LOW EXTERNAL INPUTS TECHNOLOGIES AND BIODIVERSITY IN ETHIOPIA

Location: Tigray, Ethiopia

A low external input approach has been successfully promoted in Tigray to improve local food security, restore soil fertility and reduce reliance on chemical fertilizer inputs. Farmers, researchers, and agricultural experts worked together to devise a system based on local inputs, biological diversity, and ecosystem services; this collaboration restored communities' control and effective management of natural resources.

CHALLENGE

Following extended droughts in the 1980s, Ethiopia pursued intensive output-oriented agriculture that relied heavily on external inputs, including chemical fertilizers, the use of which doubled in the 1990s. By 2002, many farmers were deeply indebted from soaring chemical input costs.[1] Although national grain production rose from under six million tons to more than 10 million tons per year during the 1990s,[2] several regions, including Tigray (an area roughly 50,000 km^2 in size, where 85 percent of its four million inhabitants are small farmers), have remained impoverished and food insecure. In 1996, despite record harvests and lower than average food prices, millions remained unable to secure adequate food and some 240,000 tons of food aid were delivered. A government report concluded: "The current situation is therefore one of food abundance coexisting with widespread food insecurity."[3] In Tigray and other especially poor farming areas, experts found a close interrelationship between degraded farmland, poverty, and food insecurity.[4]

RESPONSE

Starting in four Tigray communities in 1996, family farmers, the Institute for Sustainable Development (ISD), the Bureau of Agriculture and Rural Development of Tigray (BoARD) and Mekelle University collaborated on a low external input approach to promote local food security, restore soil ecology, and reduce reliance on costly chemical fertilizers that were contributing to farmer debts.[5] They emphasized technologies such as:

- Organic composting for more stable and fertile soils with increased water-holding capacity
- Trench bunding between fields
- Construction of upstream check dams in gullies to hold water and soil and decrease water flow that exacerbates soil erosion
- Creation of ponds and small earth or stone and cement dams to collect water for the dry period
- Planting multipurpose trees like *Sesbania sesban,* which provide forage, fuel, and shade while also acting as an erosion barrier and natural nitrogen fertilizer
- Reintroduction of indigenous grass species, particularly elephant grass, in order to decrease soil erosion and increase the water-holding capacity of the catchment area

- Plantings of leguminous crops and cover crops
- Agroforestry to improve soil and water quality, boost nitrogen content and organic matter, and reduce erosion
- Support for low technology solutions to improve access to water in the dry season, such as rain water harvesting and foot pumps
- Support for poor female-headed households
- Use of by-laws to control access to and use of local biological resources, including the restrictions of free-range grazing by domestic animals.

After 2000, the project was scaled up from the four initial communities, so that by 2006, project activities were taking place in 57 local communities in 12 of the 53 weredas (districts) in Tigray. In 2002, ISD published a compost manual in Tigrinya, the local language, in order to reach out to larger numbers of farmers and communities.[6]

Since 2000, BoARD has been using the project approach as part of its extension work throughout Tigray Region. It has thus been promoting the land rehabilitation 'package'—compost, trench bunding for soil and water conservation and planting multipurpose trees and grasses—in over 90 communities within 25 weredas in the drier more degraded areas of the region. By 2007, an estimated 25 percent of the farming population in Tigray were using this package, particularly making and using compost.[7]

In 2006, the United Nations Food and Agriculture Organization (FAO) provided funding to help collect, enter and analyse yield data from plots in farmers' fields during the harvesting season. The final database included plot yields from 974 farmers' fields and 13 crops taken over the years 2000 to 2006 inclusive.[8] This represented the single largest study of its kind in the world comparing yields from the application of compost and chemical fertilizer. The results were presented at the FAO International Conference on "*Organic Agriculture and Food Security* " held in Rome in May 2007.[9]

RESULTS

The Tigray project shows how farmers, researchers, local advisors, and agricultural experts can collaborate to devise a system based on local inputs, biological diversity, and ecosystem services. The initiative has also helped communities develop and enforce by-laws to restore local control and maintain effective management of their natural resources. More specifically, the project has accomplished the following:

- Between 2003 and 2006, grain yield for the Tigray Region nearly doubled from 714,000 to 1,354,000 tons. Many farmers have also diversified their vegetable crop production.[10]

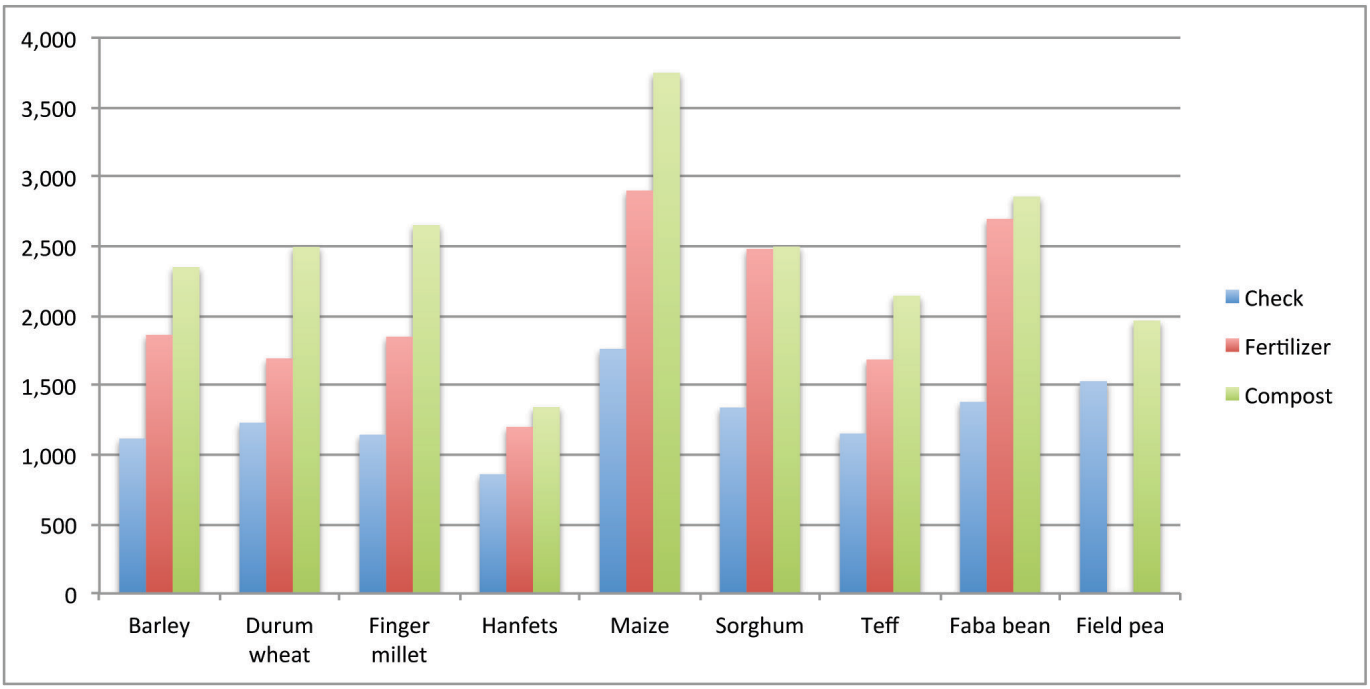
Compost generally doubled grain yield compared to a control group that received no inputs.

Compost for farming. © SusanA

The Tigray project shows how farmers, researchers, local advisors, and agricultural experts can collaborate to devise a system based on local inputs, biological diversity, and ecosystem services.

There are various techniques that improve field moisture availability—terraces, trenches and deep furrows, contour soil and stone bunds, contour bund terraces, semicircular and trapezoidal bunds, trash lines, vegetative bunds (e.g. vertiver strips), zai planting pits, inter-row systems, contour ridges, tied furrows and negarim microcatchments (diamond-shaped basins surrounded by small earth bunds). These measures slow down surface runoff, improve infiltration, and increase soil moisture. Other measures, such as windbreaks, reduce evaporation and extend the effective presence of dew.

Figure 1: Average grain yields by treatment for 9 crops (kg/ha), Tigray 2000-2006



- There was a steady decrease in the use of chemical fertilizers, which dropped from 13,700 to 8,200 tons between 1998 and 2005. Many farmers have stopped using chemical fertilizer without any loss in production;[11] in fact, crop yield often increased (see Figure 1). The official sample survey for the crop year 2007/2008 showed that 86 percent of the nearly 700,000 Tigray farmers were using natural fertilizer on nearly 200,000 hectares (ha). Only 16 percent of the farmers had used chemical fertilizer on 48,000 ha.
- Field studies from 2000-2006 have shown significantly higher crop yields among farmers using composting than among those using chemical fertilizers. For instance, average grain yields from composted fields were 2,473 kg/ha, versus an average of 1,812 kg/ha for those using chemical fertilizers. With the exception of field peas, compost generally doubled grain yield compared to a control group that received no inputs.
- Farmers soon observed the residual effect of compost in maintaining soil fertility for two or more years: They can rotate compost application on their cultivated land and do not have to apply it to all of their cultivated land each year.
- Farmers using compost reported the reduction of difficult weeds, such as Ethiopian wild oats (*Avena vaviloviana)* and

Milled wheat for sale at the local market in Tigray. © Astrid Randen / FAO

improved resistance to pests—tef shoot fly—as compared to crops treated with chemical fertilizer.

- Farmers reported a host of agro-ecological benefits, including improved soil moisture retention, higher local water tables due to conservation, and increased crop diversity and rotation.
- Farmers adopted land rehabilitation practices: compost application, trench bunding for soil and water conservation, and planting indigenous trees and grasses such as elephant grass. *Sesbania sesban* has been the most successful indigenous tree; it supplies animal forage, compost biomass in rehabilitated gullies and on bunds between fields.[12]
- By 2010, the project was estimated to have benefited between 18,000 and 20,000 households, impacting approximately 100,000 beneficiaries. In addition to becoming the regional government's model to mitigate soil erosion and combat poverty, the project is also being expanded throughout Ethiopia through the Ministry of Agriculture and Rural Development's extension system, the Environmental Protection Authority, and the Institute for Sustainable Development.

Farmers reported a host of agro-ecological benefits, including improved soil moisture retention, higher local water tables due to conservation, and increased crop diversity and rotation.

FOR MORE INFORMATION
www.oaklandinstitute.org
www.afsafrica.org

This case study was produced by the Oakland Institute. It is copublished by the Oakland Institute and the Alliance for Food Sovereignty in Africa (AFSA). A full set of case studies can be found at www.oaklandinstitute.org and www.afsafrica.org.

ENDNOTES

1 Edwards, Sue. *Greening Ethiopia for Food Security & End to Poverty.* Institute of Science in Society, 2008. http://www.i-sis.org.uk/GEFSEP.php (accessed October 14, 2014).

2 Spielman, David J., Byerlee, Derek, Kelemework, Dawit and Dawit Alemu. "Policies to Promote Smallholder Intensification in Ethiopia: The Search for Appropriate Public and Private Roles." *Food Policy* 35.3 (2010): 185-194.

3 For a fuller discussion of the interrelationship between food insecurity and poverty in Ethiopia, see Devereux, Stephen. *Food Insecurity in Ethiopia.* Institute for Development Studies, 2000. https://www.ids.ac.uk/files/foodsecethiopia4.pdf (accessed October 29, 2014).

4 Araya, Hailu and Sue Edwards. *The Tigray Experience: A Success Story in Sustainable Agriculture*. Third World Network, 2006. http://www.twnside.org.sg/title/end/pdf/end04.pdf (accessed October 14, 2014).

5 This work has been supported by the Third World Network (TWN) since 1996 and the Swedish Society for Nature Conservation (SSNC) since 2005.

6 Asmelash, Arefayne. *Dekuaie tefetro: intayn bkhmeyn (Making compost: what it is, and how is it made), in Tigrinya*. Tigray Bureau of Agriculture and Natural Resources and Institute for Sustainable Development, 2002.

7 Edwards, Sue. *Greening Ethiopia for Food Security & End to Poverty. Op. Cit.*

8 The yield data from farmers' fields was collected by development agents and local experts and compiled by Arefayne Asmelash and Hailu Araya, Project Officer and Sustainable Community Development Team Leader at ISD.

9 Edwards, Sue. *The impact of compost use on crop yields in Tigray, Ethiopia, 2000-2006 inclusive*. Third World Network, 2009. http://www.twnside.org.sg/title/end/pdf/end10.pdf (accessed October 14, 2014).

10 Edwards, Sue. *Greening Ethiopia for Food Security & End to Poverty. Op.Cit.*

11 Edwards, Sue. "The Tigray Project." *Institute of Science in Society*. http://www.i-sis.org.uk/TTP.php (accessed October 14, 2014).

12 Edwards, Sue. *The impact of compost use on crop yields in Tigray, Ethiopia, 2000-2006 inclusive. Op. Cit.*

FRONT PAGE PHOTO:
Women preparing soil for tree seedlings at a nursery in Tigray. © Astrid Randen / FAO