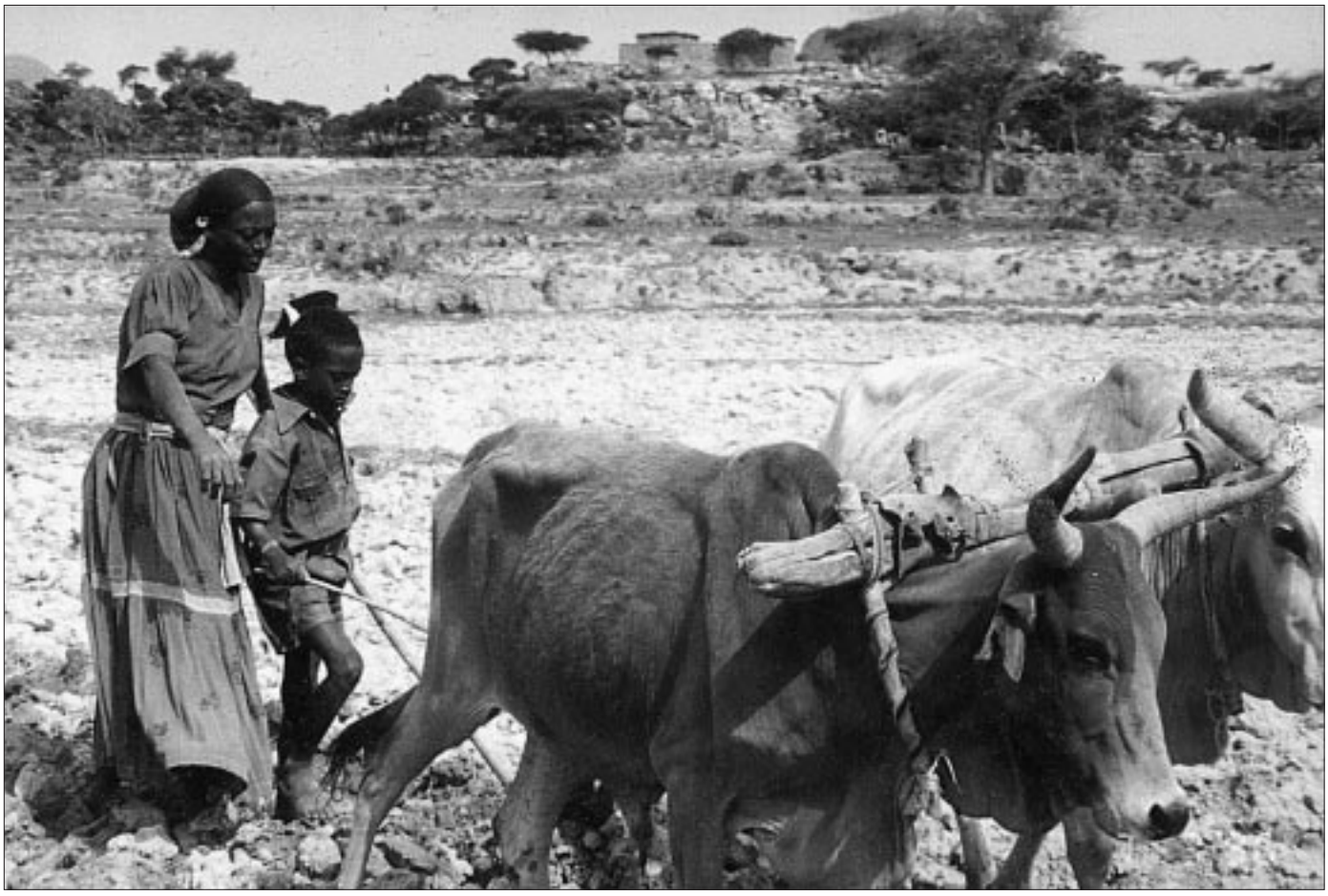

Photo: Fetien Abay

Farmers' innovations in land and water management

In the semi-arid highlands of Tigray in Northern Ethiopia, generations of farmers have developed land-husbandry systems that allowed them to live under harsh conditions. Their systems involve physical and biological techniques of soil and water conservation (SWC) and integrate aspects of agronomy, livestock husbandry and forestry. Farmers continue to innovate and refine their practices. Local innovation can be a source of inspiration for more widespread development.

Mekelle University College (MUC), the Bureau of Agriculture and Natural Resources (BoANR) and other governmental and nongovernmental organisations in Tigray are looking for indigenous land husbandry innovations and see this as an entry point into Participatory Technology Development (PTD), in the second phase of a Dutch-supported programme 'Indigenous Soil and Water Conservation' (ISWC). The aim is to promote existing processes of improvement by recognising local initiatives, by linking innovative farmers with each other and with formal research and extension, by validating and disseminating successful technologies, and by supporting farmers and rural communities in their own experiments. This article deals with some of these farmers' innovations and the above programme.

Fetien Abay, Mitiku Haile and Ann Waters-Bayer

Tigray is an area of extreme land forms, with flat plateaux and lowlands separated by steep slopes and escarpments. ISWC works in the semi-arid highlands at 2000-2500 metres. Average annual rainfall is usually between 450-900 mm. The rainy season is June to September. Smallholder farms are between 0.2 and 1.5 ha. The soils are shallow, stony and of low fertility. Barley, wheat, teff, finger millet, field peas, maize and sorghum are the main crops and the land is worked with oxen and the *maresha* plough.

Seeking local innovation

Our inventory of indigenous innovations in SWC was carried out in Tigray's western, central, eastern and southern zones. Extension agents, university teaching and research staff and university students completing their 5 month practical period were involved. They observed local differences in practices and asked local people about individuals and groups who had discovered new ideas and experimented with innovations without the support of formal extension services. Attempts were made to identify both male and female innovators.

Integrated management of hill and farm

One example of a very creative innovator is Ato Haile Gebrehiwot, a 50–year old farmer in Western Tigray. Over the past 13 years, he has developed an integrated farm system that combines various innovations: revegetation with diverse indigenous species, moisture conservation and soil-fertility management, apiculture and improved farm implements. His farm has an average annual rainfall of 860 mm. He and the nine members of his family farm 1.25 ha of land. His

main crops are maize, teff and fruit and he keeps 5 head of cattle, 3 donkeys, 5 goats, numerous poultry and an increasing number of bees. In Western Tigray, where farm sizes are larger than elsewhere in the region, he is seen a moderately well–off farmer.

Slope revegetation to reduce floods

Like most other farmers in his area, Ato Haile's land is frequently flooded and covered with silt and stones from a steep, treeless hillside above his home. In 1984, without external assistance and using only family labour, he started to build stone terraces on the hillside to control run-off. He collected seeds and the vegetative parts of various local tree, shrub and grass species and established them on the slope. The hillside is now a forest dominated by indigenous species and some more recently introduced fruit trees. Altogether there are 43 tree and shrub species, 5 fruit and beverage species, and 6 grass species.

The physical structures and soil cover have solved the problem of flooding, and from the vegetation he gets firewood for home use and sale. Moreover, the organic matter has allowed much water to infiltrate and this ensures moisture over a longer period which benefits his farm and homestead garden. He has deliberately planted bee-forage species amongst the vegetation because he wanted to expand his production of honey and bees.

The sale of bees is very lucrative so he developed a system to increase swarming frequency. First, he keeps the bees in a narrow hive fixed on an elevated pole or beam. He then exposes them to alternating cold and warm conditions, and does not harvest the honey produced. The bee population increases and in their discomfort the bees form new colonies in the small gourd hives he provides. These bees are sold at the local market.

New animal–drawn implements

To make it easier to transport heavy stones for SWC, Ato Haile designed and manufactured the *menkorkor* (Fig. 1) which is drawn by two oxen. It is a kind of wheelbarrow with a wooden frame supported on a wheel made by fitting together two spent bombshells. This is an example of using resources available locally and left over from Ethiopia's long war. A wooden shaft connects the frame to the oxen yoke.

He decided to plough with one ox to solve the problem of an unbalanced team of oxen. He thought that a plough drawn by a single animal would be useful for neighbours who only have one ox. He himself has two oxen and now he can prepare land for sowing more quickly because his family can plough two plots at the same time. He made a single-ox yoke to pull the *maresha*.

Generous dissemination

Ato Haile wants to promote his innovations. Hundreds of extension agents and farmers have come to learn from him about revegetation using indigenous species, bee-keeping and manufacturing improved implements. These visits have been organised by the BoANR and the Tigray Development Association. Ato Haile takes the lead in demonstrating and explaining his innovations. He lends his implements to other farmers, so that they can try them out for themselves. He also supplies the seeds of various tree species to interested farmers and gives them technical advice - free of charge - on raising and transplanting seedlings and establishing the trees.

He says that 13 years of experience proves his system is well-adapted to the environment and is effective. He has integrated SWC measures, crops, trees and livestock, including guinea fowl which he has domesticated from the wild. According to Ato Haile, his system will be sustainable if no deliberate man-made interventions disturb it.

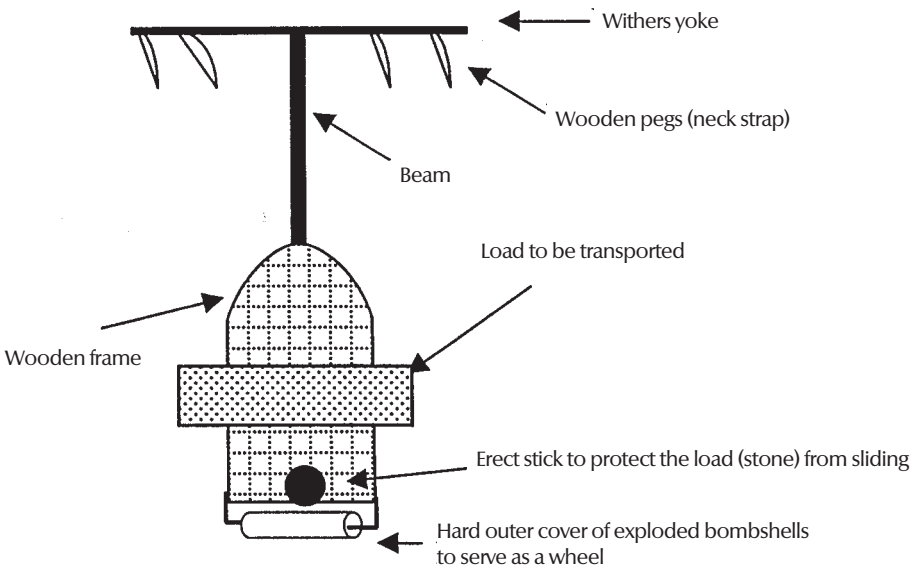

Figure 1. Menkorkor used to transport heavy loads

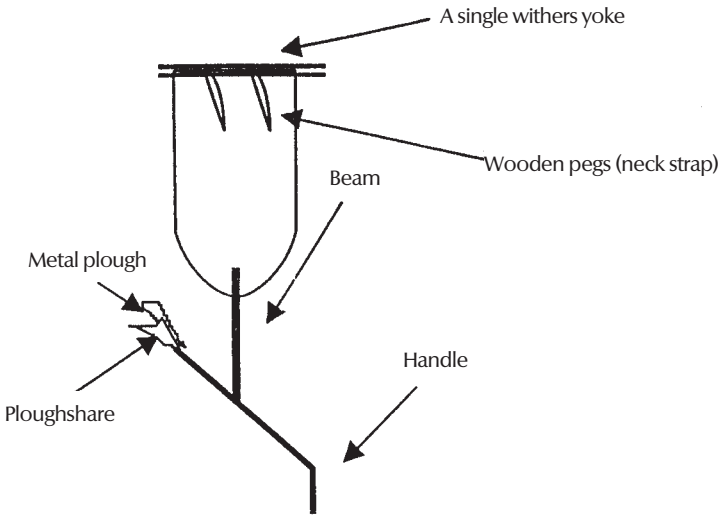

Figure 2. Single-ox plough

Seeking new ideas

Ato Haile is keen to talk to scientists and other farmers about new ideas. For example, before he reforested the slope above his home, a gully had formed on his farm. Indeed, the gully formation ultimately motivated him to plant trees above it and on its edges. The gully is not getting worse, but now he would like to re-establish his field there, and would like to exchange ideas with other farmers who have successfully reclaimed gullies. He is also interested in trying out new plant species suitable for terrace stabilisation and animal feed, including tree fodder.

Innovative women

During the inventory, examples were found of women farmers who had observed and analysed the unintended effects of actions that were either a 'mistake' or originally meant for another purpose. They recognised the useful effects of these practices and developed them further.

W/ro Leteyesus Gobena is a 26-year-old woman who farms in Central Tigray, where annual rainfall is about 600 mm. Three years ago, after her husband died, she started ploughing on her own. In the Tigrian culture, where men traditionally plough, this is an innovation in itself. Leteyesus applied various traditional practices she had learned from her husband, such as sowing presoaked seed of maize and sorghum to accelerate germination, using the hoof action of small ruminants to work teff seed into the soil, and cultivating teff by ox plough between uncultivated strips (*terwah*).

During her first attempt at *terwah*, Leteyesus formed, unintentionally, some furrows on each side of the grass strips. She observed that the teff growing in the field with these furrows had a higher yield than the teff in her neighbour's adjacent, uniformly ploughed field. She recognised the utility of the furrows and prepared them intentionally during the next season's ploughing.

In order to gain even more benefits from *terwah*, she dug up sods of the grasses livestock preferred and moved them to the grass strips. She explained that the shade from the grass stops water from disappearing so quickly in the sun. In addition, she deliberately collects seed of grasses she finds useful for different purposes, including broom-making, to plant on the strips. In the second year, she cultivated where the enriched grass strips had been, and made grass strips lined with furrows where she had previously grown teff. She thus seems to have developed a system of simultaneous enriched fallow on her very small landholding (0.2 ha). In this high-population area of Tigray, the practice of fallowing has long been abandoned.

Infiltration pits

W/ro Azmera Atseba is a 38-year-old woman farming in an area of Eastern Tigray that receives about 450 mm rainfall per year. She sows teff, wheat, barley, sorghum and tomato in irrigable fields with a total area of 1 ha. In 1996 she followed instructions given by the Home Agent to dig a shallow pit in her backyard for garbage disposal. However, in the early wet season, the pit filled up with run-off water. Later in the season, there was not enough rain for the crops and most farmers in the area failed to harvest anything.

W/ro Azmera observed that the wheat she had sown near the pit in her backyard grew well, and she harvested more grain and straw from this area than from the other parts of her backyard farm, even more than in other years with better rain. She concluded that the plants grown near the pit benefited from the water stored there which had infiltrated the soil. The next year, she deliberately dug infiltration pits in her backyard and even in the fields outside. She harvested over 3 quintals from 0.25 ha. Before her innovation she would have expected no more than 1 quintal.

Difficulties in spreading innovations

It seems to be difficult for other farmers to accept women's innovations. Indeed, the very sight of a woman behind a plough raises the comments from some men that it will bring misfortune to the village. An additional problem is that many women farmers (household heads without husbands) are quite poor and cannot spare time from their work to discuss their ideas with others. Some farmers were impressed by the results of Leteyesus' infiltration furrows, and the local council asked her would she teach this to others. She replied that she must farm and think of new ways to get the most out of the little she has for her family's survival. She cannot leave her work without some kind of compensation.

More and more examples

This is only a small sample of the still growing number of innovations being discovered by researchers, students and fieldworkers in Tigray. Other innovations include:

- trapping silt and water in ephemeral water courses to create new land (see also Hagos & Asfaha 1997);
- reclaiming farmland from a river by constructing walls in the river bed and diverting the water flow
- distributing manure through water diverted into fields at points where silt traps were built into gullies
- changing the shape of unploughed strips designed to retain more water in a traditional community-managed irrigation system.

Men and women in Tigray experiment with using every conceivable resource available to them to improve their land-husbandry systems. They integrate physical and biological methods of water control, crop husbandry, soil-fertility management, livestock and manure management, plant introduction and selection, crop-residue management and agroforestry. Indeed, the innovations go beyond agriculture and include the use of wildlife. One farmer in Central Tigray, for example, uses manure of the wild *ghybe* (hyrax) on his cropland. The *ghybe* has the convenient habit of depositing its manure repeatedly on the same site; it is therefore easy to collect. Ato Abreha claims that it improves the fertility and moisture-holding capacity of the soil for up to 4 years and greatly increases his crop yield.

Promoting small-scale farmers' ideas

Data are still too few to be able to analyse differences in innovation behaviour, types of innovation attempted and spread of innovations according to gender, age and relative wealth. However, the initial data suggest that some women develop innovations that can be useful for both farm and household chores, and that communicating women's ideas more widely is a more difficult task than communicating those of men.

Extremely poor farmers, whether male or female, are finding new ways of making intensive use of local resources. Such innovations are of particular interest to very small-scale farmers. Other innovations discovered were developed by better-off farmers and need more resources than poorer farmers can invest. The richer farmers also have more time to teach others and can lend implements or donate planting materials. Ways must be found to compensate very poor farmers and help them share their ideas with others.

Generating enthusiasm

We publish information on farmer innovations in a Tigrigna language newsletter and distribute this to interested field staff, supervisors and farmers. T-shirts are distributed to workshop participants and as prizes for discovering farmer innovation: the picture on the T-shirt is of W/ro Leteyesus ploughing her fields.

We encourage researchers to make detailed investigations of the various innovations discovered by field workers, to assess their positive and negative impacts together with farmers and to work with farmers to improve their land-husbandry systems. In workshops in the field, the men and women farmers explain their innovations to governmental and nongovernmental researchers, field agents and programme managers. Joint on-farm experiments under the control of farmers, and in watersheds under the control of local resource users are being designed in the framework of PTD training workshops.

Farmers experiments will be complemented by studies and, where necessary, on-station research which will help explain or show how farmers' practices can be improved, and generate the information innovative farmers and communities need to continue development activities. As a result of these activities enthusiasm for local innovation and experimentation to improved land husbandry in Tigray is growing. ■

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