Food and Agriculture Organization
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The State of Food and Agriculture 2016

Climate change, agriculture and food security

CLIMATE CHANGE: WHAT DOES IT MEAN FOR AGRICULTURE AND FOOD SECURITY?

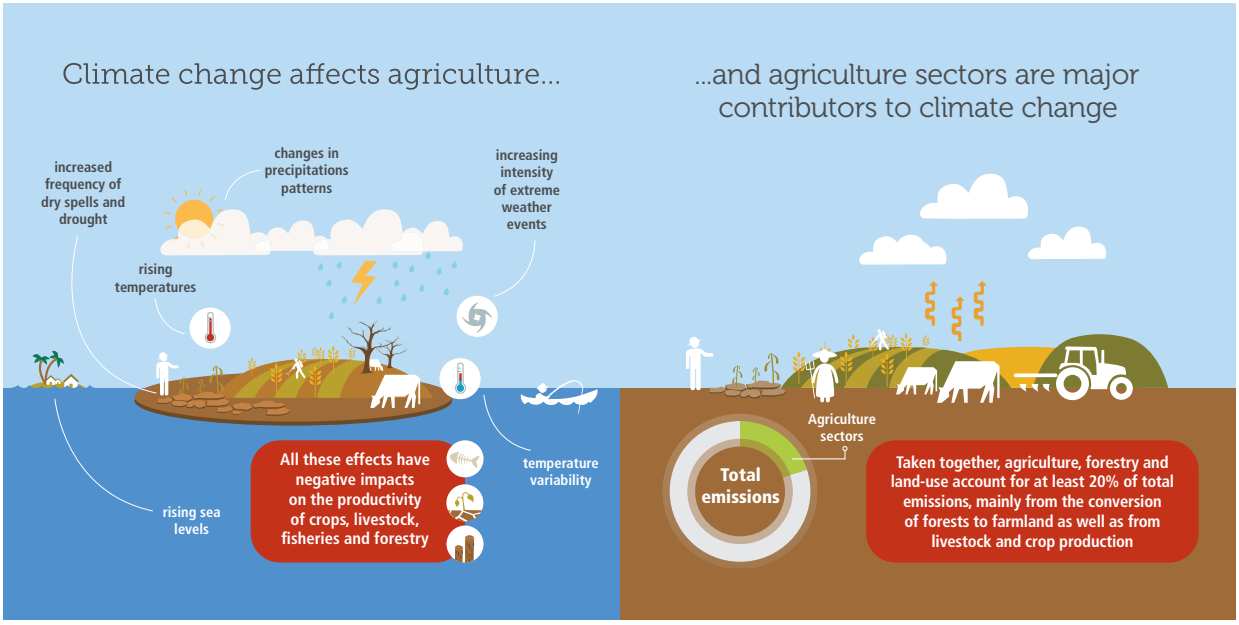
Climate change will have severe negative effects on agriculture and food security. Low-income countries and poor farmers are particularly at risk. At the same time, agriculture is a major source of greenhouse gas (GHG) emissions. Agriculture has to both adapt to climate change and contribute to mitigation. This requires changes in agricultural practices as well as improvements in livelihood options for poor farm households. Changes in the broader food system are also needed, including reductions in food waste and losses and changes in dietary patterns to reduce their carbon footprint.

Climate change threatens agriculture and food security while agriculture also contributes to climate change

All available evidence confirms that the world's climate is changing. Agriculture – including crop and livestock production, fisheries, aquaculture and forestry – is central to addressing the challenge that climate change poses to humanity. Understanding the links between climate change, agriculture and food security is crucial in order to devise strategies for adapting to climate change in ways that improve food security and ensuring that the agriculture sectors can contribute effectively to mitigating climate change.

Agriculture depends directly on natural resources and climatic conditions and is affected more than any other sector by the effects of climate change. Numerous studies have attempted to assess impacts of climate change on productivity and production in different agricultural sectors and subsectors in different locations, at different times and for different future climate change scenarios. The majority of them point to mostly negative impacts which will worsen over time if climate change is allowed to progress. They also show that negative impacts are likely to be much more pronounced at lower latitudes and that most of the cost in terms of lost production and productivity will be suffered by developing countries and countries with already high levels of poverty and food insecurity.

Productivity declines in agriculture resulting from climate change will have serious negative implications for livelihoods and food security. Food supply shortfalls will lead to major increases in food prices. Since the areas most affected will be those with already high rates of hunger and poverty, food price increases will directly affect millions of low-income people. Among the most vulnerable will be those who depend on agriculture for their livelihood and income, particularly smallholder producers in developing countries.



About 21 percent of total annual man-made GHG emissions originate in "agriculture, forestry and other land use" (AFOLU), according to the Intergovernmental Panel on Climate Change (IPCC) classification of sources of emissions. The largest share of the AFOLU emissions is caused by agricultural production, followed by deforestation. Within agricultural production, the main sources of emissions are enteric fermentation in ruminant livestock, the use of organic and nitrogen fertilizer and rice production in flooded rice fields. Smaller amounts of emissions come from losses of carbon from organic soils (often due to inappropriate agricultural practices) and the burning of biomass.

Agriculture must adapt to climate change - and contribute to mitigation

Societies at large need to take decisive action, today, to mitigate climate change in order to avoid the risk of worsening food insecurity. Future food security will depend mostly on emission reductions from other economic sectors; however, agriculture has a significant potential for reducing GHG emissions and sequestering carbon and must also contribute to climate change mitigation efforts. Changes are also needed in the broader food systems, including cutting food losses and waste and reducing demand for emission-intensive food products.

At the same time, agriculture and the populations who depend on it need to *adapt to current or expected climate change* to minimize its harmful effects. To some degree, adaptation in agriculture will be a spontaneous response by farmers, fisherfolk and foresters; however, many of them, and especially small-scale producers, may face a lack of feasible options as well as constraints to adopting what few there may be.

Agriculture must respond, by building resilience to the impacts of climate change, while contributing to the extent possible to mitigation efforts. Three areas of action are critical: i) adapting to climate change in small-scale agricultural production systems; ii) reducing emissions and increasing carbon sequestration in primary agriculture; and iii) reducing emissions in broader food systems.

How to adapt to climate change in small-scale production systems

Smallholder agricultural producers are highly vulnerable to climate change. Enhancing their resilience to the effects of climate change is particularly important. This involves building more resilient production systems and more resilient livelihoods of vulnerable populations.

Making production systems more resilient

Addressing the challenges posed by climate change will require innovation in farming systems. Enhanced resilience to climate change and significant improvements in food security can be achieved with the introduction of different sustainable agricultural

practices. Wide adoption of practices such as the use of nitrogen-efficient and heat-tolerant crop varieties, zero-tillage and integrated soil fertility management – to name a few – would boost productivity and farmers' incomes and increase resilience to climate change.

Despite this potential, the adoption by farmers of improved practices is still very limited. Smallholders, especially, face a broad range of barriers on the path to sustainable agriculture, such as limited access to markets, credit, extension advice, weather information, risk management tools and social protection. Women are especially disadvantaged.

Making livelihoods more resilient

Farmer households can further enhance their resilience by diversifying their activities in order to reduce the impact of climate shocks on income and provide them with a broader range of options when managing risks. One example of diversification on the farm is to integrate production of crops, livestock and trees – for example through agroforestry systems.

For farm households with limited options for on-farm diversification, livelihood diversification through non-farm rural employment or migration to cities may be necessary. Social protection, education and active labour market policies are key tools for promoting diversification of livelihoods and mitigating risks associated with climate change.

How to mitigate climate change in agriculture

Agriculture can contribute to climate change mitigation through reduced emissions from agricultural production and through enhanced carbon sequestration – carbon sinks – in soils and plants. Many, but not all, options for mitigation also carry co-benefits for adaptation.Two complementary goals to be pursued for mitigation are reducing the intensity of GHG emissions per unit of output and creating carbon-rich landscapes.

Reducing the intensity of emissions in agricultural production

Demand for agricultural products is bound to continue increasing due to population growth and rising incomes, but the intensity of emissions per unit of output can be reduced. A key strategy is investment in yield improvements. As crop and livestock productivity has grown over the past decades, emissions intensities have already gone down. Continued improvements in farm management strategies could further increase crop yields and herd productivity, thereby reducing pressures on natural resources, including deforestation. Improved management of nitrogen fertilizer and manure could reduce emissions of nitrous oxide. Reducing on-farm losses can also play a key role in reducing GHG emissions.

Creating carbon-rich landscapes

Forests and agricultural landscapes occupy most of the Earth's land surface and are vital to the conservation and restoration of carbon sinks.

The mitigation potential in forestry falls in two broad categories: reducing emissions of GHGs and increasing removals of GHGs from the atmosphere. The former involves reducing or avoiding deforestation. Carbon sequestration from the atmosphere can be boosted by increasing the area under forest cover through planting, seeding and assisted natural regeneration. Carbon stocks in forest can also be maintained or enhanced through activities such as reduced-impact logging, sustained yield management, maintaining partial forests cover and reducing slash-and burn cultivation. Also rehabilitation of mangroves and floodplain forests can enhance carbon sequestration.

Soils represent the world's second-largest carbon pool after oceans. Soils carry a large potential for carbon sequestration, especially through restoration of degraded soils. In addition to sequestering carbon, maintaining and restoring soil health improves fertility for agricultural production and delivers benefits in terms of productivity and food security. While many current agricultural practices contribute to losses of soil organic matter, a number of technical options are available to enhance soil carbon sequestration in agricultural systems. These include:

- reducing fires, overgrazing and soil erosion;
- recycling crop residues and manure;
- cover crops, intercropping, agroforestry and conservation agriculture;
- improved crop varieties, nitrogen-fixing legumes and fertilizers to boost crop residues.

Beyond primary agriculture – reducing emissions in food systems

In addition to primary agriculture, adjustments are required in food systems at large. About one-third of all food produced in the world is lost or wasted post-harvest. Reducing food losses and waste throughout the food chain would not only improve the efficiency of the food system but also reduce pressures on natural resources and emissions of GHGs.

The energy use and emission-intensity of food processing, conservation and transportation are high and increasing. Reducing the emission intensity of food systems will require changes in consumer awareness, as well as price incentives that favour food items with much smaller environmental footprints. Rebalancing diets towards less animal-sourced foods in areas with high consumption of such products can make a significant contribution in this direction, with likely co-benefits for human health.

Conclusions

The advancing threat of climate change poses major challenges for agriculture and food security. Agriculture needs to adapt to changing climatic conditions and to contribute to mitigating climate change. Many of the options for mitigation carry co-benefits in terms of adaptation, but in some cases there are trade-offs to be made. Often practices that can contribute to mitigation and adaptation are not widely adopted. Making progress requires addressing a range of barriers and constraints to the adoption of improved practices by farmers; it also requires putting in place appropriate policies and institutions as well as financing mechanisms and funding commensurate with the magnitude of the challenge. These issues are addressed in two separate accompanying info notes.

This is Info note number 1 of 3 drawn from *The State of Food and Agriculture 2016. Climate change, agriculture and food security*. For sources and more detail, please refer to the complete report (available at **www.fao.org/3/a-i6030e.pdf**). Info note 2 discusses the constraints to adoption of improved agricultural practices for mitigation and adaptation to climate change. Info note 3 addresses the policies, institutions and financing needed to address climate change in agriculture.

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