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Harnessing local innovation to improve food security, nutrition and climate resilience in Ethiopia

A watershed rehabilitation project, followed by a collaborative 'Operational Research' programme that harnesses local knowledge, is restoring natural resources, raising agricultural yields and improving food security in Tigray, Ethiopia.

Overview

The central and eastern parts of Tigray, a mountainous region of northern Ethiopia, are highly food insecure and were badly affected by famine in 1984. About 37 per cent of households typically eat less than 2,200 kilocalories a day.[1] Low annual rainfall and frequent drought makes farming difficult. Plots are small and often severely degraded. Yields are low, and many farmers are only able to plant one main crop each year.

Though peaceful now, recent conflict has left Tigray with many female-headed households. These often lack access to appropriate technologies and credit, and lack labour to intensify their farm production. They also find it difficult to access markets, making them particularly food insecure.

Added to that, climate models suggest an average temperature rise of 2.2 degrees by the 2050s,[2] increasing water stress for many crops. Rainfall patterns have changed in many parts of the region, starting later and finishing earlier, also becoming more erratic, intense and often damaging.

Knowledge gaps are an important aspect of these challenges. Past agricultural research and extension projects have not met farmers' needs in marginal areas. For example the varieties promoted were usually ill-suited to local conditions.

But that situation is now changing as the Tigray Agricultural Research Institute (TARI), with support from Irish Aid, is fostering local innovation and knowledge sharing, with transformative results.

The story began when the Tigray government, donors, NGOs and farmers, started work on watershed rehabilitation in the eastern zone of Tigray. The project engaged local land users' knowledge and perspectives in ways that previous environmental interventions had not. Watershed rehabilitation made more water available to farms, improved soils and helped regenerate natural resources.

Farmers started asking for new crop, livestock and natural resource management technologies in order to test and adapt. New partnerships developed between rural households, local research institutes, and local extension agents, forming an 'operational research' project (see Box 1) that allows local knowledge and innovation capacity to flourish.

Interventions and impacts

Watershed rehabilitation. Tigray has a long history of failed interventions to reverse soil erosion and deforestation. But the regional government's area-based approach in partnership with Irish Aid involved careful consultation with farmers, and built awareness of potential benefits. And watershed rehabilitation has had profound effects. Hillsides are now greener and groundwater levels have risen so farmers can build ponds and wells, and irrigate with pumps. For areas previously relying on one rain-fed

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Box 1. Operational research

Military planners first used the term 'operational research' (OR) but it is widely used by business and industry to find appropriate interventions for complex situations.

OR approaches can make a real difference for farming in marginal and resource-poor environments. Farmers Research Groups evaluate technology, participate in selecting varieties and screen potential interventions to fit with local farming systems and farmers' social and economic realities (in particular those of women farmers). This process of adaptation to local conditions is increasingly relevant as the climate changes for the worse.

crop per year this has been life-changing. Farmers grow irrigated potatoes, chilli peppers and tomatoes and a second-season irrigated maize crop. People now eat three times a day, rather than twice, and hungry periods are substantially reduced. Zero-grazing initiatives, together with enrichment planting and micro-catchment structures have helped regenerate the hillsides, creating abundant cut-and-carry fodder to support more productive livestock. This animal fodder, found close to farms, particularly reduces women's labour burdens.

Greener watersheds both reduce carbon loss through soil erosion, and lock up more carbon in vegetation, making a valuable contribution to a climate-resilient green economy – an important policy goal for the Ethiopian government.

Operational research. As natural resources in project watersheds began to recover, TARI, Mekelle University and other local partners (such as the regional Bureau of Agriculture and the Relief Association for Tigray) chose operational research (see Box 1) to enhance food security and improve nutrition through better access to appropriate crops, livestock and management techniques. OR prioritises the local context, and end-users' specific needs. It introduces external knowledge that local farmers evaluate and adapt. OR in Tigray began in two watersheds, Debre Kidan and Begasheka, in Hawzien and Kolla Tembien districts, respectively.

OR project partners jointly identified farmers' constraints and then carefully located test areas for technology solutions. These technologies were sometimes local innovations, such as a new form of beehive, and sometimes crop varieties grown in other countries with similar agro-ecosystems, such as wheat from dryland India.

For example, watershed rehabilitation has meant that chickpeas can now be grown in residual soil moisture after the main season maize crop. And the recharged groundwater from the watershed programme has also brought more natural bee fodder. Farmers (particularly women) have used the OR project to adapt local hives so they complement modern hives promoted through the agricultural extension system. Farmers also requested training in colony splitting, letting them add new hives to their farms and substantially increasing their incomes. Farmers share the technique with other farmers through local FRGs (see Box 2).

Farmers have used the OR project to test crops that help diversify diets, and raise incomes. These include potatoes, tomatoes, and other vegetables, and grains such as finger millet and sorghum. The project has introduced improved varieties of sheep, goats, and poultry, which offer new sources of milk, meat and eggs. These technologies have benefited female farmers in particular, through income from product sales and availability of nutritious food.

Participatory variety selection. Farmers now use participatory variety selection (PVS) to:

- identify the problems new varieties should address;
- manage a comparative trial;
- evaluate crop performance against their own criteria; and
- scale out new technologies through farmer to farmer seed exchange and farmer field days.

Box 2. Farmer research groups

The project organised Farmer Research Groups (FRGs), where farmers could share ideas, train each other and identify problems and analyse different solutions. FRGs have targets of at least 30 per cent female membership. For some technologies such as poultry and dairy goats, at least 50 per cent of FRG members are women. Across the two watersheds, 80 per cent of female-headed households have joined project activities.

Researchers trained farmers to collect and record data, and encouraged them to experiment, evaluate and share findings. Farmers specify their own assessment criteria. For example, farmers were interested not only in maize yields, but also in stalk wind resistance and value as animal feed.

An Ethiopian woman sells locally grown onions tomatoes and chillies

Irish Aid

PVS is reducing the time taken to identify and deploy an appropriate variety to around two years, compared with around five years for conventional testing first at research stations and then on farm.

PVS is identifying effective early maturing and heat and moisture-stress tolerant varieties of wheat and maize, so improving climate resilience. Communities that were previously reluctant to grow wheat have now adopted the crop. Farmers can grow a longer-maturing variety of maize if rains arrive on time, but have several early maturing options if planting is delayed.

Having sustainable sources of seeds is also essential, so farmers have been trained in seed multiplication. This is particularly appealing to female-headed households because the premium paid for seed (over a grain crop) means the same income is available from less land and with less labour.

Main achievements and challenges

The operational research approach has strengthened government institutions' accountability to farmers and rural households. It has also helped change the mindsets of farmers who previously distrusted government interventions but now apply modern agricultural research approaches.

But its biggest achievement is rehabilitating natural resources across whole watershed areas, raising agricultural productivity, fostering climate resilience and supporting better food security.

Box 3. A farmer and a scientist

Mr Kidanu, a farmer in Hawzien district, took part in several PVS trials for wheat and maize, comparing varieties with and without fertilisers, observing and recording details of germination, weeding requirements, flowering times, heading and maturation, and evaluating criteria he had selected: grain yield, moisture stress, disease tolerance and straw palatability for animals.

Following the trials, Mr Kidanu replaced all his traditional varieties with improved OR varieties, doubling and sometimes tripling his yields. He now grows seed for other farmers and also practices improved beekeeping.

Mr Kidanu says that in the past his family only ate enjera and shiro (Ethiopian traditional sour pancake and chickpea sauce). Now that he grows sweet potatoes and a range of vegetables the whole family have a substantially better diet. He has inspired other farmers with his capacity to experiment and innovate.

As the director of the regional research station acknowledged: 'He is not just a farmer, he is a scientist!'

A lasting impact has been that researchers in the Tigray Agricultural Research Institute, and the six Agricultural Research Centres it manages, have adopted OR, PVS and FRGs as standard good practice for technology research and popularisation. The regional extension system is also engaging with OR as local-level

development agents work with researchers and farmers to spread technologies that farmers have evaluated and endorsed.

Initially, one challenge was distrust. Farmers' own sophisticated understandings of their conditions and needs meant that they were suspicious of government attempts to introduce new high-yielding seeds, which had previously often been designed for predictable, high-rainfall settings, rather than marginal environments.

However, the OR approach overcame this hurdle. Challenges remain, of course, including ensuring that institutions remain responsive and engage with local knowledge, rather than pushing inappropriate interventions. Maintaining innovation is important, but depends on external funding. FRGs, for example, may fold if researchers and extension agents lack resources to continue working in this way, or if senior management does not allow adequate time to work with farmers on local-level experimentation.

It is clear that supporting interventions can further complement local knowledge. For example, strengthening the agricultural extension network and developing new Farmer Training Centres, giving farmers information about markets and even building roads to improve market access can all take this work further. The next phase of OR will strengthen innovation networks, working particularly at the sub-regional level to build more effective linkages between research institutes, farmers and agricultural extension workers.

Lessons

Operational research is a valuable technique for harnessing local knowledge when addressing development challenges, but it requires collaboration and a sequenced approach. In Tigray, farmers' collaborative work with researchers, government, NGOs and donors to rehabilitate severely degraded watersheds and re-vegetate slopes built a crucial foundation of trust, as well as increasing water availability. This let farmers move on to experiment with new crops and varieties, and diversify farming systems.

Local knowledge can help identify needs and problems. Farmers' priorities may not be the same as those of researchers. And technology choices for complex, risk-prone settings are likely to be very different to those for high-potential areas. The OR approach in Tigray gave farmers an opportunity to articulate their challenges, and choose what sort of development support they needed.

Unleashing women farmers' insights requires a targeted approach that understands their constraints (such as labour or market access). The Tigray programme showed how participation in projects like OR can build women's confidence to engage with government research and extension institutions and demand effective services. Targets for women's participation ensured female-headed households and women farmers have been active participants.

Farmers readily understand that diversification is crucial for climate resilience and sustainability. More varieties of key cereal crops give farmers more options for different rainfall patterns, especially when combined with better interpretation and dissemination of local meteorological forecasting. And a wider range of crops, including vegetables, benefits both nutrition and incomes. Livestock options such as poultry or goats and sheep can complement crop technologies. Beekeeping making use of bee forage in regenerated watersheds can offer a valuable income stream.

Participatory variety selection that fosters expertise and draws on local knowledge and processes can slash the time needed to test new varieties – here from an average of five years to two.

References

[1] MOFED, 2012. *Ethiopia's progress towards eradicating poverty: an interim report on poverty analysis study (2010-11).* Ministry of Finance and Economic Development. Addis Ababa. [2] See Conway D. and Schipper L. 2010. *Adaptation to climate change in Africa: Challenges and opportunities identified from Ethiopia. Global Environmental Change.* 227-237 and ACCCA, 2010. Understanding the climate variability and the indication of climate change in Tigray regional state, based on the long-term recorded rainfall and temperature data. Advancing Capacity to Support Climate Change Adaptation.