Integrated Watershed Management for Improved Food Security in the Ethiopian Highlands

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The Problem and Approach

Problem - High human and livestock population pressures, highly variable and unreliable rainfall, and steep topography have accelerated the process of land degradation in the Ethiopian highlands. Rapid deterioration in land quality is reducing the already insufficient food production of the region.

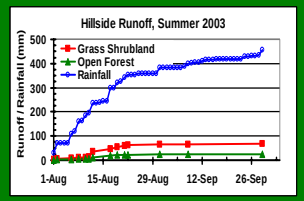
IWM Approach - An integrated watershed management (IWM) approach is currently being tested to rehabilitate and improve food security in the Lenche Dima watershed in Amhara State, Ethiopia. The major characteristics of the IWM approach are involvement of all stakeholders and holistic planning that addresses issues which extend across administrative boundaries, subject disciplines, and institutional divisions. As part of the IWM process, the communities in Lenche Dima have decided, among other things, to close parts of their hillsides from livestock grazing and to test technologies that improve soil quality and conserve soil moisture in their cropland.

Research Objectives - The study presented here tests the effectiveness of natural regeneration of vegetation on hillsides through controlled livestock grazing and techniques of improved cropland rainwater management through subsoil tillage and in-situ water harvesting on conserving soil and water resources and improving land productivity in the Lenche Dima watershed. This study is a component of a larger study of watershed hydrology and evaluation of the IWM approach.

Preliminary Results I: Hillsides

The photos to the right show hillsides at different stages of natural regeneration.

- **Runoff and Soil Loss:** Initial results presented in the graph and table to the right indicate significantly less runoff generation and erosion rates in protected wooded areas compared to free grazing grass shrublands.
- **Implications:** These results suggest that the community watershed management strategy of protecting hillside areas from free livestock grazing is effective in reducing erosive runoff. Reducing hillside runoff also functions in reducing gully formation and expansion and improves soil moisture in the croplands below.

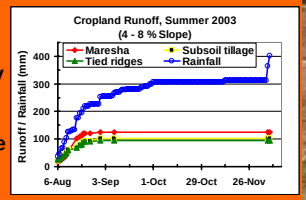


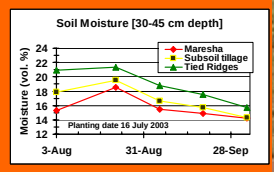
Hillside Soil Loss, Summer 2003

Land Cover	Suspended Sediment (t/ha)	Total Sediment (t/ha)
Grass Shrubland	2.0	7.3
Open Forest	0.6	2.2

Preliminary Results II: Croplands

- **Subsoil tillage** cuts the soil an extra 6-12 cm below the shallow plowing depth (8-15 cm) commonly achieved with the traditional "*maresha*" plow permitting rainwater to better infiltrate into the soil for crop uptake.
- **In-situ water harvesting** techniques such as tied-ridges store rainwater in the field giving the water more time to infiltrate into the soil.





- **Runoff, Soil Moisture and Land Productivity:** Initial results presented in the graphs and table to the right indicate less runoff, better soil moisture, and improved crop productivity with subsoil tillage and tied ridges compared with the traditional "maresha" plow.
- **Soil Loss:** From initial findings it appears that the increased soil disturbance of subsoil tillage and tied ridges on steep slopes results in more erosion than the traditional shallow tillage technique.

Cropland Soil Loss* and Land Productivity, Summer 2003

Land Preparation	Suspended Sediment (t/ha)	Total Sediment (t/ha)	Sorghum Grain (t/ha)	Sorghum Straw (t/ha)
Tied Ridges	13.4	2.4	1.43	7.01
Subsoil Tillage	16.6	1.7	1.90	7.98
Maresha	9.1	1.0	1.34	6.49

*Soil loss during August 6 – September 8, 2003

Conclusions

- Initial experimental results show that natural regeneration of vegetation by controlling livestock grazing is effective in reducing erosive runoff and degradation on hillsides.
- Cropland management options of subsoil tillage and tied-ridges are effective at conserving water for increased crop productivity, but appear to increase soil loss for the steeper areas in the watershed.
- Protecting watershed land and water resources and improving food production will require further assessments of these and other potential technologies and local community adoption and adaptation to achieve watershed-level impact.

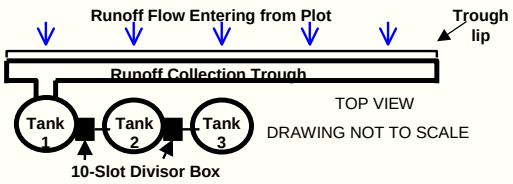
Materials & Methods

Study Site

Lenche Dima Watershed (1,546 ha) in Amhara State, Northeastern Ethiopia
Elevation Range: 1,465 - 1,900 m.a.s.l
Climate: 670 mm bimodal annual rainfall; 12 - 37 ^{o}C temperature range
Population density ~ 218 persons per km^2
Livestock density ~ 94 TLU per km^2

Experimental Setup

Runoff plots 30 x 17m (hillside), 30 x 6m (cropland)
Randomized complete block design (3 replications)



RUNOFF COLLECTION SYSTEM

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