Climate change and food security

Innovations for smallholder agriculture

IFAD
Investing in rural people

CGIAR

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How can we increase food production in a sustainable manner – without adversely affecting the environment or climate change?

Climate change is the most compelling challenge facing the world today. For rural smallholders across the developing world, increasing temperatures and drought, erratic rainfall, floods, higher sea levels and a growing number of pests and diseases are reducing yields, creating uncertainties and endangering their livelihoods. These effects pose a grave threat to their own, and to the world's food security.

It is not enough to address food insecurity by simply increasing food production alone. To achieve adequacy of food security and nutrition a number of factors play a role – including access to storable and transportable healthy food. Agriculture itself can be a contributor to climate change. Input-intensive mechanized approaches might raise yields while emitting more greenhouse gases, which contribute to climate change. So the question is, how can we tackle the twin issues of increasing food security and addressing climate change at the same time? In other words: how can we increase food production in a sustainable manner – without adversely affecting the environment or climate change?

Since 2007, the European Union (EU), in partnership with the International Fund for Agricultural Development (IFAD), has been funding scientific research that can answer that question – and thereby help rural people adapt to the effects of climate change and improve food security. The aim is to develop sustainable approaches that enable smallholder farmers to grow more food and feed more people while at the same time increasing their resilience to climate change and protecting the environment. Environment and natural resource management is at the core of IFAD's poverty reduction and food security strategies because small-scale farmers rely on the environment and natural resources for their livelihoods. IFAD finances 'multiple-benefit' approaches that promote sustainable agricultural intensification by smallholder farmers. These approaches can build climate resilience while at the same time reducing poverty, enhancing

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biodiversity, increasing yields and lowering greenhouse gas emissions from agriculture.

Developing such approaches requires research, scientific innovation, financing, and the active involvement of smallholder farmers themselves to ensure that solutions are demand-driven and context-specific. That's where the partnership of the EU, IFAD and the 15 research centres of the Consultative Group for International Agricultural Research (CGIAR) comes in.

Since 2007 the EU has invested €233 million through IFAD in agricultural research programmes carried out by the CGIAR-led partnerships. The EU's current agricultural research investment is part of a long-term commitment that stretches back to 2000. IFAD also has been actively engaged in supporting CGIAR since the 1990s. Both are members of the CGIAR Fund Council.

Climate change is affecting all smallholders, but it is affecting them differently depending on the context. That's why the research funded by the EU and IFAD is a multipronged effort encompassing a range of approaches.

Seeds of the future, food for tomorrow

Developing new seed varieties that are more resistant to the effects of climate change is an obvious area where new research can have a major impact. Flood, drought and salinity can wipe out the crops that a community has traditionally grown. Smallholder farmers

EU-IFAD financing has leveraged the agricultural research capacity of the CGIAR system to advance both the food security and the climate change agendas.

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It is not enough to develop varieties – the initiative is also ensuring that these technologies reach smallholder farmers.

in rainfed areas are especially vulnerable. In eastern India alone, nearly 3.9 million hectares are flood-prone and 4.3 million hectares are drought-prone. In the Asia and Pacific region, 195 million hectares are affected by coastal salinity while 249 million hectares are affected by inland salinity. Adaptation is not just a priority, it's a necessity.

The EU and IFAD have been funding research to develop rice varieties tolerant to flooding, salinity and drought through the International Rice Research Institute (IRRI). But it's not enough to develop varieties – the initiative is also ensuring that these technologies reach smallholder farmers, and that the farmers can make the most of them. One project in Southeast Asia, Consortium for Unfavorable Rice Environments (CURE), has distributed 1,880,000 kilograms of seeds to farmers through seed fairs, participatory varietal selection, and seed multiplication training.

Several countries including Bangladesh, India, Indonesia, Nepal and the Philippines have already released climate change-adaptive rice varieties. As of 2013, a drought-tolerant rice variety had reached 370,000 farmers and it is expected to reach 1 million farmers by the end of 2015.

Sometimes, not just new seeds but an entirely different cropping system is needed to allow rural people to adapt to climate change. For example, traditionally in parts of Kenya and the United Republic of Tanzania, maize has been the preferred grain of choice among

producers and consumers, despite its being less nutritious. Now, with water resources getting scarcer, these communities have been faced with consistently failing crops. The solution here is neither development of drought-tolerant nor early maturing maize varieties, but a decision that farmers must make, for instance, a change in farming systems from maize to sorghum.

Why sorghum? Because it requires half the amount of water as maize, is drought and heat tolerant, matures early, has the ability to withstand water-logging and grows in areas where other crops cannot. It is a winner in terms of climate change adaptation.

In line with this approach, and with the EU-IFAD funding, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) has developed high-yielding drought-, pest- and disease-tolerant sorghum varieties and hybrids. These are providing a nutritious source of protein, carbohydrates, fibre, energy, iron and potassium to communities where previously 45 per cent of children under 5 were malnourished.

More than 15 improved sorghum varieties that were bred by ICRISAT have reached 100,000 farmers in Kenya and the United Republic of Tanzania, and by completion of the current support in 2018 will have reached 100,000 farmers more. In the targeted arid and semi-arid lands, sorghum yields have doubled.

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New challenges, new techniques

Adoption of more sustainable forms of agricultural production systems which are climate-smart depends not just on tools and inputs like new seeds, but on knowledge and innovative techniques – sometimes building on local knowledge systems. For example, developing and promoting cropping systems to help farmers cope with climate change and make the most of resilient varieties is key. In the dry areas of Nepal, one project is introducing short-duration leguminous crops along with upland rice. This approach both reduces the risk of crop failure and improves soil fertility at the same time.

Another innovative agricultural practice being promoted by the EU and IFAD is evergreen agriculture, in which trees and shrubs are integrated with food cropping systems. This is a cost-effective and environmentally friendly method for increasing crop productivity and resilience to changing weather patterns. The system has been developed through the World Agroforestry Centre (ICRAF) and the International Maize and Wheat Improvement Centre (CIMMYT) for use in Ethiopia, Kenya, Rwanda and the United Republic of Tanzania. The same approach has been adopted in East Africa by ICRISAT in that sorghum production is coupled with production of dryland legumes. This is important as it improves soil fertility.

The use of shrubs has helped increase yields of maize and cowpea in Kenya, and improved nutrient recycling and nitrogen fixation. The woody part of the shrubs can be used for firewood, stakes for crops, as animal fodder or as mulch. This multiple-benefit approach also produces significant time-savings for women that can be invested in other farm or social activities. It also reduces deforestation, a source of greenhouse gases.

These practices are knowledge-intensive and successful introduction is a participatory process. In line with IFAD's people-centred approach, it requires interaction and testing with farmers themselves so that context-appropriate solutions are widely adopted and can be subsequently scaled up.

This was also the case with a reduced tillage project implemented by the International Center for Agricultural Research in the Dry Areas (ICARDA) with support from the EU and IFAD. Reduced tillage minimizes soil disturbance, maintains soil cover, and rotates crops. It enhances soil fertility and eliminates ploughing. However, for that very reason, the new method

Evergreen agriculture is a cost-effective and environmentally friendly method for increasing crop productivity and resilience to changing weather patterns.

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challenge farmers' age-old idea that ploughing is necessary for both weed and pest control and seed bed preparation. This is another case where science meets social science – because a context-sensitive, people-centred approach is essential, in order to overcome farmers' initial scepticism.

Reduced tillage has shown results in many countries. Through demonstrations in research stations and farmers' fields, smallholders have seen for themselves the benefits: it saves energy, time and labour, conserves water, promotes healthier soils with improved structure and fertility, reduces erosion, and even generates cleaner air (because farmers no longer need to burn stubble).

In another ICARDA initiative, a small lightweight machine that plants seeds in a raised bed is transforming the livelihoods of rural communities in the water-scarce Nile Delta region of Egypt. The idea is simple: the machine digs furrows for water and spaces seeds. In this way, it leaves the bottom of the furrow unplanted, thus cultivating less land area than conventional agriculture. Again, this might initially appear counter-intuitive to farmers but, once they have been involved in the project and seen the results, they do not look back.

The outcome of ten years' research, the award-winning machinery has generated average on-farm water savings of 20-25 per cent. The impact on food security and livelihoods is dramatic: up to 50 per cent more food can be produced with this technology, and

The agricultural research supported by the EU and IFAD has been participatory and inclusive of local farmers and other stakeholders, local knowledge and traditional technology.

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produces net financial benefits of US$383/hectare compared with conventional planting. One machine for each community is all that's needed. In this way, raised bed technology is really able to do more with less. The technology has the potential to be scaled up to 1.2 million hectares of land.

In the ICRISAT sorghum project, the solutions could only work if there was cultural change as well. As part of the project, the organization Africa Harvest Biotech Foundation International has provided training not only in improved crop management practices but also cooking lessons on the preparation of sorghum-based meals. This has been central to fostering uptake of sorghum use by farmers who before were dependent on maize. There was even an interchange between the scientific research and community work, because in response to local tastes, new varieties had to be developed to contain less tannin and make the sorghum less bitter – crucial to achieving local adoption as an attractive food alternative.

The proof is in the pudding, so to speak: households growing sorghum have been able to increase their food supply by 377 per cent. Sorghum as a climate-smart alternative has taken hold.

The mitigation connection

Finding new ways to help smallholders adapt to climate change, diversify household income and improve food security is only one part of the story. Agriculture, deforestation and other land-use changes account for nearly one third of global emissions, which makes the need for farming practices that reduce or mitigate emissions all the more important.

As we have already seen, evergreen agriculture reduces deforestation while improving yields at the same time, and has a positive impact through reduction of greenhouse gas emissions. In grasslands and rangelands, productivity is threatened by lack of water and increased drought, making a shift to short-cycle livestock an adaptive approach.

Thus, in Uganda, under a project implemented by the International Livestock Research Institute (ILRI) to help small-scale pig producers, the lack of good-quality low-cost feed is being addressed through the introduction of protein-rich plants for use as fodder. This cheap farm-grown substitute also aids soil carbon sequestration, a clear mitigation benefit, and enhances water and nutrient retention.

In another ILRI programme in Uganda, slaughter waste is being turned into biogas. The biogas digester not only can reduce public and environmental health risks from the waste, but also provides clean fuel and reduces the need to harvest fuelwood – a further contribution to mitigation. Pig farming in Uganda is fast becoming big business. Demand

@ILRI/Brian Kawuma

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for pork is increasing rapidly and is now the highest in East Africa. Pigs are seen as 'living banks' which can easily be sold for cash to meet household needs. Pigs convert poor resources into high-value animal-source food which can be sold or consumed by the household. This makes them a popular and strategic investment among smallholder farmers.

As this sector grows, so will the mitigation benefits. And as more farmers make the switch from large livestock to pigs due to shrinking pasturage and water resources, other natural resource management benefits will accumulate as well.

Another EU-IFAD supported research project which is promoting adaptation and mitigation relates to bananas. Bananas are an excellent 'carbon sink': they remain green throughout the growing cycle so photosynthesis occurs throughout the year, and therefore use atmospheric carbon dioxide. Banana stems are bulky and after maturity they fall and decompose, putting carbon back into the soil.

Given that bananas and plantains are a valuable source of food, nutrition and income for millions of farmers across the world, the potential to scale up these benefits is huge. But a key piece of achieving that potential is research, because of low yields due to poor soil condition and lack of access to improved varieties. In Africa, which produces one third of all bananas and plantains in the world, currently plantain yields about 7 tons per hectare; however, the potential yield could be 20 tons per hectare. And yields for highland bananas could be doubled.

This is another area where EU-IFAD financing has leveraged the agricultural research capacity of the CGIAR system to advance both the food security and the climate change agendas. The International Institute of Tropical Agriculture (IITA) developed 19 superior PITA (plantain hybrids) and 27 NARITA (highland banana hybrids) in collaboration with the National Agricultural Research Organization of Uganda. The PITA breed produces up to 20 times more than the conventional variety, while NARITA can produce up to 4 times more.

On-farm participatory trials selected the best performing varieties according to taste, yield and yield stability. The new hybrids have been distributed to a host of countries in West, Central and East Africa including Benin, Burundi, Ghana, the Democratic Republic of Congo, the United Republic of Tanzania and Uganda. Overall, around 90 million farmers stand to benefit.

Forward-looking interventions

Climate change causes, and interacts with, other factors. As populations continue to grow and resources shrink, there is increased competition for food. More people are forced to live in dry marginal lands that are prone to low and erratic rainfall and frequent droughts, and where the soil quality is poor. This means that research into and promotion of adaptive technologies and techniques must not only continue but be scaled up for the future.

Climate change means not only challenging climatic conditions but also more pests and disease, which reduce yields. Several EU-IFAD funded projects have tackled this growing challenge. In the drier areas of Benin and Cameroon, due to a warming climate the threat from the green mite is likely to increase. Genes that control for hairiness seem to be

the answer, because the hairiness of the cassava plant contributes to some level of resistance against the green mite. These genes that control for hairiness were therefore identified for improved breeding by IITA. On-farm trials in the two countries, improved varieties not only scored higher in terms of resistance to several pests and diseases, but out-yielded local varieties by up to four times.

The programme's success speaks for itself: farmers in the project distribution areas have abandoned their local varieties in favour of the improved ones. Cassava production is predicted to double in the areas where improved varieties have been adopted. A new programme will scale up the work begun by the project – a perfect example of the links between research, innovation, field testing and scaling up of benefits to reach more people.

The way ahead

Adapting to increasingly extreme weather patterns is not going to be easy. More research, collaboration and effort will be needed. The EU/IFAD/CGIAR partnership for research demonstrates the impact that can be had when science, technology – whether traditional or high-tech – local knowledge and the readiness to innovate come together. IFAD and the EU have a commitment to continue funding research to address current and emerging climate change challenges of smallholder farmers.

The agricultural research supported by the EU and IFAD has been participatory and inclusive of local farmers and other stakeholders, local knowledge and traditional technology. This approach, when combined with evidence-based research, creates a culture of innovation that can be more easily adopted widely and contribute to multiple aims: to reduce poverty, improve nutrition, promote sustainable economic growth, and foster cohesive societies and healthy ecosystems.

The poorest and most vulnerable on the planet will – and are – feeling the effects of climate change on their livelihoods and their ability to sustain their families. We cannot allow them to bear this burden alone. For without them, we will not succeed in feeding ourselves and feeding the planet. Without empowering the poorest among us to overcome poverty and hunger, we will not survive. Our future lies in uniting our strengths to take action to mitigate climate change while helping vulnerable communities to adapt to its effects. Together, we can grow more food, feed more people and reduce poverty for all.

About IFAD

IFAD invests in rural people, empowering them to reduce poverty, increase food security, improve nutrition and strengthen resilience. Since 1978, we have provided US$17 billion in grants and low-interest loans to projects that have reached about 453 million people. IFAD is an international financial institution and a specialized United Nations agency based in Rome – the UN's food and agriculture hub.

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