

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.



Water in agriculture

Ensuring universal access to water, and using it wisely in agriculture, is essential to reducing poverty, hunger and maintaining a sustainable environment. In this edition, GFAR draw attention to work in Jamaica, India and Cambodia to develop water-efficient methods of food production and manage competition over water resources.

Water harvesting technologies increase productivity in Jamaica

In the dry south of Jamaica, around 50 farming families have adopted water saving technologies, including mulching with guinea grass, gravity fed drip irrigation and solar water pumps. The Jamaican government is now promoting these technologies in other parts of the island.

Building resilient community fisheries in Cambodia

Tonle Sap, in Cambodia, is the largest lake in Southeast Asia, and one of the most productive freshwater fisheries in the world. But managing water for food and income also means harnessing the full value of these fisheries for local communities. By joining competing stakeholders, a WorldFish initiative has contributed to strengthening resilience in local livelihoods, while reducing the risk of broader social conflict.

Precision farming - sustaining agricultural productivity in India

In Tamil Nadu, India, farmers have been trained in precision farming - precise delivery of inputs such as water and fertiliser - to address a range of constraints including groundwater depletion, escalating input costs and lack of labour.

Precision farming - sustaining agricultural productivity in India



Rice, millet, pulses, sugarcane and cotton are the main crops grown in Madurai District
©Dr C Ravindran

Rice, millet, pulses, sugarcane and cotton are the main crops grown in the Madurai District of Tamil Nadu, India, where, to overcome poor management practices, Tamil Nadu Agricultural University, in partnership with the World Bank and Krishi Vigyan Kendra (KVK), provided training on 'precision farming' for 3,000 farmers between 2007 and 2010. The poor practices addressed included groundwater depletion through use of surface flood irrigation and ridge and furrow irrigation, escalating costs of inputs and a lack of labour which is a major constraint in Indian agriculture.

Precision farming is an approach where inputs, including water and fertilisers, are applied in precise amounts to maximise yields. The aim is to encourage farmers to adopt market-led horticultural production and to promote hi-tech agricultural practices. After clusters of 25-30 farmers had been selected, KVK evaluated farmers' soil, water supply and pumping equipment before beginning to provide hands-on training.

A high-tech community nursery was installed for each cluster, to produce quality planting material, and farmers were taught how to produce high quality planting materials using the pro-tray method, in which hybrid seeds are sown in compost-filled plastic trays. Made of soft plastic, seedlings can be removed from trays without damaging the roots. The nurseries were covered with 50 per cent shade net, which protects seedlings from wind damage, heavy rain, and excess sunlight.

KVK distributed seeds of tomato, brinjal, onion and lablab (bean) to each group in order to establish each nursery, and to conserve water and enable drip fertigation with water soluble fertilisers and urea, a system of drip irrigation was installed in four villages. Drip irrigation equipment supplied to farmers was subsidised, while seed and fertilisers were provided free in the first year. In subsequent years, most of the farmers continued to adopt this technology using their own money.

Overcominghurdles

Initially, many farmers did not believe that they could double their yields of vegetables while reducing the amount of water they applied to their crops by 40 per cent. But after the first harvest, most changed their minds and 2,200 hectares in Madurai District are now being cultivated using precision farming techniques. Three registered precision farming associations have also been established; involving 60 farmers, the associations meet regularly to discuss market strategies and interact with buyers and input suppliers. KVK and the other developers hope that the area under precision farming will continue to expand as awareness is raised through exhibitions and distribution of pamphlets.

Precision farming reduced water use, residues in soil and water, and chemical sprays, and substantially increased average yields compared to traditional cultivation techniques: tomato (from 35 to 100 tonnes/ha), onion (11-21 tonnes/ha) and banana (40-120 tonnes/ha). Quality also improved, leading to premium prices at market. Thiru Mitcharaha, from Nadumuthalikkulam, increased his yield of brinjal from 60 tonnes/ha to 200 tonnes/ha, earning US\$5,700 in one year.

Despite the high cost of water soluble fertilisers the total incomes of farmers increased two- to three-fold and their socio-economic status improved. The developers are now calling on the government to reduce the cost of water soluble fertilisers, improve their availability, and look to the improvement of post-installation maintenance of drip irrigation systems.

Due to increasing yields, some markets have become saturated and farmers have faced difficulties in marketing their produce. But this has been overcome by helping farmers to sell their produce at markets further afield. Farmers are also being taken to markets to be shown the importance of grading and sorting at farm level, while buyers are to be invited to demonstration sites to be made aware of the quality of vegetables that are being produced.

Gainingrecognition



KVK provided training on precision farming for 3,000 farmers between 2007 and 2010
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Precision farming reduced water use and substantially increased average yields
©Dr C Ravindran

Due to the high water use efficiency of precision farming, and high production of both staple and horticultural crops, various government departments have expressed their willingness to spread the technology throughout Tamil Nadu. The Department of Agriculture has set targets to spread the technology, send farmers for training and provide subsidies. Meanwhile, the Government of Tamil Nadu has begun to offer subsidies, including 15,000 INR (US\$260) per ha for water soluble fertilisers, 5,000 INR (US\$90) for seed, and 44,000 INR (US\$780) for drip fertigation.

According to the developers, one of the biggest challenges is that few farmers recognise the importance of this technology, and instead adopt their own combination of flood irrigation, ridge and furrow irrigation, and transplanting seedlings raised in beds, which leads to 30 per cent mortality and poor yields. Some farmers are also not adopting precision farming because of the seemingly plentiful availability of water in their region, unaware that groundwater is being depleted. Tamil Nadu Agricultural University and the Indian government, therefore, are aiming to get every farmer to adopt this technology, through raising awareness, training, and subsidies.

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Links

- Tamil Nadu Agricultural University (<http://www.tnau.ac.in/>)
- Krishi Vigyan Kendra (<http://www.kvk.pravara.com/>)

Building resilient community fisheries in Cambodia

Tonle Sap is the largest lake in Southeast Asia, and one of the most productive freshwater fisheries in the world. Fish from Tonle Sap provide an essential source of protein and micronutrients critical to the health of families in Cambodia, a country still plagued by high rates of childhood malnutrition. But managing water for food and income also means harnessing the full value of these fisheries for local communities.



Fish from Tonle Sap provide an essential source of protein and micronutrients
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Achieving this requires addressing the challenge of intense competition for resources around the lake. Local leaders like Oum Meng had long campaigned for improved community rights to access and manage local fishing grounds, and complained of unfair treatment by operators of large-scale commercial fishing lots on the lake. For years, he had organised nearby villagers to petition the government for a change in regulation. "We had failed several times before, and many people thought it wasn't worth trying more, but we decided we had to," says Oum Meng. "Our livelihoods depend on having a place to fish."

In October 2010, this advocacy effort achieved an unexpected success when Fishing Lot 1 (a fishing concession in Kompong Thom Province) was terminated and access granted to local fishers - the first instance in a decade of a lot being released to community control. This gave families access to an additional 2,500 hectares of the lake, with an annual production estimated at over 500 tons, on the condition that no large-scale commercial fishing gear was used.

The achievement boosted civil society networks around the lake, helping launch a broader campaign for reform of fisheries management. Within ten months, the Prime Minister announced the suspension of all remaining fishing lots on the lake. "This represented a dramatic policy transition that resulted in expanded access for communities and more extensive zones designated for protection, to ensure the long-term sustainability of the fisheries industry," explains Dr Blake Ratner from the WorldFish Center. "While too soon to measure the impact of this reform, local fishing families are expected to benefit from gains in income, food security and nutrition, as well as the associated opportunities in processing and trade," he says.



Local fishing families are expected to benefit from gains in income, food security and nutrition
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Enablingchange

Organisers of the civil society campaign for reform credit partnership with the WorldFish Center for creating dialogue between local civil society actors and the government. In particular this dialogue has improved awareness of the factors that lead to resource competition and the potential roles of different actors in addressing them. In 2009-2010, the Coalition of Cambodian Fishers (CCF) grassroots network, the Fisheries Administration (the key national authority) and the Cambodian Development Resource Institute (a leading policy research institute) jointly implemented a series of dialogue workshops around Tonle Sap at village, provincial and national levels.

Local and provincial consultations occurred in five communities and involved local fishers, traders, village leaders, fisheries officers, environment officers, police and district officials. Local consultations were directly followed by provincial consultations in order for participants to present outcomes and explore solutions with provincial agencies, NGOs, sector department heads and other senior government staff. A national consultation held in 2010 included senior management from the Fisheries Administration (FiA), the Tonle Sap Basin Authority, the Cambodian National Committee, and participants from provincial consultations.



The action research process prompted follow-on actions to resolve local resource disputes
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This action research process prompted follow-on actions to resolve local resource disputes. CCF and FiA, for example, agreed to work together following the national consultations to organise direct negotiations between community fishery organisations in neighbouring provinces. The negotiations resulted in an agreement between the two parties to jointly manage and use the disputed area. "By exploring the implications of various management options on all parties involved, the stakeholders were able to arrive at a solution perceived by all sides as legitimate, which would likely not have occurred in the case of a solution imposed from above," Ratner says.

For other communities around Tonle Sap, this experience demonstrated the possibilities for effective advocacy. The process also helped civil society groups create new linkages and access support from national level agencies, for example to respond to reports of illegal fishing operations. Perhaps most importantly, Ratner adds, the dialogue led to a fundamental shift in strategy by CCF, which represents fishing communities, emphasising constructive links with government and the formal NGO sector.

"This experience demonstrates the value of action research to improve natural resource governance, even amidst ongoing resource conflict," Ratner explains. By joining competing stakeholders in a collaborative process, the initiative has strengthened local livelihoods, while reducing the risk of broader social conflict. And it's done so at remarkably low cost, relying on the energy of local communities and the power of social accountability rather than conventional - and costly - structures of project management.

Continuing reform

To complete the reform process, Ratner advocates a range of measures, including the involvement of local communities in the design of new community-managed fishing areas, repositioning of fish sanctuaries to cover the richest ecological habitats, and improvement in the capacities and incentives of enforcement agencies. Despite the progress made so far, risks to fishery livelihoods remain as competition increases and household catches decrease. Water resource infrastructure and land use changes also threaten to undermine fisheries productivity within the lake.

Questions also remain about whether increasing community access will lead to improved conservation, more equitable distribution of resources and more sustainable livelihoods for the most vulnerable. There are also concerns as to whether the agreements for joint management will endure. "This story is still unfolding," Ratner states. "The long-term outcomes in terms of ecosystem functions, productivity, livelihoods, incomes and nutrition are not yet clear."

But despite the uncertainty, Ratner believes that the impact made by fisheries communities surrounding Tonle Sap suggests a strong case for adapting and implementing the approach elsewhere. "As the approach is applied in other domains and contexts, it will be essential to document and compare the lessons that emerge in order to improve the practice of supporting resilience, adaptation and transformation in large social-ecological systems," Ratner concludes.



Local and provincial consultations occurred in five communities
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* To learn more about this work, including how the action research and dialogue approach is being adapted in East Africa, visit the CGIAR Research Program on Aquatic Agricultural Systems (<http://www.worldfishcenter.org/our-research/ongoing-projects/building-livelihood-security-reducing-conflict-freshwater-ecosystem-governance>) project site at the [Worldfish Center](http://www.worldfishcenter.org/). These efforts are part of a larger initiative, the [CGIAR Research Program on Aquatic Agricultural Systems](http://www.worldfishcenter.org/our-research/cgiar-research-programs/aquatic-agricultural-systems), using action research to build resilience of local livelihoods in Africa, Asia, and the Pacific.

Water harvesting technologies increase productivity in Jamaica



The Ebanks family has been farming in Flagaman for over 50 years
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Flagaman district, in Southern St Elizabeth lies in the rain shadow area of Jamaica. The Northeast Trade Winds deposit their moisture in the mountainous interior, so are dry when they reach the south of the island. Planting traditionally coincides with the rainy seasons of May or October, but once crops germinate, a struggle normally ensues to keep them watered. Often this means sharing domestic water supplies with the plants, and in periods of severe drought, crops frequently fail. The Ebanks family has been farming in Flagaman for over 50 years and, with help from the Jamaican government and the UN Food and Agriculture Organization (FAO), has gradually developed a reliable water-efficient method of food crop production.

Mernel Ebanks, now 80 years old, recalls that in her early days of farming, water was drawn from the house tank, transported to the field to fill a 200 litre drum, and then placed at the root of every plant in the field using a watering can. This was time consuming and laborious. After a number of crop failures in the 1970s, the Ebanks discovered that if they used cut guinea grass (*Panicum maximum*) to cover the soil before planting, there was less evaporation from the soil, drastically reducing the water required. Guinea grass is still used as mulch throughout Southern St Elizabeth, with the Caribbean Agricultural Research and Development Institute (CARDI) promoting this system as a way to enhance crop production in other dry areas of the Caribbean.

Sourcing economic water supplies

The laborious process of applying water to each plant with a watering can was still being practised until the Jamaican government introduced gravity drip irrigation across the country in 2003. This allowed for cultivation of larger areas, but still required the purchase of water, to supplement harvested rainfall. Costing about US\$100 for 4,000 gallons, this could not be sustained.

The solution to the high water cost was the construction of a water harvesting and storage system in 2007. The capital cost of about US\$3,000 was high but, by not having to pay for water to be trucked to the farm, the Ebanks say that the system paid for itself in three years. And help to meet the initial costs is available to farmers through the Jamaica Social Investment Fund on the submission of a business plan. The Ebanks' system consisted of a 243m³ concrete water tank which was filled from the house roof and a 405 m² concrete catchment area. Filled twice a year during the rainy seasons, the system is able to support two crops on 1.2 hectares.



The Ebanks' have developed a reliable water-efficient method of food crop production
©CARDI

Initially, water from the tank was pumped to the field using a diesel pump, but with increasing fuel prices, this became a serious constraint. In 2009, the FAO Small Scale Irrigation and Rainwater Harvesting Project chose the Ebanks family to demonstrate how solar pumps could work alongside the gravity drip irrigation system, to improve water management and water use efficiency on farm. FAO rehabilitated the water collection and irrigation systems, and provided the solar pump, all at a cost of about US\$8,000. "The system is effective for subsistence agriculture," one FAO official states. "It adds significant income to the household."

Many benefits

The new solar pumping system provides energy to move water from the concrete storage tank to two elevated 4.5 m³ plastic tanks to which a drip irrigation system is connected and which serves the entire farm. The pumps require little maintenance, but staff from the National Irrigation Commission have been trained to service them. So far 53 farmers, or about five per cent of the farming community, have taken up various components of the system, including solar pumps.



The new solar pumping system provides energy to move water from the concrete storage tank to two elevated plastic tanks
©CARDI

Mernel Ebanks estimates that with successive improvements in irrigation and water management her yields have increased fourfold in the last 50 years, and there is less risk of crop failure. For example, a cantaloupe plot, which yielded about 12,000kg per hectare less than ten years ago, now produces 38,000kg. "With the increased yields obtained over the last two years I have been able to renovate my house and I now have my kitchen and bathroom facilities inside the house," she reveals.

These innovations have resulted in a more reliable and sustainable crop production system, higher yields, more efficient use of water and energy, and a better standard of living for the Ebanks family. As a result, the Jamaican government is promoting water saving technologies across the island, while CARDI is advocating the system

in the rest of the Caribbean.

Links

- Caribbean Agricultural Research and Development Institute (<http://www.cardi.org/>)

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