Improving Water Availability Through Watershed Management

Policy Messages

- Adopting integrated watershed management through learning watershed approach enhances water availability by maximizing recharge and soil water storage, and minimizing evaporation, transpiration and surface runoff.
- The government and other stakeholders should work together to promote sustainable land use practices, adopt rainwater harvesting techniques, invest in water infrastructure, and strengthen cooperation among stakeholders.

1. What is the issue?

The Ethiopian highlands experience land degradation which results in loss of fertile soil, reduced land productivity, food insecurity, and reduced water availability for plants. To mitigate these effects and ensure food security, multiple programs and projects have been implemented over the past a few decades using various approaches and also with support from different development partners. One approach that is currently in use by the Water & Land Resource Center (WLRC), a research center affiliated to Addis Ababa University, is the learning watersheds (LWs) approach, which promotes local level capacity building and involves local communities, stakeholders, and institutions in watershed ecosystem management. The LWs initiative aims to strengthen technical, institutional, and knowledge management efforts for integrated watershed development. Watershed management plays a crucial role in reducing land degradation and biodiversity loss, which in turn positively impacts water resource availability. This policy brief presents empirical evidence on the relationship between watershed management and soil moisture availability, and provides recommendations on how to improve water availability through watershed management.

2. Approach and Setting

Researchers from WLRC in collaboration with the Rhodes University, South Africa, recently conducted a series of detailed field measurements and hydrological modeling of water availability in a micro-watershed (Aba Germia watershed in the Lake Tana sub-basin and with an area of about 900 ha) to determine the impact of watershed management on water availability. It was carried out by comparing water availability in the Aba Gerima watershed which is covered by watershed management treatments with nearby untreated control sites.

In the treated watershed, implementation of physical soil and water conservation measures has included construction of terraces on cultivated lands that cover 937 ha, treatment of gullies with check dams on 15 ha of land and rehabilitation of hillside vegetation on 61.5 ha (Figure 1). Biological methods are also utilized on an additional 1,458 ha of land to restore the watershed between 2012 and 2017. Integrated Watershed Management (IWM) activities included engaging the community for voluntary free labor to carry out the conservation measures. To prevent further degradation of severely degraded areas, they were closed off from human and animal interference. Free grazing was stopped since it contributes to land degradation. Homestead development was integrated into the activities through cost-sharing, including horticulture, fodder production, fattening, apiculture, poultry and compost preparation. Improved agricultural technologies such as improved seeds and farm machines were also demonstrated and provided to the watershed community.

To assess changes in water availability in the watershed, the researchers employed the Hydrus 1D modeling technique to analyze the water balance components. Various data, including in-situ volumetric soil moisture content and saturated hydraulic conductivity measurements, were collected from different soil layers (i.e., 100 mm, 200 mm, 300 mm, 400 mm) between 2017 and 2019. The collected data, along with other information, were used for Hydrus 1D modeling and analysis.

Figure 1. Watershed management activities in the Aba Gerima watershed: (a) physical soil and water conservation structure, (b) seedlings for rehabilitation of hillside vegetation, (c) biological measures planted on physical structure, and (d) cut and carry system under zero grazing

3. Research Findings

Hydrus 1D model was found to be effective in predicting results, with r2 values of 0.73 to 0.853 and RMSE values ranging from 0.015 to 0.04. Figure 2 clearly indicates that, sites treated with watershed management measures have high values of water availability parameters, such as soil water storage, with lower cumulative evaporation. The cumulative evaporation estimated for control sites was 37.6% higher than that of sites under watershed management. Site treated with area closure and physical conservation structure had better annual cumulative soil water storage (106.039 mm) than the control with 100.37 mm. In terms of cumulative evaporation also, closed area treated with physical conservation structure is better in preventing loss of stored soil moisture through evaporation (32.90 mm) as compared to that of the control site (46.97 mm). The soil water storage for sites under watershed management were higher for all sites except for cultivated land under gentle slope.

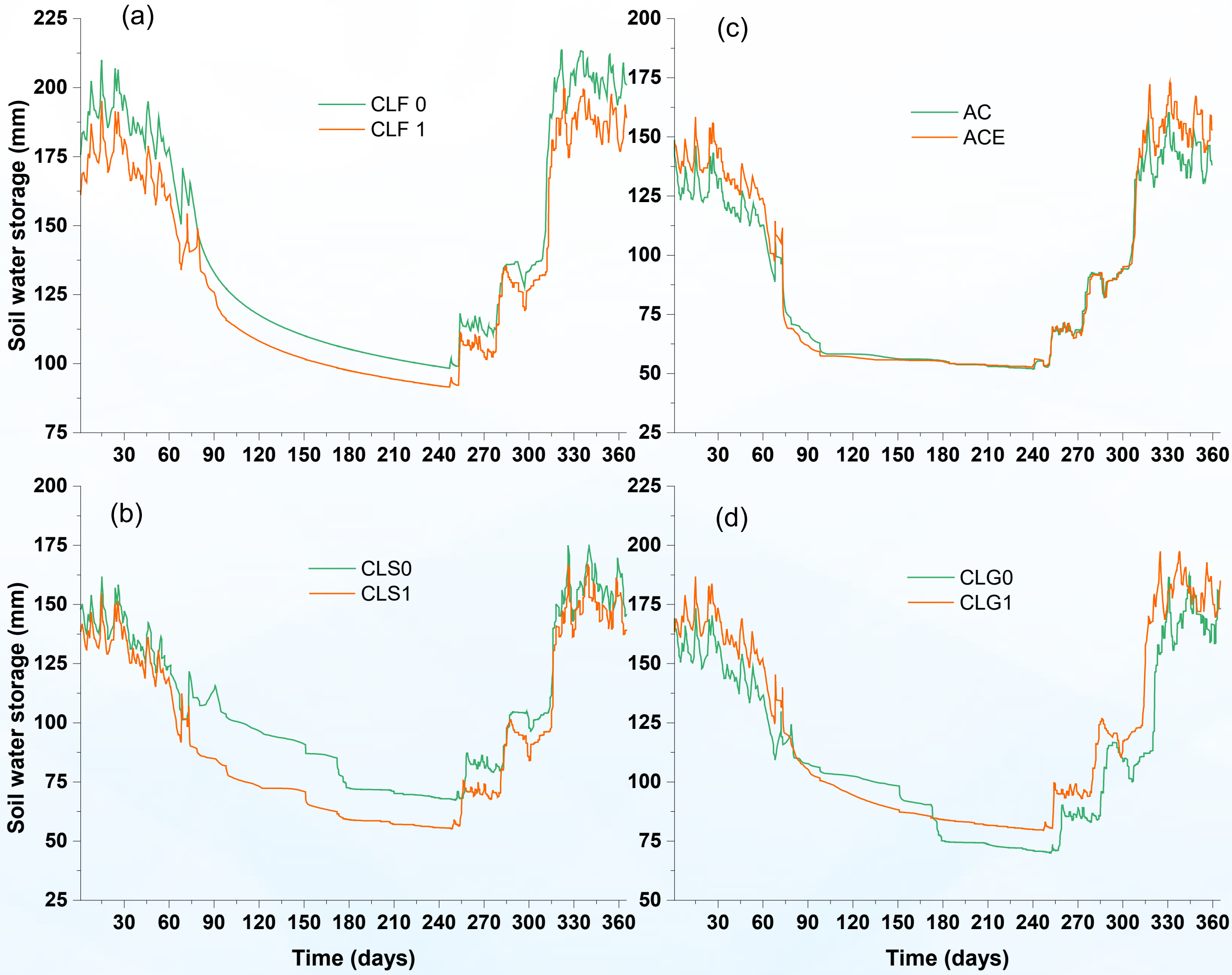

Figure 2. Soil water storage under treated versus control; The horizontal axis represents days from 23/08/2017 to 22/08/2018. (Notes: CL; cultivated land under (F) Flat, (G) Gentle, (S) Steep slopes; 0 = treated, 1 = control; AC, Area closure; ACE, Area closure with structures)

4. Conclusion

The findings demonstrate that watershed management improves soil water availability through maximizing recharge and soil water storage, and minimizing evaporation, transpiration and surface runoff. Water availability is critical to achieve sustainable agricultural development in the rainfed farming systems of Ethiopia. As shown by this study, adopting integrated watershed management approach enhances water availability. Ensuring long-term water availability requires consistent efforts and the involvement of all stakeholders. The government and other stakeholders should work together to promote sustainable land use practices, adopt rainwater harvesting techniques, invest in water infrastructure, and strengthen cooperation among stakeholders.

References

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