New challenges: climate change and bioenergy

THE CHALLENGE

Agriculture both affects and is affected by climate change. Agricultural and food production 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 agriculture to climate change will be costly but necessary for food security, poverty reduction and maintenance of ecosystem services. Also reduction of greenhouse gas emissions and enhancement of carbon sinks (mitigation) from agriculture will be necessary, if global mitigation efforts are to be successful. In fact, agriculture and forestry are by nature carbon sinks. They contribute, and could still contribute more, to mitigating climate change by storing carbon.

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 up to a certain level of global temperature rise. However significant production decreases are expected in regions that are already food insecure. Developing countries in Africa, Asia and Latin America could experience a decline of between 20 and 40 percent in overall potential agricultural productivity if temperatures rise by more than 2 °C. More demand for liquid biofuels for transport will increase the use of productive resources for biofuel production of biofuel feed stock diverting land, water and other resources from food production and putting increasing pressure on forests.

Access to food: Impacts on access will be mixed, as a reduction in agricultural incomes associated with climate change will reduce access to food for many of the world's poorest people. 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. Increased demand for agricultural commodities for the production of liquid biofuels will increase food prices for consumers while it will increase agricultural incomes for some producers. The exact impacts are not certain as they will depend on policy and energy market developments.

Stability of food supplies: Climate change will increase the variability of agricultural production across all areas, with increased frequency of extreme weather 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. Climate change is also altering the distribution, incidence and intensity of animal and plant pests and diseases and may result in new transmission modalities and different host species.

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, and could reduce time spent by women on fuelwood collection, improving health and time available for child care and nutrition.

CLIMATE CHANGE ADAPTATION

Adaptation to climate change is essential for any efforts to promote food security, poverty alleviation, or sustainable management and conservation of natural resources. Many countries are already dealing with climate change impacts, including irregular, unpredictable rainfall patterns, uncommonly heavy rainfall, increased incidence of storms and prolonged droughts. In addition, changing temperatures and weather patterns have allowed for the emergence of pests and diseases that affect animals, trees and crops. All these have a direct effect on yields as well as product quality, not to mention the availability and price of food, feed and fiber in the marketplace.

Rural communities, particularly communities in fragile environments such as mountain areas and coastal zones, face growing risks, including increased and recurrent crop failure, loss of livestock and reduced availability of fisheries and forest products. More frequent and more intense extreme weather events will have serious impacts on livelihood assets in both rural and urban areas.

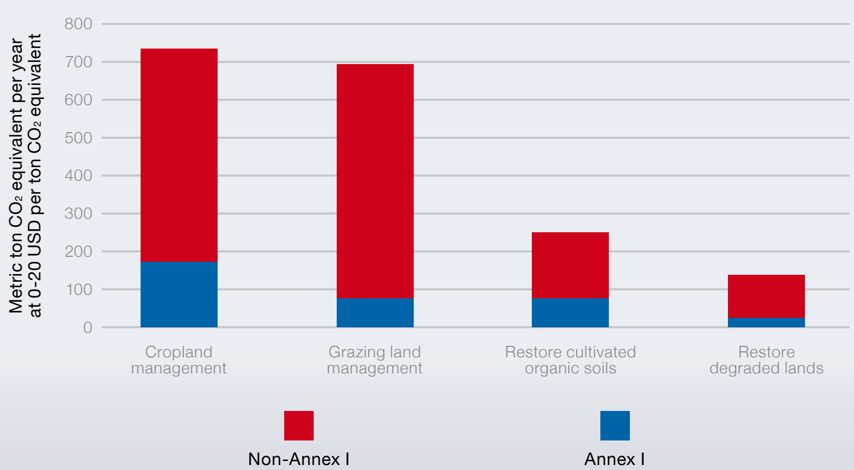
Proactive and anticipatory adaptation approaches are required that address the short-term impacts of increasing climate variability but also help local communities prepare for the long-term impacts resulting from changes in mean temperatures, rainfall, salinity and sea levels. Long-term climate change impacts can emerge gradually or arrive abruptly when certain thresholds are reached. Adaptation must be an integrated, flexible process that is tailored to the local context. It is critical for adaptation activities in agriculture, forestry and fisheries to consider both the opportunities and constraints that local populations face and the diversity of systems they rely upon.

Investments made to deal with climate change should also be seen as an opportunity to increase support to the agriculture, forestry and fisheries sectors, which has declined in developing countries for the last decades.

Local people, the actual land managers, play a central role in adapting agriculture, forestry and fisheries sectors and food systems to climate change. Equally important are the policy and legal frameworks, incentives and services for rural producers that can stimulate and guide adaptation processes and link producers to markets. National and regional policies and laws for land and water management, resource use and access, environmental conservation, livelihood strategies, crop development, land-use planning, land tenure, risk management, food security and trade have great potential to influence adaptation to climate change. To be successful, adaptation activities need the support of strong institutions with clearly defined and coordinated responsibilities.

The concept of adapting to climate impacts is not new to farmers, forest dwellers and fishers. However, today, the need to increase production coupled with the speed and magnitude of the expected changes in climate presents new challenges. Traditional ways of coping may not be sufficient to ensure adaptation in the medium to long term. Adaptation in agriculture, forestry and fisheries needs to be supported by strong research efforts and often involves substantial changes in practices that may take some time to implement or show benefits.

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



Source: Smith et al., 2008

CLIMATE CHANGE MITIGATION IN AGRICULTURAL SECTORS

It will not be possible to reach the global mitigation target, if the agriculture, forestry and fisheries sectors, are not significantly contributing to mitigation. Agriculture, forestry and other land-use sectors are responsible for about a third of global anthropogenic GHG emissions. However, oceans, lakes, forests and agricultural lands also sequester and store large amounts of carbon, thus contributing to climate change mitigation.

In many areas, agriculture is the main driver of deforestation, indicating the close linkages among the different land-use sectors. According to The Stern Review (2006), reducing deforestation and forest degradation would be one of the most cost effective mitigation approaches. In addition to protection, improved management and restoration of the Ocean's 'blue forests' (kelp, macro-algae, mangroves, salt marshes and sea grasses) may also contribute towards mitigation of GHGs.

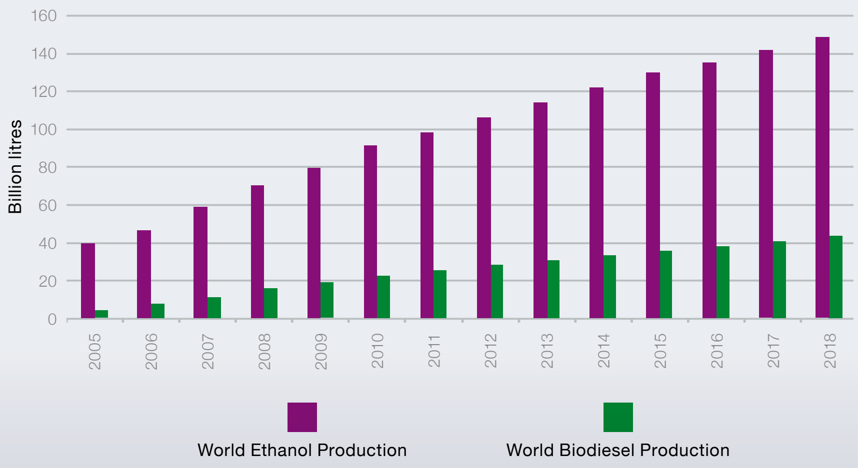
Existing forestry and agricultural practices and measures already provide mitigation opportunities. Emissions can be reduced by adopting better management practices and more efficient management of carbon and nitrogen flows. Avoiding or displacing emissions can be achieved if the energy efficiency of the agriculture sector can be improved. In addition, fossil fuel energy used in agricultural production can in some cases be replaced by biofuels produced from wood, agricultural feedstock and residues, algae and fish waste. Forest conservation activities can help to avoid carbon emissions.

GHGs can be absorbed from the atmosphere through sinks. In the forestry sector, activities such as afforestation, reforestation and forest restoration can increase carbon capture from the atmosphere and lock it into plant biomass, roots and soils. Sustainable forest management can help maintain the forest carbon. Carbon sequestration in crop- and grass-lands and agroforestry also has the potential to make a significant contribution to GHG mitigation. According to IPCC, 89 percent of agriculture's technical mitigation potential lies in soil and biomass carbon sequestration through different management practices, such as improved cropland and grazing land management, agroforestry and the rehabilitation of degraded lands. For example, soil disturbance is limited and soil carbon can be increased by the use of reduced or zero-tillage agriculture in association with diversified cropping patterns and increased soil cover.

While suitable mitigation technologies and practices exist, more work is needed to develop technologies over a wider range of farming systems and agro-ecological zones. In addition, simple but effective, accurate and verifiable methodologies for measuring and accounting for changes in carbon stocks are required, particularly in the context of monitoring commitments and allowing the development of effective carbon financing mechanisms.

The challenge is to design financing mechanisms for the remuneration of environmental services in general and

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



Source: OECD-FAO Agricultural Outlook 2009-2018

mitigation services in particular that are provided by smallholder agriculture and forestry. These financing mechanisms need to offer incentives for providing and safeguarding ecosystem services such as watershed protection, carbon sequestration and biodiversity provision, while at the same time encouraging farmers to adopt better crop and livestock production techniques to boost their productivity.

BIOENERGY

An estimated 2 to 3 billion people rely on unsustainable biomass-based energy resources and 1.6 billion people, mostly rural poor, lack access to sustainable energy services. This situation entrenches poverty and food insecurity. National policies and programmes aimed at providing broader access to energy services for the rural poor will significantly contribute to sustainable development and the achievement of the Millennium Development Goals.

Bioenergy development has the potential to bring new investment into the agricultural sector and provide market and employment opportunities for the 2.5 billion people dependent upon agriculture, comprising most of the 900 million rural poor. Bioenergy growth, if managed appropriately and targeted to benefit the needy people, can also contribute to improving infrastructure and market access in rural areas.

Assessments of the climate change mitigation potential of bioenergy use need to take food security and resource availability into account. Sustainability criteria are required to ensure sustainable soil and water management, and protect high biodiversity and nature reserve areas. At the same time, the rights and livelihoods of local people must be safeguarded. Improving household energy systems can significantly reduce GHG emissions at a relatively low cost.

Impacts of biofuels production on climate change mitigation have been mixed so far, as GHG emission reductions vary widely across liquid biofuels, feedstock, location and production technologies. In all cases, however, emissions reductions will be limited, and emissions can even increase if liquid biofuel production accelerates the conversion of forests or grasslands into cropland.

By contrast, increased liquid biofuel production has already had significant impacts on agricultural markets and food security. Liquid biofuels have been the largest source of new demand for agricultural commodities in recent years. 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. It is expected that demand for agricultural feedstock for liquid biofuels will be a significant factor for agricultural markets over the next decade and perhaps beyond.

The impacts of liquid biofuel production depend critically on where and how it is produced. Innovative technologies including second generation technologies, aquatic biofuels, the promotion of sustainable production methods and integrated food energy systems, can mitigate negative impacts and promote greater benefits at all levels. There is a need to develop research into better options and to exchange experiences and knowledge on biofuel technologies so as to share benefits by all.

IN CONCLUSION

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. By the same token, a climate change agenda will need to recognize and value agriculture's potential contributions to adaptation and mitigation through options that also safeguard its contributions to global food security and overall development.

POLICY CONSIDERATIONS ARISING FROM THE FAO HIGH-LEVEL FORUM ON HOW TO FEED THE WORLD IN 2050 (ROME, 12-13 OCTOBER 2009)

- There are natural resource constraints and challenges involved with feeding a growing world population. And, there are trade-offs involved in solving some of them. For example, expansion of biofuels to solve the energy problem may exacerbate food insecurity if not managed properly.
- The forum agreed that food security needs should come first. Governments could consider controlling biofuel expansion through land-use regulations. Agriculture and energy are intertwined, with agriculture being affected not just by the amount of energy available to it, but also by the price level and volatility. Mechanisms to reduce this volatility could aid rational planning.
- Following from this, the panel recognized that increased productivity may come at the expense of sustainability. Not surprisingly, some forum participants questioned whether the international community has enough knowledge to feed the world sustainably.
- A strong and recurrent theme concerned the lack of integrated policies across sectors (e.g., agriculture, forestry, energy) and the lack of coherence in policies from the international level to the national and local levels.
- The panel recognized that crop biodiversity provides the means for crop adaptation to climate change. Panellists stressed that the Climate Change Conference in Copenhagen should acknowledge crop adaptation efforts, including conservation of diversity and its use in plant breeding programmes as an integral part of overall adaptation efforts.
- There was the view that minor and underutilized crops could be developed further and could become more valuable in future climates particularly for the poor, and that biodiversity could be used not just to increase production but also to increase the nutritional quality of the foods produced. The quantity of food produced is important, but so is the quality especially in view of a richer and more educated future population.

For further information

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