

Research and innovation

The Global Forum on Agricultural Research (GFAR) brings together all those working to strengthen and transform agricultural research for development around the world. As part of this role, GFAR is working with New Agriculturist to showcase and raise awareness of important initiatives and their outcomes, to update and inspire others.



Climate sustainable agriculture

Across most of the tropics, agriculture is facing enormous challenges from changing weather patterns. In addition to raising awareness of and planning responses to the agricultural implications of climate change, GFAR works across a wide range of institutions to actively support the strengthening of international research on climate change and agriculture, helping farmers to better manage risks. In this edition, GFAR highlights work underway to draw attention to policy implications and enable smallscale farmers to adapt to and mitigate climate change.

How to achieve a sustainable global food system

Early in 2011, the Commission on Sustainable Agriculture and Climate Change began devising specific policy responses to the challenge of feeding a world confronted by climate change, population growth, poverty, food price spikes and degraded ecosystems. The Commissioners released their final report in March 2012.

Enhancing natural resources in Ecuador's highlands

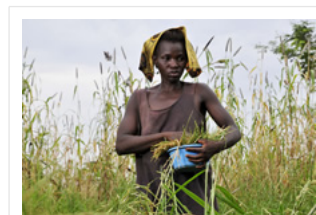
Ecuador's highlands are characterised by environmental degradation. Farmers are also concerned that rainfall is becoming increasingly irregular and water sources are not being recharged quickly enough. In response, a research partnership is helping to identify and introduce environmentally friendly farming practices to the area.

Finding solutions for climate change mitigation that benefit small farmers

Researchers from the International Food Policy Research Institute are working in Ghana, Mozambique, Morocco and Vietnam to assess the contribution that small farmers can make to carbon markets and ways to link them to these markets.

Finding solutions for climate change mitigation that benefit small farmers

Smallholder farmers need more income and the world needs to cut emissions of greenhouse gases that are contributing to climate change. Although both of these needs can be met through carbon markets, it's notoriously difficult to link smallholder farmers to these markets. Researchers from the International Food Policy Research Institute (IFPRI) are working in four countries to assess the contribution that small farmers can make to carbon markets and ways to link them to these markets.



Farmers in Ghana could save up to 1 million tons of carbon a year
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Climate friendly agriculture

Greenhouse gas emissions can be significantly reduced and carbon sequestered through the adoption of climate-friendly agronomic practices - for example crop-residue management and no-tillage farming - and through improved use of organic and chemical fertilisers. By 'trading' carbon stored or emissions reduced, a carbon market provides a means to turn this useful activity into a profitable one. In a carbon market, a wealthy emitter who does not want to pay the high cost of reducing emissions pays someone else to reduce enough emissions to offset their pollution.

"With the proper financial incentives," explains Alex De Pinto, a senior researcher at IFPRI, "smallholder farmers in developing countries could reduce emissions and sequester carbon while generating much-needed income." But carbon markets, currently dominated by developed and emerging economies and industrial sectors, have not been designed to include smallholder farmers with tiny plots, sometimes in remote areas. "It is difficult to design a way to effectively and predictably measure and track how much carbon these farmers reduce or store," De Pinto adds. "Without such a system, it is difficult for farmers to join such markets."

De Pinto and colleagues, including Senior IFPRI Research Fellows Claudia Ringler and Gerald Nelson, are examining agricultural systems and their policies in Ghana, Morocco, Mozambique, and Vietnam to determine which agronomic practices have the highest climate change mitigation potential and possible ways for smallholder farmers to take advantage of carbon markets.



In Vietnam, key mitigation strategies include alternative wetting and drying
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A combination of on-site measurements and crop-modelling simulations were used to assess the mitigation potential of smallholders in Ghana and Mozambique where very little, if any, organic or inorganic fertiliser is used and smallholders rely on the soil fertility regenerating power of a long fallow period. In collaboration with scientists at the Soil Research Institute in Ghana and at the Eduardo Mondlane University in Mozambique, IFPRI researchers found that, adjusting applications of manure, nitrogen fertiliser, and crop residue management, farmers in Ghana could save up to about 1 million tons of carbon a year and, in Mozambique, up to about 600,000 tons. These amounts could translate into significant earnings in a carbon market: Ghana could earn up to US\$38 million a year and Mozambique up to US\$24 million*.

Advantage Vietnam

With high use of inorganic fertiliser and a focus on rice production, Vietnam has an even greater potential for climate change mitigation. Key mitigation strategies could include alternative wetting and drying (AWD) and direct seeding of rice, which both considerably reduce methane emissions. AWD, for example, could reduce emissions by 63 million metric tons CO₂e (carbon dioxide equivalent), with potential gains for farmers of US\$627 million annually.

Many farmers are already using these potentially lucrative mitigation options to reduce production costs and increase yields. For example, dry seeding for the spring rice crop in the Mekong Delta of Vietnam is already common. However, although the overall potential is enormous, varying planting dates, fertiliser applications, and soils lead to a range of potential outcomes across agro-ecological zones and provinces. For example, while AWD has a large potential in the Red River Delta, it is less likely to find acceptance in the Mekong Delta, where water control is more limited.

These results are timely for Vietnamese policymakers. In December 2011, the government signed a 'Decision'

officially committing to increase agricultural production and reduce emissions and poverty (each by 20 per cent) by 2020 through 'green and safe agricultural production' methods. In a recent workshop in Hanoi, researchers** met with policymakers to address implementation challenges including measurement, reporting and verification, capacity building within the government, and the impact of agricultural mitigation on adaptation and economic development - and to identify potential ways to achieve these commitments and benefit small farmers.

Overcoming barriers

IFPRI has found that carbon markets in developing countries are often hindered by a lack of institutional support. However, analysis in Ghana, Morocco, and Mozambique indicates that NGOs and farmers' organisations are already in place and, with some additional funds and training, they could aggregate farmers, disseminate the necessary knowledge to participate in carbon payment schemes, and help enforce and verify adoption of climate change practices.

With Vietnam, the country has an advantage, says Dao The Anh, director of the Center for Agrarian Systems Research and Development (CASRAD). "Although farm sizes are small, rural organizations are very strong and tend to link directly to the commune level, and can facilitate organizing farmers and developing projects," he states. Carbon projects are best placed at the district level, combining two or more communes to achieve sufficient project size.

In all four countries, IFPRI researchers found a link between the poorest areas and those that have the biggest potential for agricultural climate change mitigation. In Vietnam, they found that poverty concentration is largest in the Mekong and Red River Deltas, the same areas that also boast the largest mitigation potential from food crops. In Ghana and Mozambique, the linkages were somewhat weaker, but high mitigation potential overlapped with high poverty in certain zones. Additional research is needed, but if these results are confirmed, says De Pinto, this would indicate that "climate change mitigation and poverty reduction are compatible, if not synergistic, goals."

* Assuming a price of US\$10 per ton of carbon dioxide equivalent ** IFPRI, the International Fund for Agricultural Development (IFAD), the Centre for Agrarian Systems Research and Development (CASRAD), and the Institute for Agricultural Environment (IAE)

Links

- IFPRI (<http://www.ifpri.org/>)

Written by Marcia MacNeil, IFPRI



Rice straw can be converted into biochar
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Enhancing natural resources in Ecuador's highlands

Dominated by the Andes, Ecuador's highlands are characterised by environmental degradation. Lagging agricultural productivity has led to incursions into highland areas and farming on steep slopes. Farmers in the region are also concerned that, due to climate change, rainfall is becoming increasingly irregular and water sources are not being recharged quickly enough.

To enhance natural resources in Ecuador's highlands, a research partnership was formed between Ecuador's national agricultural research institute, several US universities and local farmers. To help identify and introduce environmentally friendly farming practices to the area, the research programme used an adaptive watershed management process, which involves consultation with stakeholders, formation of a watershed plan and ongoing research and monitoring to adapt the plan over time.



Thirteen production systems were selected for on-farm research
©Victor Barrera

Mapping the scene

To begin with, farmers, local government officials, and community leaders from the communities of Illanagma and Alumbre in Bolivar Province came together to identify income-generating activities, local assets and stakeholder perceptions about environmental conditions. This information was used to create a Geographic Information System (GIS) thematic map to help community members visualise current agro-ecological conditions and the ways their farming practices affect the natural environment. The farmers, together with the research team, then designed on-farm research to identify land use practices to increase productivity while also reducing environmental damage.



Substantial adoption of new varieties has occurred
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Thirteen production systems were selected for on-farm research, including improved crop rotations, structures such as deviation ditches and use of native species to create live barriers, reduced tillage, improved ground cover, contour planting, and improved pastures. Trials were established on pilot farms to evaluate impacts on income, labour use and environmental degradation. A vulnerability mapping exercise also uncovered evidence that some of the most eroded land was being farmed intensively. Research, therefore, also focused on the physical and economic consequences of less intensive land use.

Conservation agriculture

Research results demonstrated the benefits of using improved varieties of potato, faba beans, barley, quinoa and chocho. "Conservation agriculture practices also increased productivity, enhanced soil retention and improved soil health," explains Carlos Monar, Dean of Natural Resources at the State University of Bolivar. More intensive management was also concentrated in less vulnerable and more productive areas, which helped improve incomes. Meanwhile, integrated pest management practices reduced input costs and increased agro-diversity, and lower profit risks increased food security.

Using the results, recommendations for best management practices were then prepared, but varied according to farm location, farm size and farmer preferences. In Illangama, improvements in farmers' income between 2006 and 2010 resulted from incremental increases in yields of potatoes, faba beans, chocho, barley, quinoa and pasture. Late blight-resistant potato varieties, improved soil fertility and use of better-quality seeds helped lower costs. Ground cover throughout the year became more widespread, the net profits of potato rose due to reduced pesticide use, and milk production increased following the adoption of improved forages and better sanitation and feeding practices. Food security also improved due to the introduction of diversified grain sources, such as quinoa, which increase energy and protein intake.

Substantial adoption of new varieties has therefore occurred and land use patterns are changing. "Improved land use planning has reduced cultivation on the most vulnerable land and improved ecosystem services," states Luis Escudero, one of the project leaders. "And the ability to observe farming practices on local farms has built confidence in the new practices which have spread naturally. Prior to 2006, conservation agriculture was not practised but various techniques are now widely found." An indigenous innovation resulting from the project intervention, for example, led to the protection of deviation ditches with various local species. Contour cultivation is also widely practised now in both watersheds, irrigation management has improved and actions have been taken to protect areas of water recharge.



Conservation agriculture practices increased productivity, enhanced soil retention and improved soil health
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Team work

A lack of finance to help households survive during the transition from intensive to extensive production is one challenge that constrains adoption of conservation agriculture. The communities are, however, seeking means of easing the transition to more sustainable practices and a local bank is being established. "Farmers high in the watershed do not benefit from reduced flooding lower in the watershed or from carbon that is sequestered in their own soil. We have identified ways of compensating them for their actions: negotiations with governments in areas lower in the watershed, where benefits are felt, and the possibility of receiving carbon credits from international organisations," says Escudero.

"Key to the programme's success was the participatory research. Results of the research and adoption of the technologies enabled farmers to address long-term problems of resource degradation," states Rosa Arévalo, a local university student participating in the project. The most important lesson, however, was the necessity of building consensus within communities and engaging all of the stakeholders. "The effort required to reach this point was substantial and involved tireless exercises in outreach, networking and engagement. This process is long, but results clearly demonstrate that the programme was well worth the effort," adds Monar.

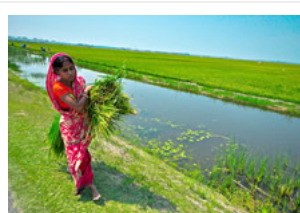


The school curriculum in the area now includes components related to water quality and biodiversity
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Written by Victor Hugo Barrera and Jeffrey Alwang

The project worked closely with local governments in Illangama and Alumbre, and the regional governments of Guaranda canton and Bolivar province. To monitor water quality, for example, key macro-invertebrates were identified in exercises with local schools, and the school curriculum in the area now includes components related to water quality and biodiversity. The University of Bolivar has also used the experience to engage advanced undergraduate students in agriculture-based community development. And at a national level, the Ecuadorean secretariat for scientific research (SENESCYT) has provided resources to expand the project to other areas.

How to achieve a sustainable global food system



More investment in sustainable agriculture and food systems is necessary
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Early in 2011, the Commission on Sustainable Agriculture and Climate Change took up the challenge of proposing specific policy responses to the global prospect of feeding a world confronted by climate change, population growth, poverty, food price spikes and degraded ecosystems. The Commissioners began their work by reviewing the major components and drivers of the global food system including the role of changing diet patterns, the link between poverty, natural resource degradation and low crop yields, the need to address inefficiencies in food supply chains, gaps in agricultural investment, and the patterns of globalised food trade, food production subsidies and food price volatility.

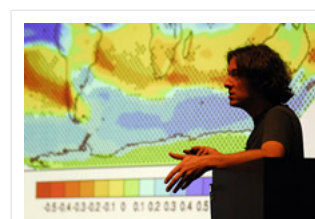
"As a Commission, we were charged with harvesting the wealth of scientific knowledge and practical solutions that have been accumulated by recent assessment reports on food security and climate change," says Professor Judi Wakhungu, executive director of the African Center for Technology Studies. "Together, we carefully distilled the seven most important ways for policymakers to make global food security and climate stabilization a reality."

Seven recommendations

The Commissioners released their final report in March 2012, which outlines seven recommendations designed to be implemented concurrently by a constellation of governments, international institutions, investors, agricultural producers, consumers, food companies and researchers. They call for changes in policy, finance, agriculture, development aid, diet choices and food waste, as well as revitalised investment in the knowledge systems to support these changes.

Significantly raising the level of global investment in sustainable agriculture and food systems in the next decade, sustainably intensifying agricultural production on the existing land base while reducing greenhouse gas emissions, and reducing losses and waste in the food system are other notable recommendations. "Farms of every size all over the world are fundamental to human nutrition and economic well-being, but they are also facing critical choices with significant implications for the way we manage the planet for long term sufficiency," says U.S. Commissioner Professor Molly Jahn of the University of Wisconsin-Madison.

The report cites recent evidence that closing the gap between potential and actual yields for 16 major crops could increase productivity by more than 50 per cent and also discusses the need for more research on understudied edible species. Sustainably intensifying agricultural production on existing land, while reducing greenhouse gas emissions from agriculture, and improving data and decision support for land managers and policymakers, are two of the leading recommendations.



Policy makers need better tools and data for analysing options and trade-offs
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Successful innovations

Examples of successful innovation from 13 countries are also used to complement the seven recommendations. To show that higher yields and climate benefits are possible through upscaling of integrated crop management techniques, for example, the report describes findings of higher rice yields and significantly reduced use of nitrogen fertiliser, seeds, water and pesticides on farms in Vietnam. "To produce enough food for our rapidly growing population, much greater investment is needed to dramatically increase agricultural yields now and in the long-term," states Commissioner Dr. Nguyen Van Bo, president of the Viet Nam Academy of Agricultural Science. "In Viet Nam, we have established model programs to boost rice productivity and quality, mitigate greenhouse gases and increase income for farmers."



More efficient production and more opportunities to market their produce can create sustainable livelihoods while helping to meet growing demand for food
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The report also highlights the East Africa Dairy Development Project, as an example of how improved market access and post-harvest loss reduction can empower marginalised food producers. And to illustrate the importance of investment, the report points to China's ten per cent annual increase in agricultural R&D since 2001 and the resulting reduction in poverty (seven people out of poverty for every US\$1,500 of investment). "We have an opportunity and a plan to stop unnecessary greenhouse gas emissions from inefficient farming practices," explains Commissioner Professor Lin Erda, director of the Research Centre of Agriculture and Climate Change at the Chinese Academy of Agricultural Sciences. "We are mobilizing public policies and budgets towards low-emission crop breeds and conservation of land, water and energy."

The Commission's recommendations dovetail with GCARD's six-point plan for transforming agricultural research for development around the world, calling for increased support for revitalised extension services, farmer-to-farmer exchanges and direct researcher engagement with smallholder farm communities to adapt holistic farming techniques to local assets. They emphasise the importance of deliberate strategies to engage women farmers. In this regard, the report highlights the efforts of Bangladesh through its five-year US\$7.8 billion Bangladesh Country Investment Plan (BCIP) to invest in smallholders and food security. With its focus on scaling up successful innovations and recognising the key role of women in food production, the BCIP addresses the need for extension services, such as farmer field schools, to promote agricultural adaptation to climate change.

The report points to opportunities across the whole food supply chain to protect the environment and the bottom line. "Many public and private sector leaders are already taking steps to overcome technical, social, financial and political barriers to a sustainable food system," says Dr. Bruce Campbell, director of the CGIAR Research Program on Climate Change, Agriculture and Food Security. "The Commission's work spells out who needs to do what to take these early efforts to the next level."

For each of their seven recommendations, the Commission's final report characterises the current policy landscape, the major opportunities for positive change and the roles that specific communities can play. The report highlights specific opportunities under the mandates of the Rio+20 Earth Summit, the United Nations Framework Convention on Climate Change (UNFCCC) and the Group of 20 (G20) nations. A number of the Commissioners have co-authored a recent Policy Forum article - What next for agriculture after Durban? (<http://www.sciencemag.org/content/335/6066/289.summary>) - that articulates key roles for the research community in pursuing policy progress for agriculture.



Integrated Crop Management helps farmers to boost production while adapting to climatic changes and resource scarcity
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* Chaired by Sir John Beddington, the Commission drew upon the diverse expertise of its members which include senior natural and social scientists working in agriculture, climate, food and nutrition, economics, and natural resources in governmental, academic and civil society institutions in Australia, Brazil, Bangladesh, China, Ethiopia, France, Kenya, India, Mexico, South Africa, the United Kingdom, the United States and Vietnam * The Commission has created an Commission on Sustainable Agriculture and Climate Change (<http://bit.ly/SafeSpaceClimateFood>) to illustrate why and how humanity must transform the way food is produced, distributed and consumed in response to changes in climate, global population, eating patterns and the environment.

Links

- <http://ccafs.cgiar.org/commission>

Written by Dr Christine Negra, Commission on Sustainable Agriculture and Climate Change