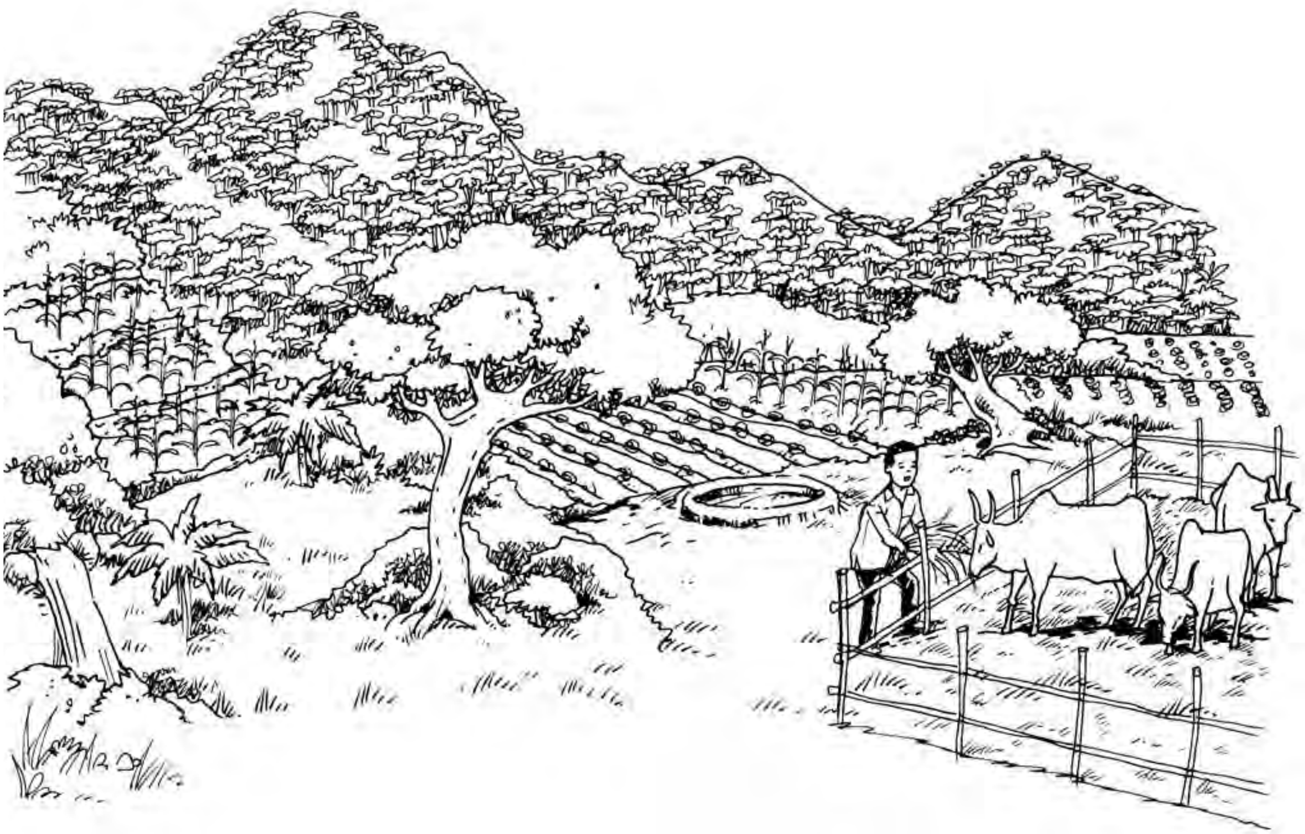
Participatory Watershed Management as the Driving Force for Sustainable Livelihood Change in the Community:

The Case of Abreha we Atsebeha



Agriculture, the main sector of the Ethiopian economy, accounts for 85% of total employment and is the backbone and mainstay of the economy (Pausewang *et al.*, 1990). However, agricultural productivity is decreasing because of land degradation, particularly due to soil erosion. Hurni (1988) estimated that the extent of erosion from arable land in the highlands of Ethiopia averaged 42 tons/ha/yr. This erosion results in a decline of soil productivity.

As in all parts of Ethiopia, the economy of Tigray is based on agriculture, with more than 90% of the population depending on rainfed subsistence crop production (REST, 1997). Soil erosion, nutrient depletion, and soil moisture stress are the major land degradation problems facing the region (Hagos *et al.*, 2003).

Abreha we Atsebeha watersheds in the eastern part of Tigray located northwest of Mekelle, the capital of Tigray region, were highly degraded and the people have been food-insecure for many years. Drought occurs almost every year. During the previous Ethiopian government's regime, for example, the people of Abreha we Atsebeha were selected for resettlement, and many were moved far away from their homes to the southwestern part of Ethiopia. The community of Abreha we Atsebeha is one of the most food-insecure communities of the Wereda.

The intervention

Participatory watershed management

Two decades ago, the Tigray regional government designed a strategy to reverse the immediate causes of land degradation in the whole region (REST, 1997). The World Food Program (WFP) took the initiative of assisting watershed development in collaboration with the Ethiopian government. They embarked on a program called MERET, Managing Environmental Resources to Enable Transition to a More Sustainable Livelihood.

The Abreha We Atsbeha watersheds were included in the MERET project and other development initiatives,[1] including participatory community soil and water conservation (SWC) campaigns initiated by the regional government to mitigate land degradation problems. Many physical and biological conservation measures were implemented as part of the environmental management of watersheds. As a result of improved watershed management and the land and water resource rehabilitation efforts carried out in the area since 1991, the people of Abreha we Atsebeha have successfully attained food self-sufficiency.

This article describes the impact of the intervention—i.e., the MERET project—as a participatory watershed management approach, on reversing land degradation and improving the watershed, encouraging water-smart agriculture, and improving the livelihood of the community. It is based on a study that assessed the impact of specific conservation measures: stone bunds, stone-faced trenches, deep trenches, check dam, constructions, percolation pits, gabion check dam, and sediment storage dam constructions and area closures (Table 1).

Assessing the impact of the intervention

The impact assessment study is entirely focused on four sub-watersheds. In three sub-watersheds (Mendae, Anchel, and A/Atsebeha[2]) different environmental management practices were implemented, including area closure and reforestation activities. The fourth one, Machew, received very little or no environmental management support and was therefore used as a control to compare the impacts of the conservation practices. Major watershed characteristics (geologic data, rainfall data, SWC measures put in place and effects on runoff and infiltration) were analyzed.

Transect walks were undertaken, dividing the landscape into three areas with each landscape then divided into upper, middle, and lower ranges. Two plots, 10 m wide by 10 m long, were established to estimate the percentage of vegetation canopy cover in each landscape position for all study sites. The area of each sub-watershed was 561.34 ha in the case of Mendae, 601.21 ha in Machew, 921.62 ha in Anchel, and 556.31 ha in A/Atsebeha.

The study compared soil loss rate from treated and untreated watersheds. Eight soil samples were collected during the transect walk using systematic random sampling, combined to form a composite sample. This was done across three slope ranges (upper, middle, and lower) and across three locations in each of the four sub-watersheds. The soil samples collected and analyzed totaled 36.

***Fig. 1**. Community members participate in soil and water conservation activities.*

[1] For example, work by GTZ and the PSNP USAID–funded program.
[2] A/Atsebeha is a sub-watershed name within the wider Abreha we Atsebeha watershed.

Results

Improved vegetation cover and impact on soil erosion

The study found that most of the area closures under the steep slopes of the study sites are covered by a large variety of grasses and herbs, which humans and animals are restricted from accessing. The exception is in the control site, which permits free grazing but prohibits cutting of trees/shrubs. Ground vegetation cover was very significant in Mendae (40%) and least significant at Machew (4%), the control site. The variation in ground cover among the study sites can be explained by the difference in access to livestock for free grazing. The control site has lower amounts of trees/shrubs and saplings primarily because free grazing was allowed in the sub-watershed.

Reduced erosion occurs in well–protected sites because the canopy formed by the mature shrubs and under-story vegetation shields the soil from the erosive energy of the falling raindrops, thereby protecting the soil from splash erosion and surface or sheet erosion. Soil loss was less pronounced in the treated sub-watersheds, e.g., 14.69 and 19.1 tons/ha/yr for Anchel and A/Atsebeha, respectively. The result is mainly attributed to the relatively high vegetation canopy cover in the two sub-watersheds, 32.8 and 36.6% at 2–m effective height and to ground vegetation cover of 23-40%.

In contrast, the control sub-watershed had higher rates of soil erosion (37.33 tons/ha/yr), which might be the result of very low vegetation cover (4%) and canopy cover (36.7%). When the soil's protective vegetation cover is removed, the structurally unstable soils are exposed to the striking action of rains. Losses due to erosion immediately after land clearing are normally alarmingly high.

However, the study also found that steep slopes and cultivated areas are more affected by soil erosion in all the sub-watersheds. The mean calculated soil loss in the control site varied between 29.09 and 39.23 tons/ha/yr with a mean of 37.33 tons/ha/yr. The soil loss was higher than the mean of the treated sites but was closer to the mean calculated from cultivated areas of 42 tons/ha/yr (Hurni, 1988). The mean annual soil loss in Mendae where mitigation measures were done intensively and which has loamy sand varied from 1.69 to 29.42 tons/ha/yr and at the other two sites, from 8.35 to 29.23 tons/ha/yr.

Increase in honey bee production and restoration of biodiversity

Before the intervention there were 470 traditional beehive colonies and no modern ones. After the intervention there was an increase in honey-bee flora, farmers therefore switched from traditional beehives to modern beehive colonies. The previous 268 traditional beehives were replaced with 1,077 ones. The annual production of honey before the intervention was 3kg/yr with the traditional colonies. The honey production after intervention with the modern ones was 45kg/year, an increase of 1,500%. As a result of area closures, endangered tree species also regenerated.

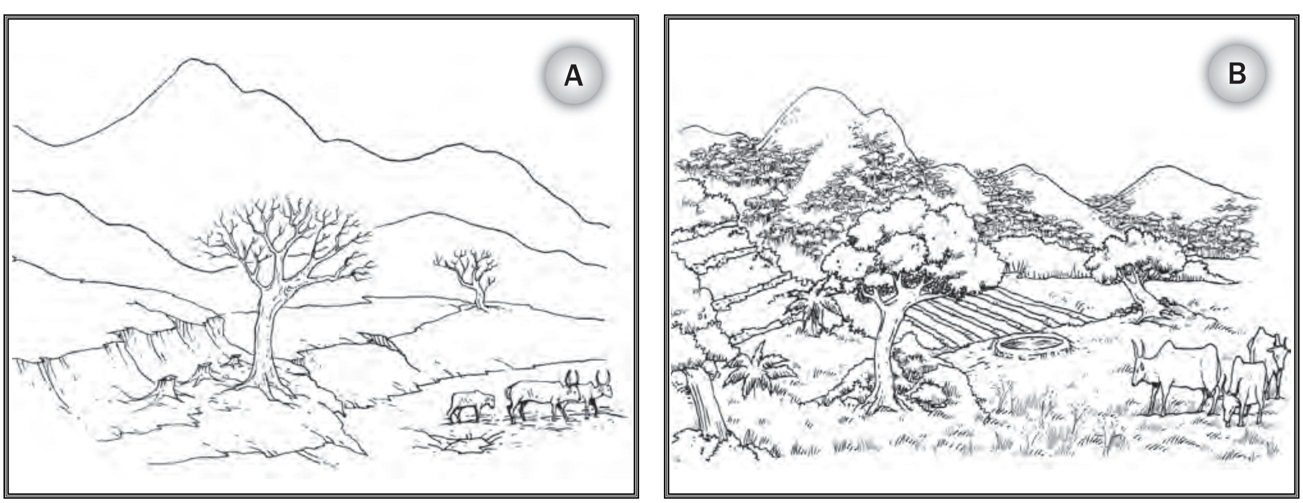


Fig. 2. *The area before (A) and after the intervention (B).*

The water management structures in the sub-watersheds before and after the intervention are shown in Table 1. The data very clearly demonstrate the difference between the control site and the others in terms of both environment and water resource development.

The annual income of all study sites before the intervention was below US$1/day (US$0.72). After the intervention, all study sites (including the control) recorded incomes above US$1, however, the increase was lowest in the control site. These findings are similar to those of other studies that demonstrate that watershed development programs influence biophysical and environmental aspects and thereby bring changes in the socioeconomic condition of the people (Kuppannan *et al.*, 2009). Socioeconomic indicators that could be measured include changes in household per capita income and changes in consumption and expenditure, employment, migration patterns, household assets, and wage rates at the village level.

Table 1. *SWC structures in the sub-watersheds before and after the intervention.*

Activity	Number	Mendae	A/Atsebeha	Anchel	Machow
Trench construction before intervention	15,906 (m^3)	9.09%	9.02%	72.3%	8.9%.
Area enclosure before intervention	800 (ha)	50%	25%	25%	0%
Shallow hand-dug wells, SS dams or deep trenches before intervention	0%	0%	0%	0%	0%
Trench construction additions after intervention	13,778 (m^3)	50.3%	49.7%	0%	0%
Check dams after intervention	16,934 (lm)	100%	0%	0%	0%
Percolation pits after intervention	16,750 (m^3)	10%	90%	0%	0%
Enclosure after intervention	4,100 (ha)	44%	20%	24%	12%
SS dams after intervention	4	75%	25%	0%	0%
Deep trenches after intervention	1,987 (m^3)	0%	50%	50%	0%
Shallow hand-dug wells after intervention	700	33%	31%	53%	0%

Source: Kelte Awelaelo Wereda office of Agriculture and Rural Development (WOARD)

Increased household income

The biophysical improvement of the study sites has brought significant changes in the income of households in the community. Data obtained on differences in household income before and after the intervention are shown in Table 2.

The data showed an increase in income in all study sites, including the control site (Maichew).

Table 2. *Mean annual income of households in the study sites (US$)*[3].

Study site	Time of intervention	Income (birr/yr)	Income (US$/yr)	Income (US$/day)
A/Atsebeha	Before intervention	1,897.83	171.75	0.47
	After intervention	9,538.00	870.44	2.38
Anchel	Before intervention	3,850.00	348.42	0.95
	After intervention	8,382.00	758.52	2.08
Mendae	Before intervention	3,617.00	327.30	0.90
	After intervention	10,193.00	922.47	2.53
Machew	Before intervention	3,357.00	303.77	0.83
	After intervention	4,557.00	412.37	1.13
Total	Before intervention	2,922.92	264.52	0.72
	After intervention	6,806.25	615.95	**1.69**

[3] Exchange rate (2008): US$1 = 11.05 birr.

Conclusion

This study looked at four sub-watersheds, three of which had significant environmental management support (one was the control). This allowed an assessment of the effects of environmental management on vegetation cover, soil erosion, honey bee production, and restoration of biodiversity. The links between these different effects of environmental management and the links with water resource management were also presented. It was shown that these effects in turn influence the socioeconomic conditions and livelihood opportunities in the community.

For each measure, the control sub-watershed fared worse. Environmental management initiatives very clearly resulted in benefits across the board in terms of land and water management, and they also translated into improved livelihoods. It was shown that the unbelievable journey from famine and risk of resettlement in 1991 to becoming a winner of the 2012 UNDP Equator Prize at Rio de Janiero is the result of water availment for agriculture, the consequence of good watershed management practices.[4]

Due to the complex nature of soil nutrient patterns (which, to a large extent, depends on land use and landscape position), additional research is needed to more fully understand the interactive relationships between landscape position, soil erosion, soil nutrients, land use, and its history and management.

An overall recommendation is that a complete sedimentation and erosion control plan be made for all sub-catchments and should include protection of degraded land from the interference of livestock. It should also include the installation of grassed waterways to carry runoff from the catchments at velocities that will not destroy the vegetation.

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[4] 2012 World Food Program Award.