HOW TO FEED THE WORLD 2050

HIGH-LEVEL EXPERT FORUM

Rome 12–13 October 2009

Climate change and bioenergy challenges for food and agriculture

THE CHALLENGE

Agriculture both affects and is affected by climate change. No other sector is more climate sensitive. Agricultural and food production in developing countries will be adversely affected by climate change, especially in countries that are already climate-vulnerable (drought, flood and cyclone prone) and that have low incomes and high incidence of hunger and poverty. Adaptation of the agriculture sector to climate change will be costly but necessary for food security, poverty reduction and maintenance of ecosystem services. Reduction and removal of greenhouse gases (mitigation) from agriculture will also be necessary, if global mitigation efforts are to be successful. By nature, agriculture and forestry are carbon sinks. They currently contribute, and still could contribute more, to mitigating climate change by acting as carbon sinks and through their ability to maintain and increase existing carbon stocks.

While climate change introduces new challenges to food and agricultural production, bioenergy introduces new challenges on the demand side as the largest source of new demand for agricultural commodities in recent years.

The interrelated challenges of achieving global food security, adapting to and mitigating climate change, and meeting growing demands for energy cannot be addressed in isolation. The current impetus for investing in improved agricultural policies, institutions and technologies to meet food security and energy goals offers a unique opportunity to mainstream climate change mitigation and adaptation actions into agriculture.

Further research is needed on the various dimensions and impacts of climate change and biofuels on food security across regions and over time. However, quantitative assessments by the Intergovernmental Panel on Climate Change (IPCC) and other sources have yielded a number of findings:

- Global mean surface temperature is projected to rise between 1.8 °C to 4.0 °C by 2100. The actual rise will depend on the degree of emissions reductions achieved in the next few decades. Stabilizing global warming below 2 °C is considered necessary to avoid severely dangerous effects of climate change. Meeting this goal will require halving CO_2 emissions by 2050 compared with 1990 levels.

- Emissions from the agricultural sector account for roughly 14 percent of global greenhouse gas (GHG) emissions. Most emissions from agriculture (74 percent of the 14 percent total) and most of the technical and economic mitigation potential from agriculture (70 percent) are in developing countries.

- Climate change is predicted to affect in many ways (sometimes positively) agriculture and forestry systems through higher temperatures, elevated carbon dioxide (CO_2) concentration, precipitation changes, increased weeds, pests and disease pressure. In the short term, the frequency of extreme events such as droughts, heat waves, floods and severe storms is expected to increase.

- The impact of carbon fertilization is uncertain. Changes in the composition of the atmosphere could result in crop yield increases as a result of CO_2 fertilization and improvements in the efficiency of water uses, but could also increase in pollution.

- All current quantitative assessments indicate that climate change will adversely affect food security in developing

countries, particularly Africa, and increase the dependency of many of these countries on food imports. It is estimated that climate change will reduce African potential agricultural output up to the 2080–2100 period by 15 to 30 percent, at varying degrees among countries.

- Production of biofuels, particularly ethanol and biodiesel for use in the transport sector, has tripled since 2000 and is projected to double again within the next decade.

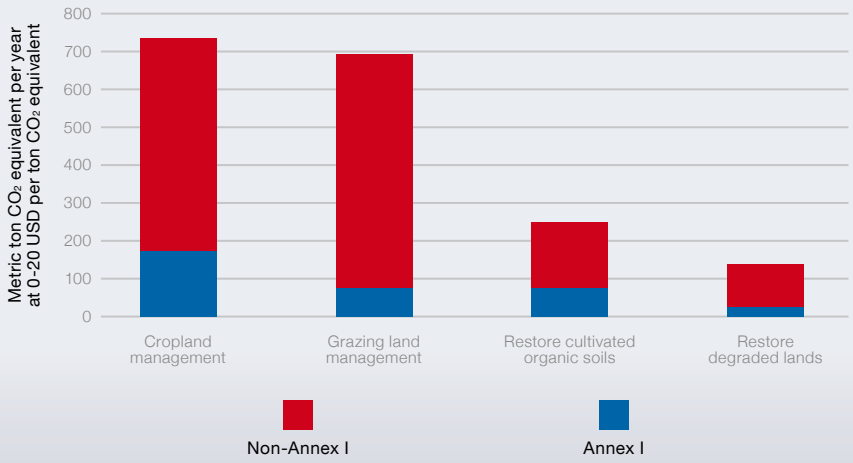
- The increase has been driven largely by policy support measures in the developed countries, seeking to mitigate climate change, enhance energy security, and support the agricultural sector.

- Biofuels are estimated to reduce greenhouse gas emissions by 10–90 percent relative to fossil fuels, depending on the type of feedstock and production technology.

- Biofuels currently account for 0.2 percent of total global energy consumption, 1.5 percent of total road transport fuels, 2 percent of global cropland, 7 percent of global coarse grain use and 9 percent of global vegetable oil use. These shares are projected to rise over the next decade.

- The increased use of food commodities for biofuel production has contributed to higher food prices, with adverse effects on consumers. Benefits for farmers in developed countries could be extended to farmers in developing countries if appropriate policies and investments are put in place. Also biofuel by-products can be used as feed in the livestock industry.

Figure 1: Mitigation Potential from Agriculture, Annex I (Developed) and Non-Annex I (Developing) Countries



Source: Smith et al, 2008

KEY ISSUES

CLIMATE CHANGE MITIGATION AND ADAPTATION

Agriculture currently contributes about 14 percent to GHG emissions (6.8 Gt of CO_2), but also has the technical potential to mitigate between 5.5–6 Gt of CO_2 per year, mainly through soil carbon sequestration and mainly in the developing countries. Additionally, several agriculture-based mitigation options generate significant benefits for both food security and climate change adaptation (see Figure 1). Increasing soil carbon sequestration through improved cropland and livestock management, forestry and agro-forestry initiatives and tillage practices, improving efficiency of nutrient management and restoring degraded lands, are examples of actions that have large mitigation potential and high benefits.

However, agriculture has largely remained a marginal issue in climate change negotiations, with some exception for deforestation and forest degradation mitigation activities. In 2009, FAO identified three main reasons for this: 1) the sheer number of areas, farming systems, agro-ecosystems and farmers involved; 2) either undeveloped or very expensive methodologies for measurement, reporting and verification (MRV), which are required to address uncertainties related to permanence/saturation, leakage and additionality; and 3) the fact that the scope of existing financing mechanisms has tended to exclude many agricultural activities, including many soil carbon sequestration methods.

Adaptation to climate change – including the ability to mitigate exposure to, and cope with, extreme weather shocks – will be necessary to ensure global food security in both the short and long-term. To the extent that certain activities fulfill both adaptation and mitigation objectives, such activities could offer new opportunities for financing. The main obstacles include significant data requirements, as well the legal and institutional frameworks that reduce transactions costs of participation in mitigation programs.

INCREASED PRODUCTION OF BIOFUELS

Production of biofuels from agricultural commodities has increased rapidly in recent years, and is projected to continue expanding in the future, due primarily to policy support measures and quantitative mandates in the developed countries. These are motivated by interest in mitigating climate change by reducing or offsetting greenhouse gas emissions, enhancing energy security by reducing dependence on imported oil, and supporting farmers by increasing demand for the crops they produce.

Impacts on climate change mitigation have been mixed so far, as greenhouse gas emission reductions vary widely across biofuels, feedstocks and production technologies. Emissions reductions are estimated to be smallest (10–30 percent) for ethanol from maize in the United States and largest (70–90 percent) for ethanol from sugarcane in Brazil and second-generation biofuels. In all cases, emissions reductions will be smaller to the extent that increased biofuel production accelerates conversion of forests or grasslands to cropland.

Impacts on energy security have been limited, as liquid biofuels still represent only a small share of energy consumption – about 1.5 percent of total road transport fuel and 0.2 percent of total energy consumption. The International Energy Agency projects that biofuels' share of road transport fuel would rise to 5 percent by 2030, and the International Institute of Applied Systems Analysis estimates that this figure could reach 8 percent by 2050, depending on policies and technology.

By contrast, increased biofuel production has already had significant impacts on agricultural markets and food security.

Biofuels are the largest source of new demand for agricultural commodities in recent years, currently accounting for about 7 percent of global coarse grain use (rising to 12 percent by 2018), 9 percent of global vegetable oil use (rising to 20 percent by 2018) and 2 percent of global cropland (rising to 4 percent by 2030). As such, they have contributed both to the recent spike in agricultural commodity prices and to the expectation that prices will remain higher in the future than they would be in the absence of increased biofuel production.

Higher food prices reduce access to food for consumers (including most of the world's poor who buy more food than they produce, and who spend a large share of their incomes on staple foods). The International Food Policy Research Institute estimates that the number of malnourished preschool children in sub-Sahara Africa and South Asia could increase by 5 million under a scenario of drastic biofuel expansion up to 2050.

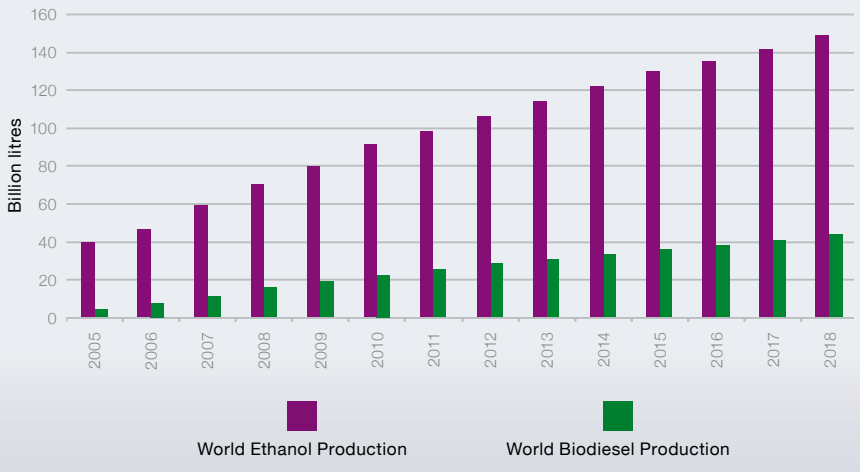
But higher prices and new markets also benefit net sellers of agricultural commodities. In the short term, the benefits have gone primarily to farmers in developed countries – who have good access to inputs, technology and markets (as well as policy support). In the longer term, however, higher prices could also benefit farmers and rural economies in developing countries – if appropriate policies and investments are in place to improve their access to inputs, technology, credit and markets (and secure access to land).

FOOD SECURITY

Climate change and bioenergy development will affect food security in all of its four dimensions – availability, accessibility, stability and utilization.

Food availability: Globally, climate change impacts on food production may be small, however significant decreases are expected in areas that are already food insecure. Developing countries could experience a decline of between 9 and 21 percent in overall potential agricultural productivity as a result of global warming. While increased atmospheric CO_2 concentrations are expected to have a positive effect on the yield of many crops, the nutritional quality of agricultural produce may not increase in line

Figure 2. World ethanol and biodiesel projections, 2005-2018



Source: OECD-FAO Agricultural Outlook 2009-2018

DISCUSSION POINTS

Several key areas have been identified that could help overcome the challenges of climate change and bioenergy:

1. **Given current and predicted impacts on food security due to climate variability and exposure to extreme weather events, what are (or soon will be) the key constraints to adaptation?**
2. **Where are the key synergies between food security, adaptation and mitigation in terms of technological, institutional and financing options for agriculture? What tradeoffs between land use for food, bioenergy and carbon sequestration need to be considered? To what extent are low-carbon growth agricultural strategies compatible with agricultural development/food security strategies?**
3. **How can the global and national agendas for achieving adaptation to climate change, food security and climate change mitigation be made more coherent and mutually supportive to address these interrelated challenges posed by climate change?**
4. **Can climate data analysis and forecasting help to mitigate the effects of climate change? How can the developing countries be assisted in the development and use of early warning systems?**
5. **Are public policies to support increased production of biofuels appropriate? If so, what form should they take, and who should pay for them?**
6. **What opportunities do biofuels offer for developing countries? What can be done to help developing countries, and in particular small farmers, to take advantage of these opportunities? What should be done to ensure that biofuel development is actually pro-poor?**

with higher yields. Increased demand for biofuels may actually increase production of food commodities, but much of the increased production would be diverted away from use as food.

Access to food: Impacts on access will be mixed, as a reduction in agricultural incomes associated with climate change will reduce access for many of the world's poorest people, while increased demand for agricultural commodities due to biofuels will increase agricultural incomes for some producers but also increase food prices for consumers. The strongest negative impact of climate change on agriculture is expected in sub-Saharan Africa, which means that the poorest and most food insecure region is also expected to suffer the largest contraction of agricultural incomes. On average, food prices are expected to rise moderately in line with moderate increases of temperature until 2050. After 2050 and with further increases in temperatures, prices could increase more substantially. Increased production of biofuels will increase pressure on prices.

Stability of food supplies: Climate change will increase the variability of agricultural production across all areas, with increased frequency of extreme climate events. Increases in the incidence of droughts and floods, which are dominant causes of acute food shortages in semi-arid and sub-humid areas particularly in sub-Saharan Africa and parts of South Asia, mean that the poorest regions with the highest levels of chronic undernourishment will also be exposed to the highest degree of instability in food production. Also climate change is altering the distribution, incidence and intensity of animal and plant pests and diseases and may result in new transmission modalities and different host species. At the same time, agriculture will become more closely linked with energy markets through the production of biofuels, introducing additional variability in agricultural commodity prices.

Food utilization: Climate change will alter the conditions for food safety by increasing the disease pressure from vector, water and food-borne diseases. The result could be a substantial decline in labour productivity and increases in poverty and mortality rates. Increases in daily temperatures could also raise the frequency of food poisoning. By contrast, improved access to bioenergy could improve indoor air quality in poor households otherwise reliant on fuelwood, charcoal or animal dung for cooking and heating, and could reduce time spent by women on fuelwood collection, improving health and time available for child care and nutrition.

For further information

High Level Expert Forum - How to Feed the World in 2050
Office of the Director, Agricultural Development Economics Division
Economic and Social Development Department
Viale delle Terme di Caracalla, 00153 Rome, Italy

Tel: (+39) 06 57053354
Fax: (+39) 06 570 56172
Email: HLC-2050@fao.org