Impact of Watershed Management in controlling Desertification in Atsbi district of northern Ethiopia

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Résumé

Impact de la gestion d'un bassin versant pour le contrôle de la désertification dans le district d'Atsbi (Ethiopie du Nord)

Dans le district d'Atsbi, dans une région semi-aride de l'Ethiopie septentrionale, la gestion intégrée d'un bassin de 180 km^2 a débuté en 1991. Nous en avons mesuré l'impact et analysé les implications. Des photos aériennes et des images satellitaires ont été utilisées comme outil pour l'étude des changements d'affectation et couvert du sol. Les mesures de conservation de l'eau et du sol et de reboisement ont mené à la réhydratation. Ceci a permis l'irrigation de 222 ha de fonds de vallées et le développement de 215 ha de terres humides sempervirentes. En outre, en aval du bassin, l'irrigation a fortement augmenté. Ces changements dans l'affectation du sol reflètent l'utilisation optimale des ressources et leur impact sur l'environnement. La population locale a commencé a voir l'agriculture avec un intérêt renouvelé pour le développement.

INTRODUCTION

The study area, located in Tigray administrative Region, is part of the northern highland of Ethiopia. The area is in the arid, semi-arid agro-climatic zonewith highly dissected and rugged terrain, poor vegetation cover, and high susceptibility to soil erosion.

The erratic rainfall, coupled with poor ground cover and high human and livestock population pressure on land resources, have contributed to a multitude of serious problems, such as depletion of vegetation cover, advanced soil erosion, yield decline and human suffering.

To mitigate such a serious and urgent problem, the Irish and the Ethiopian government jointly promoted an integrated watershed management program, starting in 1991, in Gergera watershed (area 180 km^2). The objectives were to , starting 1991 with the aim of arresting land degradation, restore farming systems, and enhance food security on a sustainable basis in the area. Improved agricultural production was the aim of the project, since most of the inhabitants were farmers. Intensification of agriculture was the main objective, with livestock feed resource development and water harvesting as priority items.

This paper presents findings from field research regarding the impact of integrated watershed management in the semi arid tropical climate of Atsbi district. The integrated watershed management approach has improved agricultural production in the area and generated genuine enthusiasm in the people residing within the watershed. In addition, there has been a radiation effect to outlying villages.

METHODS AND MATERIALS

Aerial photographs and satellite imagery were used to study changes in land cover and land use. Through systematic interpretation of multi-temporal aerial photographs both land-cover and land use maps indicating pre and post integrated watershed management intervention scenario were established.

To validate the data ground checking was made using base maps (Land Sat 2000) and GPS. Digital change detection was performed using GIS and its spatial analysis capabilities to evaluate the changes.

Moreover, PRA (Participatory Rural Appraisal) was employed to assess overall impact of the intervention on: food security, household income, human resources development, and fodder and fire wood availability.

RESULTS AND DISCUSSIONS

Conservation of resources through mechanical measures

Physical conservation measures and tree planting were given first priority and implemented in the watershed. Thus, the implemented conservation measures (terracing, gully stabilization, check dam construction and plantation of multipurpose, fruit and fodder trees) enhanced the in-situ moisture conservation, storage of water and recharged ground water. This opened an opportunity for supplementary irrigation, and thereby encouraged farmers to go on for cultivation of high-value commercial crops.

Surface water harvesting

Water harvesting was not practiced before integrated watershed management program was launched. Currently, farmers within the program area have constructed 274 ponds, each with a capacity of holding about 180m^3 of water, and they have implemented some river diversions. The harvested water is being used for supplementary irrigation during the cropping season, and often for growing a second crop during the long dry spell.

Ground water improvement

The soil conservation measures resulted in reduced runoff and soil loss, thereby improving ground water recharge. Observable water levels in open wells increased by up to 1-2 m, resulting in an increase in available water from each well. Consequently, farmers have dug 78 shallow wells, and they are shifting from subsistence crops to high value, market oriented crops such as vegetables. Currently, 70 motor pumps have been introduced in the watershed.

Crop Production and Productivity

Adoption of conservation agronomic practices in the watershed resulted in better productive performance of crops over time due to decrease in soil erosion and enrichment of the soil. In addition, supplementary irrigation during critical periods of crop growth through hand dug wells and ponds enhanced crop yields in the watershed.

To asses the impact of conservation measures on crop production, current yields were compared with pre intervention yields.

Table 1. Productivity of major crops in the watershed

Crops	**Pre-project (1989-1990)**		**Post intervention (2003-04)**	
	Variety	Ave. Yield q/ha	Variety	Yield q/ha
Wheat	Local	5.0	Hp-PAVEN	12.0
Barley	Local	4.5	Local	7.5
Teff	Local	3.0	KIROS 37	7.5

The area under specialty crops has increased from zero to 127 ha after the intervention, with yields ranging up to 25-30 q/ha for tomato and 15-20 q/ha for onion. On the whole, the use of improved varieties and introduced crops, coupled with increased applications of fertilizers and improved soil and crop management practices, have resulted in increased crop production, and this has increased the net income of the farmers..

LU/LC change (1965-2005)

The changes in land use pattern reflect the reaction of farmers to optimize the use of the land. While the area under rainfed agriculture and wetlands remained approximately the same, the area under assured well irrigation increased from 7.1 ha to 222.4 ha in post intervention. Similarly, the area under dense forest increased from 32.45 to 98.00 ha,.

Table 2 Significant Land use land cover dynamics

Cover type	**LU/LC; dynamics -1965-2005**					
	Pre intervention		**Post intervention**			
	1965		**1994**		**2005**	
	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%
Intensively cultivated land(rainfed)	7405.1	51.1	7980.2	55.1	7483.5	51.7
Intensively cultivated (irrigation)	7.1	0.1	55.2	0.4	222.6	1.5
Dense forest	37.5	0.3	32.5	0.2	98.0	0.7
Bush shrub land	1475.3	10.3	192.4	1.4	358.8	2.5
Shrub land	415.9	2.9	114.7	0.8	1248.7	8.6
Built up area	35.0	0.3	73.2	0.5	244.1	1.7
Wet land	198.4	1.4	-	-	215.7	1.5

Source: Digital change detection analysis result

Apiculture

Improvement in the ecology has enhanced apiculture. Hillside tree plantations, in addition to protecting the soil from water and wind erosion, provide the needed forage for honey bees, and this has created an opportunity for farmers to realize benefit over a short time. With the introduction of modern bee-hives, honey production has increased by about 100% over the traditional hives.

CONCLUSIONS

One of the most striking impacts of the project is that the local population has started looking at agriculture with renewed interest for development. This has resulted in recovery and rejuvenation of arable lands, and increased interest in surface water harvesting and in-situ soil water management. Moreover, there are indications that farmers are becoming more environmentally conscious and will manage farms better in the future.

Integrated watershed management incorporating water-holding structures, improved agronomic practices, specialty crops, and horticulture resulted in an improvement in farmers' income and employment levels. The project was implemented on a watershed basis, which illustrates the importance of delineation of such a the natural land unit, watershed, for integrated management of land and water resources.

The study concludes that development of water resources, coupled with emphasis on high value crops, specialty crops, fruit trees and vegetables are priority considerations for agricultural development in semi-arid regions.

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