Soil Erosion and Land Suitability in the Womba Watershed: Policy Directions for Sustainable Land Management

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Executive Summary

Soil erosion is a major environmental challenge threatening agricultural sustainability in the Womba watershed, Southern Ethiopia. Recent findings show that the average annual soil loss rate is 10.84 t ha^{-1} yr^{-1}, while severely affected areas experience losses exceeding 163.58 t ha^{-1} yr^{-1}. These alarming rates indicate the urgent need for effective soil and water conservation measures. This policy brief explores the major findings of the study and proposes practical recommendations to reduce land degradation, improve land management practices, and promote sustainable agriculture. Implementing these measures will help enhance agricultural productivity and strengthen long-term food security in the study area and surrounding regions.

Keywords: Soil erosion, Land suitability, Policy directions, Sustainable land management

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1. Introduction

Soil erosion, driven by rainfall intensity, land use change, and unsustainable agricultural practices, represents a pressing environmental challenge in Ethiopia (Haile et al., 2025). According to these authors, the Womba watershed, characterized by rugged terrain, experiences severe soil degradation due to both natural and human-induced factors. This policy brief addresses the challenges of soil erosion in the watershed and emphasizes the need for effective soil and land management practices to enhance agricultural productivity, support sustainable land use, and maintain environmental sustainability.

2. Background Context

Study area setting

The Womba watershed is located between the GezeGofa and DembaGofa districts, about 155 km northwest of Arba Minch city in Southern Ethiopia (Haile et al., 2025). The watershed is characterized by steep slopes, rugged terrain, and elevations ranging from 1,407.5 m to 2,649.5 m above sea level. The area receives high annual rainfall, averaging 1,821.66 mm, which, combined with unsustainable land use practices, increases vulnerability to severe soil erosion (Haile et al., 2025).

Socioeconomic dynamic

The local community predominantly relies on subsistence agriculture. Rapid population growth has led to an increased demand for land, intensifying pressure on natural resources. Many farmers employ traditional farming methods that do not adequately address erosion risks, resulting in significant soil loss and reduced agricultural productivity (Haile et al., 2025).

3. Key Findings

Soil loss estimates

The study in the Womba watershed revealed severe soil erosion rates that vary across the area. Estimated soil loss ranges from 2.18 t ha^{-1} yr^{-1} in less affected areas to 163.58 t ha^{-1} yr^{-1} in extremely degraded areas (Haile et al., 2025). The average annual soil loss rate was estimated at 10.84 t ha^{-1} yr^{-1}, indicating substantial land degradation within the watershed. Areas classified

under severe erosion categories exceed the tolerable soil loss limits for sustainable land management (Hurni et al., 2008, Neitsch et al.,1997).

The high rates of soil erosion in these categories not only threaten the agricultural productivity of the area but also highlight the urgent need for immediate and effective intervention measures. Without prompt action to address these severe erosion issues, the sustainability of land resources and the livelihoods of local communities could be significantly compromised.

Land capability classification

The watershed is classified into four land classes based on erosion severity (Haile et al., 2025), Class I, which is considered less severe, covers approximately 64.3% of the area and is suitable for agricultural cultivation. Class II, labeled moderately severe, accounts for 25.6% of the watershed and can support a range of crops with appropriate land management practices. In contrast, Class IV is classified as highly severe, accounting for 7.8% of the land; this class is suitable for perennial crops and urban development (Haile et al., 2025). Lastly, Class VI is deemed extremely severe, representing 2.3% of the area and is designated for forest development and wildlife conservation.

These severe soil erosion rates threaten agricultural productivity, environmental sustainability, and local livelihoods in the watershed. The findings highlight the urgent need for effective soil and water conservation measures to reduce land degradation and ensure sustainable use of land resources.

4. Drivers of soil erosion

Topographyplays a critical role in soil erosion dynamics, particularly in the area characterized by steep slopes, like the Womba watershed. The rugged landscape significantly increases runoff rates during rainfall events, as water flows more rapidly down inclined surfaces. This swift movement of water not only displaces soil particles but also enhances their detachment from the ground, leading to increased soil loss (Gashaw et al., 2021). In steeply sloped areas, the rate at which soil is washed away, contributing to a cycle of degradation that can be difficult to reverse. Consequently, these topographical characteristics create a high risk environment for erosion, necessitating targeted conservation interventions to stabilize vulnerable areas Gashaw et al., 2021).

Land use change, particularly expansion of Sawla town and the conversion of agricultural land to build environments, have a profound impact on soil erosion in the Womba watershed (Haile et al., 2025). As the town area expand, natural vegetation is often cleared, removing the protective cover that helps anchor soil in place. This loss of vegetation leaves soil exposed to the forces of erosion, particularly during heavy rainfall events. Additionally, the conversion of agricultural lands for urban development typically involves significant alterations to the landscape, including grading and excavation (Usman et al., 2023). These activities disturb the soil structure and increase its susceptibility to erosion. As more land is taken out of agricultural production and converted to urban use, the overall potential for soil erosion increases, highlighting the need for sustainable land management practices that can mitigate these impacts (Usman et al., 2023).

Climate variability is another critical factor influencing soil erosion in the Womba watershed. Increased rainfall intensity, a consequence of changing weather patterns, poses significant risks to soil conservation efforts. Sudden and heavy downpours can overwhelm the soil's ability to absorb water, leading to surface runoff that carries soil particles away. This is particularly problematic in areas lacking adequate vegetation cover, where the absence of roots makes the soil more susceptible to erosion (Hurni et al., 2008). As rainfall events become more erratic and intense due to climate change, areas like the Womba watershed may experience heightened erosion risks, necessitating proactive measures to enhance soil resilience and reduce vulnerability.

The interaction between topography, land use changes, and climate variability creates a complex environment in the Womba watershed where soil erosion is pervasive (Haile et al., 2025). Addressing these drivers through comprehensive management strategies is essential for preserving soil health and ensuring sustainable agricultural practices in the area and beyond.

5. Conclusion

The findings indicate that soil erosion in the Womba watershed has exceeded tolerable limits in highly and extremely severe erosion areas, particularly in the northern and western parts of the watershed. These conditions threaten agricultural productivity, environmental sustainability, and local livelihoods. Therefore, urgent implementation of integrated soil and water conservation measures, landscape restoration, and sustainable land management practices is essential to

reduce land degradation, improve soil productivity, and strengthen long-term food security in the area.

6. Policy Recommendations

By adopting these recommendations, stakeholders can effectively address land degradation particularly, soil erosion, improve crop productivity, and ensure long-term food security in the area and beyond.

Implement soil and water conservation strategies

- ✓ Ministry of Agriculture, local government (district/woreda offices), and extension agents should promote agro-ecological practices such as terracing, cover cropping, and reforestation to reduce erosion.
- ✓ Local communities, farmer cooperatives, and watershed management committees (with support from NGOs and development partners) should establish community led initiatives that enable farmers to adopt sustainable agricultural practices and strengthen awareness of soil conservation measures across the watershed.

Enhance community engagement and education

- ✓ District and kebele educational experts and agricultural offices, together with development agents and NGOs should facilitate workshops on sustainable land use, soil management, and erosion control techniques to strengthen farmers' and community members' capacity to implement effective erosion-mitigation measures.
- ✓ Local farmers, farmer cooperatives, watershed committees, and community leaders should establish local cooperatives or forums that promo1te knowledge sharing and joint problem-solving for improved land management.

Establish monitoring and evaluation systems

- ✓ The responsible implementing bodies such as the Ministry of Agriculture/land and environment agencies, in collaboration with regional and district (woreda) offices, and GIS/remote-sensing technical units (e.g., universities or research centers) should develop a comprehensive GIS- and remote-sensing based database to monitor soil erosion dynamics over time. They should also conduct regular assessments to track changes and evaluate the effectiveness of soil and water conservation measures in the watershed and beyond.

- ✓ Local communities, farmer cooperatives, and watershed management committees should participate in data collection and field observations, strengthening local ownership and shared responsibility for soil conservation.

Strengthen legislative and institutional frameworks

- ✓ Federal/Regional government (Ministry of Agriculture and relevant land/environment authorities) should enact and enforce legislation that compels sustainable land use practices and regulates agricultural activities to reduce land degradation.
- ✓ Regional and district (woreda) authorities together with the land administration and natural resource management offices should provide institutional support (guidelines, coordination, and resources) to strengthen community led land management initiatives and empower local stakeholders.

Provide financial and technical support:

- ✓ Ministry of Agriculture, environment agencies, and district offices should allocate budget and technical resources to conservation programs focused on high risk erosion areas. They should also use grants and subsidies to incentivize farmers to adopt soil and water conservation practices based on land suitability standards
- ✓ Regional/district governments, together with responsible ministries and agencies should forge partnerships with NGOs and international organizations to mobilize technical expertise and additional funding for soil conservation projects.

Promote research and assessments:

- ✓ Invest in research that deepens understanding of soil dynamics and erosion processes in the region, while exploring integrated land management approaches that consider hydrology, climate change, and socioeconomic factors.
- ✓ Emphasize interdisciplinary collaboration among environmental scientists, agronomists, and community stakeholders to develop effective and sustainable land management strategies.

Utilize technological innovations

- ✓ Foster the application of advanced technologies such as satellite imagery for regular monitoring of soil erosion hotspots and assessing the effectiveness of conservation measures.
- ✓ Promote user-friendly mobile applications tailored for farmers that provide assistance in adopting best practices in soil management and report erosion incidents.

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