

# World food security:

the challenges of climate change and bioenergy



CLIMATE CHANGE AFFECTS EVERYONE. But the worst hit will be hundreds of millions of small-scale farmers, fishers and forest-dependent people who are already vulnerable and food insecure. By affecting the availability of land, water and biodiversity, and the price of food, the rising demand for biofuels produced from food crops also has an impact on the poor.

World Food Day provides an occasion to once again highlight the plight of 862 million undernourished people in the world. Most of them live in rural areas where their main source of income is the agricultural sector. Progress towards the World Food Summit goal of reducing their numbers by half by 2015 has already stalled. Global warming and the biofuel boom are now threatening to push the number of hungry even higher in the decades to come. This paper examines those challenges and how they might be handled.





# *Adapting to climate change*

MANY OF THE WORLD'S SMALL-SCALE FARMERS work marginal land in the tropics, which is most vulnerable to climate change phenomena such as more frequent and more intense drought. They are the people who can least withstand a drop in income from their modest fields and who are least equipped to adapt to changing conditions. Climate change will affect the suitability of land for different types of crops, livestock, fish and pasture. It will also have an impact on the health and productivity of forests, the incidence of pests and diseases, biodiversity and ecosystems. Some farms will be wiped out due to increased aridity, groundwater depletion, salinization and the rise in sea level.

Historically, farmers, pastoralists, forest dwellers and fishers have learned to cope with climate variability and have often adapted crops and farming practices to suit new conditions. But the severity and pace of climate change is presenting new challenges. Changes in temperatures and precipitation as well as more frequent extreme weather are expected to result in crop and livestock production shortfalls and other asset losses, thereby threatening food production but also access, stability and utilization of food resources. In some areas, the changes may well exceed the adaptation capacity of the people.

Many adaptation measures will focus on strengthening measures already in place, such as sustainable and ecological farming practices, early warning systems, systems to identify climate change "hot spots" and disaster risk management. Others will focus on rural investments to reduce the long-term effects of short-term climate variability on food security, through crop insurance

(see Insuring against weather-related crop failure) and incentives that encourage farmers to adopt better agricultural and land use practices.

Agriculture is not only the victim of climate change, it is also a source of greenhouse gases. Crop production and livestock release greenhouse gases into the air and are responsible for an important part of the emissions of methane (from cattle and wetlands, especially rice paddies) and nitrous oxide (from fertilizer use). Changes in land use such as deforestation and soil degradation – two devastating effects of unsustainable farming practices – emit large amounts of carbon into the atmosphere, contributing to global warming.

Agriculture should contribute to reducing greenhouse gas emissions through such measures as reduction of deforestation, improved forest conservation and management, better control of wildfires, agro-forestry for food or energy, soil carbon sequestration, restoring land through controlled grazing, improving nutrition for ruminant livestock like cattle, more efficient management of livestock waste including biogas recovery, and other strategies that conserve soil and water resources by improving their quality, availability and efficiency of use.

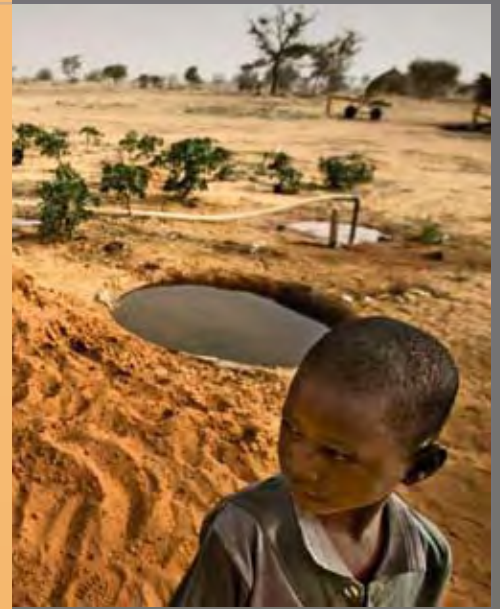
The use of biofuels as a solution to reduce carbon emissions and to become more independent from fossil fuels has crucial implications for food security as well as for current and future land use (see Bioenergy and food security). Let us examine one by one the different agricultural components, and what issues will arise as the climate gets warmer.



# Land

Climate change threatens to uproot many rural communities. For example, rising sea levels may force many communities in low-lying coastal areas and river deltas in developing countries to move to higher ground. Similarly, increasingly frequent droughts brought on by climate change may leave farmers and pastoralists who rely on rainfall to raise their crops and livestock in conflict over land and water.

This displacement of people is likely to result in competition between migrants and established communities for access to land. Reconciling diverse land use needs presents daunting challenges for governments at all levels. In cases where land rights are informal and different customary land tenure systems coexist, governments will need to work closely with local communities to establish fair and equitable systems of land tenure and develop mechanisms for resolving disputes. For many displaced communities, it may be impossible to maintain their farming or pastoral traditions. Land tenure policies designed to facilitate resettlement will need to be incorporated into a broader programme that provides opportunities for the displaced to earn livelihoods outside the agricultural sector.



# Water

As a consequence of climate change, farmers will face growing unpredictability and variability in water supplies and increasing frequency of droughts and floods. However, these impacts will vary tremendously from place to place. Scientists expect that a temperature increase of 1 to 3° C will benefit agriculture in the northern latitudes, while large parts of the arid and semi-arid tropics will face declining rainfall and runoff – an ominous trend for the mostly food-insecure countries located there.

Hardest hit will be rainfed agriculture – which covers 96 percent of all cultivated land in sub-Saharan Africa, 87 percent in South America and 61 percent in Asia. In marginal semi-arid zones with prolonged dry seasons, the risk of crop failures will increase. Where stability of production cannot be assured, people will be forced to migrate. By the 2080s, land unsuitable for rainfed agriculture in sub-Saharan Africa due to severe climate, soil or terrain constraints may increase by 30 to 60 million hectares.

But irrigation in large river basins and deltas are also at risk from a combination of reduced runoff, salinity (Indus), increased flooding and sea level rise (Nile, Ganges-Brahmaputra, Mekong, Yangtze), and urban and industrial pollution. These stresses on some of the prime productive land will reduce the agricultural output, biodiversity and the natural ability of ecosystems to recover – with possible negative impacts on millions of farmers and consumers across the world as food supply becomes progressively constrained.

The impacts of climate change will be uneven between countries and regions. China, with 140 million undernourished people, should gain 100 million tonnes in cereal production, while India, with 200 million undernourished, is expected to lose 30 million tonnes.

Areas projected to experience lower precipitation will need to improve water storage, management and productivity. Large irrigation schemes will need to adapt to changes in water supply regimes and support will be needed for small-scale, field-based water control measures.



# *Biodiversity*

The 2005 Millennium Ecosystem Assessment estimates that by the end of this century, climate change will be the main cause of biodiversity loss. But as climate changes, the value of biodiversity for food and agriculture will increase. Genetic resources are the living material that local communities, researchers and breeders use to adapt food and agricultural production to changing needs. Maintaining and using this reservoir of genetic diversity will be the foundation for coping with climate change.

The Intergovernmental Panel on Climate Change reports that a significant number of species will be at risk of extinction as the global mean temperature increases. Of particular concern are relatives of major crops surviving in the wild. For example, research by the Consultative Group on International Agricultural Research based on distribution models of wild relatives of three staple crops that sustain the poor – peanuts, cowpea and potato – suggests that by 2055, between 16 and 22 percent of wild species will be threatened by extinction.



## *Fisheries and aquaculture*

Fisheries employ more than 200 million people worldwide – 98 percent from developing

countries. And fish is a major source of protein in many poor people's diets, comprising about 20 percent of animal protein in the diets of over 2.8 billion people. Climate change threatens this important source of income and nutrition for the poor.

Here is what climate change will bring: higher water temperatures, rising sea levels, melting glaciers, changes in ocean salinity and acidity, more cyclones in some areas, less rain in others, shifting patterns and abundance of fish stocks. Climate change compromises the sustainability and productivity of a key economic and environmental resource, but it also presents opportunities, especially in aquaculture.

Impacts of climate change will affect fisheries- and aquaculture-dependent people as production and marketing costs increase, buying power and exports decrease and dangers from harsher weather conditions rise. Small fishing communities in some areas will face greater uncertainty as availability, access, stability and use of aquatic food and supplies diminish and as work opportunities dwindle.

Now accounting for 45 percent of global seafood consumption, aquaculture production will continue rising to meet future demand. Here, climate change offers new opportunities. Production in warmer regions will likely increase because of better growth rates, a long growing season and the availability of new fish farming areas where it was once too cold. Therefore, aquaculture development opportunities will increase in particular in tropical and sub-tropical regions, such as in Africa and Latin America.





# *Transboundary pests and diseases*

Pests and diseases have historically affected food production either directly through losses in food crops and animal production, or indirectly through lost profits from insufficient cash crop yields. Small-scale farmers naturally have the most to lose. Today, these losses are being exacerbated by the changing climate and its increasing volatility, threatening food security and rural livelihoods around the globe.



## *Managing the risk*

Whether global warming affects land, water, crops, livestock, fish, or pests and diseases, there are new ways of managing the risk they pose. In order

to minimize the impact of climate change on hunger, a multi-pronged approach is needed, at national, regional and international levels.

There needs to be closer cooperation between climate change scientists, who make projections well into the future, and groups working on disaster risk management and food security, who deal with the here and now.

New ways of funding efforts to address climate risks and food security should be explored. These include micro-finance tools for communities and households; expanding the role of the private sector; increasing the role of foundations; and enabling the rural poor to access the carbon credit market system.

While there is clear evidence that climate change is altering the distribution of animal and plant pests and diseases, the full effects are difficult to predict. Changes in temperature, moisture and atmospheric gases can fuel growth and generation rates of plants, fungi and insects, altering the interactions between pests, their natural enemies and their hosts. Changes in land cover, such as deforestation or desertification, can make remaining plants and animals increasingly vulnerable to pests and diseases.

New farming practices, different crops and animal breeds, and integrated pest management principles must be developed to help stem the spread of pests. Countries may need to consider the introduction of biological control agents or new pest- or disease-resistant crops and breeds. Governments also need to strengthen national animal and plant health services as a top priority.



Much can be done now and in the next few decades to lessen the worst effects of global warming. These measures include:

- ✧ developing climate and climate impact models that give a better understanding of how climate change may affect farming and forestry at a local level in order to be better prepared;
- ✧ diversifying livelihoods and adapting agricultural, fishing and forestry practices by encouraging better water management, soil conservation, resilient crops and trees;
- ✧ improving and expanding weather and climate forecasting;
- ✧ improving monitoring and early warning systems;
- ✧ developing disaster risk management.

To better adapt to climate change impacts:

- ✧ land use plans, food security programmes, fisheries and forestry policies must all be adjusted.
- ✧ cost/benefit analyses are needed to take account of climate change risks for irrigation or coastal protection.
- ✧ farmers' best practices should be promoted through capacity building and networking.
- ✧ implementation of National Adaptation Programmes of Action on climate change needs to be supported.
- ✧ Contingency plans need to cover new and evolving risk scenarios.

# Conclusion

Much can be done to reduce agriculture's contribution to greenhouse gas emissions and it is important to pursue strategies and practices with this end in view. However, mitigation alone is not enough and will not be felt before the second half of the century. Global warming is already underway and adaptation strategies are now a matter of urgency, especially for the most vulnerable poor countries.



**Insuring against weather-related crop failure** Weather-based index insurance is a relatively new risk management tool that links insurance payouts to objective, measurable events like rainfall or temperature. Such insurance policies allow farmers to better manage risk and encourage them to invest in agricultural activities that require a higher initial investment. Because triggers can be verified independently, there is far less likelihood of fraud or political interference, making banks and insurance companies more likely to provide index insurance to poor rural communities. Payouts are proportional to the difference in rainfall or temperature, and thus only provide farmers with partial protection. Although weather-based index insurance is still being tested, smallholder farmers in a 2005 study in Malawi reported that index insurance was their primary strategy for climate change adaptation.

Humanity must learn to live with climate change. But we cannot allow climate change to become one more aggravating factor for hunger in the world, one more thing that widens the gap between rich countries and poor countries. This World Food Day should be the occasion for everyone to realize that the weakest members of the global family will be affected the most by events. Let's not forget them.





**Bioenergy and food security** For millennia, households have used bioenergy in the form of biomass from wood and organic wastes. Interest in developing modern bioenergy forms, such as liquid biofuels, emerged in the 1970s. The trend presents both opportunities and risks for food security. It could revitalise the agriculture sector, foster rural development and alleviate poverty, not least by improving rural access to sustainable energy. But if not managed sustainably, it could seriously threaten food security, hindering access to food for some of the most vulnerable.

Bioenergy can help mitigate climate change – but not if forests and peatlands are cleared to cultivate energy feedstocks such as sugar cane and palm oil. Producing biofuels from agriculture and forest residues or waste may offer an alternative, but the technology is not yet commercially viable. Policy-makers face the challenge of calculating how to exploit bioenergy opportunities while ensuring that people can continue to grow or buy adequate supplies of food.

Risks to food security through higher prices are greatest where bioenergy is based on food crops or uses land and water that would otherwise go for food production. This competition is more acute in producing liquid biofuels than in biomass for heat and power. Based on current technology, the rapid expansion of liquid biofuels is contributing significantly to rising food prices. This benefits rural farmers with surplus to sell but hurts urban consumers and the rural poor who must buy food.

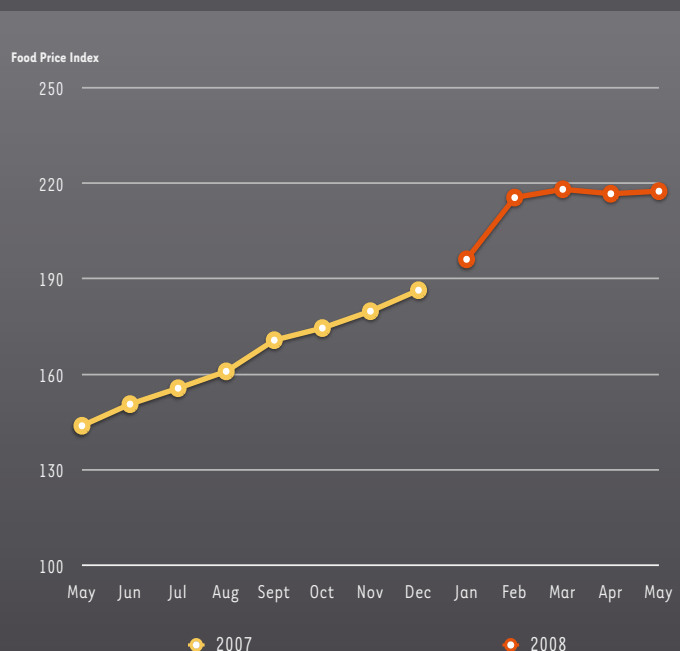
Pressures on food supply can be reduced through technologies that make use of degraded or marginal lands, by sustainably intensifying production, by integrating food and energy production systems and by using appropriate farming practices.

Food security may improve locally where the demand for feedstocks drives investment in agriculture, creates new employment and market opportunities for small producers, and revitalizes the rural economy. To what extent households can benefit from this will vary according to population and income, location, age and gender, and with the production system – large plantations or individual farms.

Large-scale plantations could provide jobs for labourers but might displace small-scale farmers. Support for outgrower schemes and cooperatives and pro-poor bioenergy policies that ensure land tenure security for marginalized farmers could help mitigate the negative effects.



**Brazil: linking small farms and big biofuel producers** It is possible for the poor to profit from the biofuel boom. Brazil's poor farmers benefit from biofuel production through the Social Fuel Seal (Selo Combustível Social) programme. Biodiesel producers who buy feedstocks from small family farms in poor regions pay less federal income tax and can access finance from the Brazilian Development Bank. By the end of 2007, 400 000 small farmers had joined the scheme. The farmers are organized into cooperatives and receive training from extension workers. During the national petroleum agency's biodiesel auction in December 2007, 99 percent of the fuel sold came from companies with the Social Fuel Seal. Ethanol production is labour intensive and has created over a million jobs mostly in poor rural areas.



**Multiple factors send food prices soaring** As if climate change and the biofuel boom weren't enough to worry about, food prices soared in 2007-2008, pushed by other factors as well. The price hikes were driven by increasing cereal demand due to growing populations and higher meat consumption in emerging countries, historically low food stocks, droughts and floods linked to climate change, high oil prices, increased speculation on food commodities, and growing demand for biofuels. For low-income food-deficit countries in Africa, the cereal bill was projected to increase by 74 percent in 2007-2008, due to a sharp rise in international cereal prices, freight rates and oil prices. Finally, conflicts and disasters caused food crises in 37 countries.

Numerous world leaders gathered in Rome in June 2008 to address the crisis and seek consensus on solutions. At the "High-level Conference on World Food Security: the Challenges of Climate Change and Bioenergy", convened by FAO, countries agreed on the need to expand agriculture and food production in developing countries and countries in transition and boost investment in agriculture, agribusiness and rural development. The conference's final Declaration also calls for immediate expansion of food assistance and safety net programmes to address the current food needs of countries hit by the food price crisis.



# Sky-high.

The cost of food is climbing fast. People everywhere are affected, and the poorest are hit hardest. Changing weather patterns and rising demand for biofuels are part of the problem. In the search for solutions, let's remember: *food is energy.*



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**World Food Day**  
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