

Participatory Innovation Development in water management in Tigray, Ethiopia

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One of the local innovations identified by the Northern Typical Highlands (NTH) platform of PROLINNOVA–Ethiopia is an intricate system of harvesting water from waterlogged land so as to allow cultivation in the long wet season, coupled with storage of this harvested water to use for supplementary irrigation in the following dry season. This had been developed by Mr Abadi Redehay, a 45-year-old man who lives with his wife and four children in Mai Berazio village of Tahtai Maichew District, near the historical town of Axum in the Central Zone of Tigray Region in northern Ethiopia. This local innovation was identified by district experts and development agents (DAs) in the Bureau of Agriculture and Rural Development (BoARD), but was already known to the local farmers. Indeed, the DAs learned about it from the local people.

Abadi's innovation

To sustain his family, Abadi has less than 0.5 ha of cropland on reddish and clay soils. He has had to be innovative in order to solve the water-drainage problems on his sloping land and to improve the crop productivity. When he was visiting Axum, he saw a sewage canal being constructed. He was inspired when he realised that the sewerage system was draining water away so that it did not stay on the soil surface, as was happening on his farm. He decided to try to use a drainage system like this on his own land.

Completely on his own, Abadi dug deep and long canals diagonally across the slope and then placed long and flat stones on both sides of each canal to help the water pass easily. He also put flat stones on top as a cover and replaced the soil on top of these stones. The underground canals lie at depths varying between 40 and 180 cm below the soil surface. During the rains, they capture excess runoff water as well as water coming up from deeper levels through capillary action. They lead the water to collection points (excavated pits with earth walls), where it is stored. Water that exceeds the capacity of these pits is drained to a nearby stream.

During the dry season, Abadi draws water from the pits, using a treadle pump, and gives supplementary irrigation to crops in the plots below the pits. He bought the pump with his own money after he was successful in collecting water in this way. Over time, still working on his own, he gradually expanded the drainage system throughout the entire farm, connecting the canals and leading the water to three collection points.

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Before he started this innovation, he grew mainly *teff*, a local cereal that can be sown late in the wet season, and sometimes chickpea, a crop than can be sown in September after the rain stops. Now, because he can sow the land earlier in the wet season, he has more options and, because he can also irrigate land, he can even grow vegetables in the dry season. He gets up to three harvests per year from the same piece of land.

The waterlogged land had been used part of the year for free-range grazing but, now that the land has been drained and is cultivated year-round, the total output of the crops plus the crop residues for livestock is worth more than simply the grass that used to be grazed there. In addition, Abadi can harvest more and better-quality forage from his farm boundaries as well as around the water reservoirs year-round. As a result of his innovation in water management, he was able to buy more animals. Abadi and his wife now have two oxen, one cow, one donkey, six goats and several chickens. Before starting his innovation, Abadi did not even have a pair of oxen to plough his land. He had to go off to towns to find wage labour, but now he can devote himself entirely to farming, and his neighbours regard him as being relatively well off.

Starting up Participatory Innovation Development (PID)

In April 2005, the NTH platform organised a workshop for farmers, DAs, the Wukro Marai agricultural technical college, and district and regional experts in agriculture and natural resource management (NRM). It introduced the concepts of local innovation and Participatory Innovation Development (PID). The workshop participants examined some examples of local innovation, which the farmer innovators presented themselves, and then considered what should be done with the local innovations: whether 1) to disseminate them more widely; 2) to explore questions about the innovations in a PID process; or 3) to see the innovations as useful only for the specific circumstances of the local innovators. The workshop was held in Axum, as NTH partners – specifically those from the BoARD and the local NGO Institute for Sustainable Development (ISD) – had identified several innovations in Central Tigray, of which Axum is the main town.

The workshop participants visited several farms, including Abadi's farm, and were particularly impressed with how, using his drainage technology, he so skilfully managed the water flows to gain benefits in both wet and dry season. Many farmers experience the same problems as Abadi did: temporary waterlogging in one season and insufficient moisture in another season on the same piece of land. Because they cannot plough the waterlogged fields during the main rains, they cannot use these fields until late in the season. This limits the type of crops they can grow there and has a negative effect on the productivity of field crops, trees and livestock. While on Abadi's farm and inspired by his innovation. the farmers and DAs discussed what they could do together. They brought back their observations and suggestions and presented them to the other workshop participants.

The BoARD, in collaboration with NGOs (including ISD) and farmers, had already been trying to help farmers deal with problems of waterlogging and moisture deficiency. It had been promoting standardised methods that did not suit the varied conditions of the smallholder farmers. But now the BoARD started to look at what solutions the farmers themselves were developing. At the workshop in Axum, the participants discussed the water-harvesting and drainage interventions promoted by the BoARD and the locally developed innovations in water management, as well as other new technologies coming from outside and inside the farming communities, e.g. in bee-keeping. Then, the farmers taking part in the workshop selected three

local innovations that they wanted to explore further and possibly improve in PID processes. One of these innovations was Abadi's system of sub-surface drainage and supplementary irrigation with the harvested water. Farmers wanted to try this out on other farmers' plots and see if it works or could be adapted to other conditions. The farmer participants pointed to specific aspects of Abadi's innovation that needed to be further explored, such as the strength of the canals and the capacity and durability of the water-collection ponds. The DAs and experts with different specialisations listened to the farmers and posed questions, but did not decide which innovations to explore in PID.

A second workshop was held in May 2006 to launch the PID activities supported by the NTH team in Tigray Region. In preparation for this workshop, the NTH asked Abadi and the Tahtai Maichew District agricultural experts to suggest three volunteer farmers to do PID on his innovation. Abadi proposed three farmers who live very close to him and to each other in Tahtai Maichew District, who likewise faced waterlogging problems on their farms, who were keen to try out his innovation on their adjoining plots, who were on good relations with each other and who were open to sharing their experiences with other farmers.

Adapting as they went along

After the launching workshop, it took some time for the funds for the PID to be released by the PROLINNOVA–Ethiopia coordinating office in Addis Ababa, so the experimenting farmers had to wait until December 2006 before starting to dig the canals and water reservoirs. The PID grant was needed to buy materials such as sledge hammer, shovel, cart, etc for breaking and transporting stones, and a notebook, camera and films to document their work and the results.

The farmers could not do experimentation on the water-harvesting innovation in a conventional scientific way with treatment and control, as the characteristics of the land of each farmer differs. They had to figure out how to take the same principles the original innovator had used and apply them on different land. As a group, under Abadi's guidance in assessing slopes and water flows, they dug canals draining water from different directions and connected these canals at five points, where they excavated small water reservoirs. They did not use any reinforcement material, because the soil has sufficient clay content to retain the collected water. Indeed, the clayey nature of the soil was causing the drainage problem. Moreover, the farmers involved in the PID thought that putting in reinforcement would affect water flow into and from the small reservoirs, because the water comes into them not only through the canals. However, the experimenting farmers, including Abadi, do recognise that a problem of collapsing reservoir walls may occur after 2–3 years, so they are keeping an eye on this.

Canals connecting these small water reservoirs also lead overflowing water down to a lower area where the three farmers made a larger water reservoir. This is on a piece of land that was completely useless for cropping because of severe waterlogging. Excess water from the farm and the smaller water reservoirs flows to this main water reservoir and from there to a nearby stream. Thus far, there are no signs of erosion damage caused by overflowing water, because the farms are near the stream and the banks of the stream are covered with grasses.

The three experimenting farmers have made their collection ponds smaller and shallower than those made by Abadi, partly because their land is stonier. They are adjusting things as they go along, depending on what they find. For example, at one point where they wanted to dig a pond, they found a huge rock, and had to use fire and a hammer and chisel to break it down.

In June of this year (2007), the farmers sowed their drained land with cereals that are growing throughout the wet season. In the coming dry season, they plan to grow vegetables on the land below the reservoirs, just as Abadi is doing, using the water from the small and larger reservoirs for irrigation and using their customary water-lifting devices, such as clay pots, can or plastic containers, and Abadi's treadle pump on loan free of charge.

The three farmers and Abadi meet 2–3 times per month to work together and to observe what is happening in this experiment with setting up a new system of joint water management. They look at how well the land is drained and whether and where they need to build additional canals. They look at the labour they have to invest, the inputs they have to buy, and the level of water collected. They cannot quantify the amount of water because of the irregular size and shape of the ponds. They regulate the height of the water in the ponds by plugging and unplugging the below-surface outlets to the canals. Thus, they monitor and evaluate their work continuously. They also discuss what to do next and how they plan to use the land in the future.

Any interested farmer in the neighbourhood can join these meetings and learn from Abadi and the other farmers, as well as share their own experience in water management. The experimenting farmers have not recorded how many farmers visit them to see their work. Only men come to these meetings in the field, and only male members of the family are involved in this PID activity, as it involves a lot of strenuous digging work.

In an area like Tigray Region, where many activities in agriculture and NRM are supported through Food-for-Work (FFW) or Cash-for-Work (CFW) schemes, it is noteworthy that the experimenting farmers are not receiving any food or cash for the work they are doing to try and improve their land. They receive only some advice from BoARD and ISD staff, and the PID funds that allowed them to buy tools and other things they needed for the experimentation.

The role of different actors in the PID process

Even though all the local farmers already knew about Abadi's innovation through their own observations, he plays an important role in the PID process by explaining his experience and guiding the work. Most of the problems in experimentation – the trial-and-error process and the costs of initial mistakes – occurred while Abadi was developing his innovation on his own. With his help, the farmers can avoid making the same mistakes. That is why they value his presence so highly.

Their main external partners in the PID process are staff from ISD and the DAs and experts from BoARD at village and district level. Thus far, they have had relatively little contact with formal researchers. The Axum Agricultural Research Centre and Axum University were only recently established and first contacts were recently made, when the Head of the Research Centre and the Dean of Agriculture went to the field to see the PID work. Tahtai Maichew District is too far away (about 280 km) from the university in Mekelle, the capital of Tigray Region, for people from there to take part in any of the meetings of the experimenting farmers. However, some staff members from Mekelle University do show interest in PID and have made occasional visits, although the funds made available through PROLINNOVA–Ethiopia to support PID are not enough to cover their travel costs and *per diem* payments.

About once a month, someone from ISD attends a meeting of the experimenting farmers. In between, ISD staff members from Addis Ababa and Mekelle keep in touch by telephone (at least once a week) with the districts experts for NRM and agriculture, who are in frequent contact with the DAs in the field. The DAs join the meetings of the experimenting farmers about twice a month, and occasionally the district experts for NRM and agriculture also come. The main tasks of ISD and extension staff are to help the farmers monitor their work and its effects and to help them analyse what they are doing. It was agreed from the outset of the PID that the farmers themselves would do most of the monitoring.

During the PID launching workshop, the experimenting farmers were given a still-photo camera and two films so that they could take their own photographs of their experiment. Abadi himself takes the photos and pays for film development and prints. They distribute the photographs among themselves, show them to other farmers and use them to show visitors how they did the work, e.g. when they were digging the canals which can now no longer be seen because they are underground. Abadi keeps a set of the photographs in his house, but intends to put them into an album so that it is easier to show them to visitors. There is nowhere suitable nearby where they could display the photographs, e.g. on a wall, for other people to see whenever they want. However, his wife and the wives of the other farmers in the group are well aware of what their husbands are doing and bring out the photographs to show them to visitors.

The farmers are also keeping written records in a large DIN A4 notebook. Abadi does most of the writing. The DAs and the district experts also write down their observations during their meetings with the farmers, keep their records on file in the district agricultural office, and refer to them when reporting to their colleagues and superiors.

Making the PID process and results more widely known

The experimenting farmers disseminate their interim results when other farmers take part in their regular meeting-cum-working days, during visits to the PID site on farmers' days organised by the Agricultural Office and the District Administration, and through informal communication among farmers. This happens, e.g., when attending church, when gathering to celebrate a saint's day, at market places, at coffee or funeral gatherings or during neighbourhood meetings for other purposes. The men and women sit together and both take part in these informal discussions, except in the church, where they sit separately.

The Agricultural Office has organised visits of farmer groups to Abadi's farm 3–4 times a year in the last couple of years. Since January 2007, they organised two visits by farmer groups to the new PID site. The period of most frequent farmer-to-farmer visits and farmers' days is between January and March. The Agricultural Office is planning a farmers' day in January 2008 to see the experimenting farmers' work on water drainage and supplementary irrigation. In addition, by writing about the process in this and other articles³, we from ISD and the BoARD are trying to share the learning even more widely.

A big problem with respect to communication and dissemination is the frequent turnover of extension staff in Tigray, including in the Axum area. The handover from one DA to the next is not well done, so it is difficult for the new DAs to learn about the local innovations and PID

³ Hailu Araya. 2007. The story of a smart water harvester in Tigray Region, Ethiopia. In: *Smart water harvesting solutions for rain, fog, run-off water and groundwater* (Netherlands Water Partnership), pp 36–39.

processes. They just find a pile of papers on the desk or in the drawers or cupboards. It has proved quite useful to have posters in the district agricultural office about the outstanding farmer innovators and to have their work featured in the catalogue of local innovations⁴. More posters will need to be made so that all DAs and experts and the farmers themselves have copies that they can display, and also so that they can be used for teaching in the farmer training centres, agricultural technical colleges and universities in Tigray. PROLINNOVA–Ethiopia has printed posters on local drop irrigation and water-lifting innovation in Tigray but not yet on Abadi's innovation in water management. The NTH platform is planning to make a poster and leaflet of his innovation and the PID process for use within Tigray. It is also preparing a workshop of the emerging PROLINNOVA–Axum platform (Farmer Innovators Association, BoARD, Axum University, Axum Agricultural Research Centre, ISD and other NGOs working in the area) where the results of the PID process will be presented.

⁴ PROFIEET (Promoting Farmer Innovation and Experimentation in Ethiopia). 2006. *Catalogue of farmer innovations*, Vol. 1. Addis Ababa: AgriService Ethiopia.