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Integrated Watershed Management for Improved Food Security in the Ethiopian Highlands

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he Problem and Approach

roblem - High human and livestock population essures, highly variable and unreliable rainfall, and steep pography have accelerated the process of land egradation in the Ethiopian highlands. Rapid deterioration land quality is reducing the already insufficient food oduction of the region.

VM Approach - An integrated watershed management WM) approach is currently being tested to rehabilitate and nprove food security in the Lenche Dima watershed in mhara State, Ethiopia. The major characteristics of the VM approach are involvement of all stakeholders and olistic planning that addresses issues which extend cross administrative boundaries, subject disciplines, and stitutional divisions. As part of the IWM process, the ommunities in Lenche Dima have decided, among other ings, to close parts of their hillsides from livestock azing and to test technologies that improve soil quality nd conserve soil moisture in their cropland.

esearch Objectives - The study presented here tests e effectiveness of natural regeneration of vegetation on llsides through controlled livestock grazing and chniques of improved cropland rainwater management rough subsoil tillage and in-situ water harvesting on onserving soil and water resources and improving land oductivity in the Lenche Dima watershed. This udy is a component of a larger study of watershed ydrology and evaluation of the IWM approach.

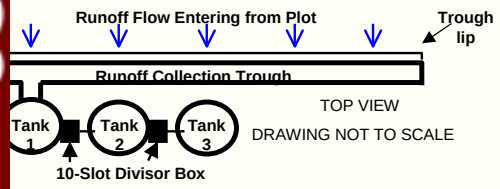
Materials & Methods

Site

e Dima Watershed (1,546 ha) in Amhara State, Northeastern Ethiopia
on Range: 1,465 - 1,900 m.a.s.l
e: 670 mm bimodal annual rainfall; 12 - 37 °C temperature range
tion density ~ 218 persons per km^2
ck density ~ 94 TLU per km^2

imental Setup

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

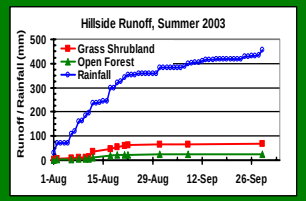


RUNOFF COLLECTION SYSTEM

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.

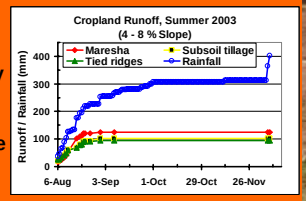


Hillside Soil Loss, Summer 2003

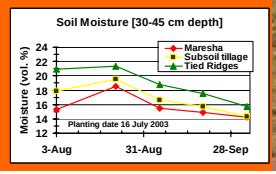
Land Cover	Suspended Sediment (t/ha)	Total Sediment (t/ha)
Grass Shrubland	2.0	7.3
Open Forest	0.6	2.2

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	5.49

*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.**

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REFERENCES

Rockstrom J., Barron J., Fox P. (2002). Rainwater management for increased productivity among small-holder farmers in drought prone environments. *Physics and Chemistry of the Earth*, 27, 949-959.

Sonneveld, B.G.J.S., Keyzer, M.A. (2003). Land under pressure: Soil conservation concerns and opportunities for Ethiopia. *Land Degradation & Development*, 14, 5-23.