestions are being offered by market watchers, but several recurring themes are present:

- Reverse protective country-level policies of export bans and/or limitations that have exacerbated the problem.
- Reduce or eliminate subsidies that divert agricultural land from food and feed production to the production of feedstocks for biofuels.
- Remove or phase out domestic policies that keep market prices low in favor of consumers, but at the expense of sustained investment in the agricultural sector.
- Remove barriers that have constrained the production and use of genetically-modified crops.

In April, the International Food Policy Research Institute (IFPRI) — a major international agriculture research agency that operates as part of the Consultative Group on International Agricultural Research (CGIAR) — issued a 2-page policy brief that enumerated several policy recommendations for dealing with high international commodity prices and their harmful effect on groups vulnerable to food insecurity. First, IFPRI calls for short-run reinforcement and expansion of social protection and nutrition programs targeted to vulnerable groups. Second, IFPRI calls for elimination of biofuel subsidies and mandates. Third, IFPRI recommends the elimination of trade barriers to reduce market distortions and thereby allow correct price signals to reach agricultural producers. Finally, IFPRI encourages long-term investment in agricultural research and extension, rural infrastructure, and market access for small farmers.[110]

The World Bank (WB) also has released a list of policy recommendations in response to the emerging global food crisis. The WB's recommendation focus on those policy options designed to improve household food security. The WB recently

---

[109] For example, see "Food Price Hikes Threaten Political Crises," by John Baize, *World Perspectives, Inc.*, April 9, 2008.

[110] "Rising Food Prices: What Should Be Done?" Joachim von Braun, IFPRI Policy Brief, April 2008, at [http://www.ifpri.org/themes/foodprices/foodprices.asp].

released a policy option paper as a partial guide for government policy designed to respond to the current high commodity prices in international markets.[111] As such, the WB prioritizes policy options by their effectiveness at reaching target groups, the equity of distribution of program benefits, and the degree of market distortions introduced. The WB lists country-level policy options under three broad classes: Targeted Safety Net Programs; Measures to Lower Domestic Food Prices; and Measures to Stimulate Medium-term Food Grain Production

Possible World Trade Organization (WTO) Implications

In an attempt to deal with its own food-import dependency while responding to the global food crisis and the proliferation of export restrictions, Japanese officials have announced that Japan will be offering a formal proposal in the WTO's Doha Round of multilateral trade negotiations calling for stronger disciplines on exporting members.[112]

Doha agriculture negotiations chair, Crawford Falconer, has proposed eliminating all existing export restrictions by the end of the first year of the implementation of any new agreement.[113] In addition, he has proposed that any new export restrictions and prohibitions be allowed only for a period of 12 months, extendable up to a maximum of 18 months, in consultations with affected importers.

---

[111] Rising Food Prices: Policy Options and World Bank Response," Background note for the Development Committee, prepared by PREM, ARD, and DEC drawing from across the Bank; undated mimeo, at [http://www.worldbank.org/].

[112] "A Proposal on Food Export Restrictions," *World Trade Daily*, Vol. 17, No. 87, April 30, 2008.

[113] "Revised Draft Modalities for Agriculture," TN/AG/W/4/Rev.1, WTO, Feb. 8, 2008.

AF&PA®

AMERICAN FOREST & PAPER ASSOCIATION
GROWING WITH AMERICA SINCE 1861

American Forest & Paper Association

Statement Submitted for the Record

U.S. Senate Committee on Environment and Public Works
Subcommittee on Clean Air and Nuclear Safety

Environmental Protection Agency Oversight:
Implementing the Renewable Fuel Standard

July 10, 2008

The American Forest & Paper Association (AF&PA) appreciates the opportunity to share our perspective on the Renewable Fuel Standard (RFS) that was enacted as part of PL 110 -140, the Energy Security and Independence Act of 2007. As you may know, the forest products industry is a leader in the generation and use of renewable energy from biomass residue in our mills. Sixty-four percent of the energy used at AF&PA member pulp and paper mills, and 74 percent of the energy from our wood products facilities, is generated from carbon-neutral biomass. Forest product facilities account for 82 percent of the total biomass energy generated by all industries collectively. This is accomplished while adhering to disciplined market based standards of accountability that ensure the wood fiber we use is grown in a sustainable manner.

AF&PA is the national trade association of the forest, pulp, paper, paperboard, and wood products industry. The industry accounts for approximately 6 percent of the total U.S. manufacturing output, employs more than a million people, and ranks among the top 10 manufacturing employers in 42 states with an estimated payroll exceeding $50 billion. We support policy efforts to increase our nation's energy security and our member companies are leading the effort to achieve this objective by combining advanced technology and innovative manufacturing practices with responsible stewardship of our natural resources.

AF&PA urges Congress to modify the definition of renewable biomass in the RFS provision of PL 110 -140, which currently restricts eligibility based on forest types and successional stage and disqualifies fiber from public ownerships. We also recommend adding criteria to the waiver provision that will help balance the resource needs of existing biomass users, the emerging resource needs of the cellulosic biofuels industry, and the health, viability and productivity of our agricultural and forest lands throughout the country.

The definition of renewable biomass in the RFS statute creates a number of implementation challenges and would meaningfully reduce landowner options and raise fiber costs for manufacturers of paper and wood products. We urge Congress to revisit this issue and replace the existing definition of "renewable biomass" with the definition contained in Sec. 102(4) from the version of H.R. 6, the Energy Security and Independence Act that passed the Senate on June 21, 2007.

As written, the definitional approach in PL 110-140 regarding tree plantations established prior to enactment excludes large swaths of timberland and provides a disincentive to prospective market entrants who wish to grow new forests. This language also excludes materials from forests in the Lake States, Northern New England, Central Appalachians, and other regions that are managed to allow natural tree regrowth, with potentially negative effects on jobs and economic growth in these already distressed rural areas. In addition, the renewable biomass definition in the RFS encourages would-be producers of renewable fuel to focus their procurement efforts on existing softwood plantations, which are already intensively managed and supply the raw material for existing wood fiber-based manufacturing.

Second, the prohibition on the use of "slash and thinnings" from either old growth or forests on any list of imperiled forests is unworkable because of numerous technical ambiguities that make it difficult, if not impossible, to map and apply. We are concerned the prohibition in practice will either exclude large amounts of wood fiber out of confusion or an abundance of caution, or be enforced entirely in the breech because of difficulties verifying the source of the generally low value fiber being used to produce biofuels. In any event, landowner decisions regarding harvest are driven primarily by regional market dynamics which make harvesting old growth timber to produce low-value biomass impractical.

Third, the exclusion of fiber from public lands prevents the utilization of low value materials removed from the forest to reduce fire risk and improve forest health. There are over 90 million acres of Federal public lands that are at high risk of uncharacteristic fire, insect, or disease outbreaks. Eliminating the biofuels market as a tool to reduce hazardous fuel loads will exacerbate the decline in infrastructure needed to do this work, placing both forests and adjacent communities at increased risk.

In addition to definitional modifications, AF&PA urges Congress to further amend the RFS by adding language that would clarify that a state's petition for a waiver from the RFS mandate should be granted if compliance with the mandate would severely harm the long-term agricultural and silvicultural capability of a region of the country. Clarifying that a waiver should be granted if mandated production levels threaten the ability of natural resources in the state or region to satisfy production levels, in addition to meeting demand from existing biomass feedstock users that rely on the same resource to produce food and manufacture products, would improve the standard. Enhancing the waiver will help maintain a working balance between the resource needs of existing biomass users and the emerging resource needs of the cellulosic biofuels industry. The

modification would also help preserve the health, viability, and productivity of our agricultural and forest lands throughout the country as well as economies in rural areas.

The forest products industry is a leader in developing innovative energy solutions that decrease our reliance on fossil fuel and is the largest producer of biomass energy in the country. We urge Congress to assist our efforts by supporting an unbiased definition of renewable biomass, ensuring the long-term silvicultural and agricultural capability of regions, and maintaining the current biomass needs of existing facilities.

We thank the committee for creating an opportunity to comment on this important issue and look forward to working with you and others in Congress in the coming months to craft a workable and balanced renewable energy policy.

For more information please contact:
Elizabeth VanDersarl
Vice President, Government Affairs
American Forest & Paper Association
(202) 463-2748
elizabeth_vandersarl@afandpa.org