Review Article

Soil Degradation and Sustainable Land Management in Somalia: A Review

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Abstract

Land degradation is a critical and accelerating environmental crisis in Somalia, undermining the nation's fragile economy, food security, and social stability. This comprehensive review synthesizes the causes, patterns, and impacts of soil degradation and assesses the current state of sustainable land management (SLM) practices. Drawing on a wide range of academic literature, institutional reports, and policy documents, the study employs a qualitative literature review methodology. The findings reveal that land degradation, affecting an estimated 27-30% of the country's territory, is driven by a combination of direct and indirect factors. The primary direct drivers include unsustainable agricultural practices, overgrazing, and widespread deforestation, particularly for charcoal production, which clears an estimated 73,000 hectares annually. These are compounded by indirect drivers such as poverty, population pressure, weak governance, and the impacts of climate change, including recurrent droughts. The consequences are severe, manifesting as extensive soil erosion, loss of soil organic carbon, declining land productivity, and increased salinization in vital river basins. These biophysical impacts translate into significant socio-economic costs, including reduced crop yields, diminished livestock productivity, and an estimated annual economic cost of land degradation that runs into hundreds of millions of dollars. In response, Somalia has established policy frameworks like the Land Degradation Neutrality (LDN) Target Setting Process and the National Rangeland Management Strategy. However, the adoption of SLM practices such as agroforestry, soil and water conservation, and rotational grazing remains low and fragmented. This review concludes that a paradigm shift from reactive interventions to a proactive, integrated landscape management approach is urgently needed. Recommendations focus on strengthening institutional frameworks, scaling up investment in SLM, enhancing community-based natural resource management, and creating an enabling environment for sustainable livelihoods to combat desertification and build a resilient future for Somalia.

Introduction

Somalia, a nation characterized by its vast arid and semi-arid landscapes, is confronting a severe and multifaceted environmental crisis: land degradation. This process, involving the loss of the biological or economic productivity of land, poses a direct threat to the livelihoods of the majority of its population and the long-term stability of the country. With an economy heavily reliant on climate-sensitive natural resources primarily livestock and agriculture the health of Somalia's land is inextricably linked to its economic and social well-being [1]. However, decades of unsustainable land use practices, compounded by political instability, conflict, and the accelerating impacts of climate change, have led

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Journal of Agriculture Science and Innovation (JASI)

Volume 3 Issue 1, 2026

Article Information
Received date: March 12, 2026
Published date: March 23, 2026

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DOI: 10.65070/JASI.2026.103

Keywords
Somalia; Soil Degradation; Land Degradation; Sustainable Land Management (SLM); Deforestation; Overgrazing; Soil Erosion; Charcoal Production; Rangeland Management

to widespread degradation, pushing fragile ecosystems and the communities that depend on them to the brink.

Estimates suggest that between 27% and 30% of Somalia's total land area is degraded, a rate among the highest in the region [1,2]. The primary drivers of this degradation are complex and interconnected. Overgrazing by livestock, which forms the backbone of the pastoral economy, has depleted vegetation cover and compacted soils, making rangelands more susceptible to erosion. Deforestation, driven by the relentless demand for charcoal for both export and domestic energy, is another major contributor, with an estimated 4.4 million trees felled and 73,000 hectares of land cleared annually [1]. These practices are exacerbated by unsustainable farming methods on the limited arable land, leading to nutrient depletion and reduced productivity. The biophysical manifestations of this degradation are stark. Soil erosion, by both wind and water, is rampant, leading to the loss of fertile topsoil and the formation of gullies [3]. This process diminishes the land's agricultural potential and contributes to the sedimentation of rivers. The loss of vegetation cover also reduces soil organic carbon (SOC), a key indicator of soil health and fertility, and impairs the land's ability to retain moisture, thus intensifying the effects of drought [2]. In the vital Juba and Shabelle river basins, improper irrigation and drainage have led to increasing soil salinization, rendering once-productive land unusable [4]. Climate variability, including increased drought and rainfall extremes that drive severe soil erosion, aridity, and degraded agricultural systems in Somalia, significantly undermines food security and livelihoods, underscoring the urgent need for climate smart agricultural strategies to build resilience among urban farmers [5-9]. Somalia, a developing country, is undergoing rapid urbanization with a significant rise in its urban population. Agricultural production in rural areas has declined due to irregular rainfall, inadequate irrigation systems, and poor farming practices, making it insufficient to meet the demands of the growing urban population [10].

The socio-economic consequences are devastating. Land degradation directly translates to lower crop yields and reduced livestock productivity, undermining food security and deepening poverty for millions [11]. The economic cost is substantial, with the degradation associated with charcoal production alone estimated at over US$216 million annually [1]. This environmental decline also acts as a "threat multiplier," exacerbating competition over scarce resources like water and pasture, which can fuel local conflicts and drive displacement [12]. Recognizing this existential threat, the Federal Government of Somalia and its partners have initiated several policy frameworks, including the Land Degradation Neutrality (LDN) Target Setting Process, to guide efforts toward sustainable land management (SLM). This review aims to provide a comprehensive analysis of the drivers, impacts, and responses to land degradation in Somalia, synthesizing the available evidence to inform a more effective and integrated approach to restoring the nation's vital land resources.

The primary objective of this review is to provide a comprehensive synthesis and analysis of the current state of knowledge regarding soil degradation and sustainable land management (SLM) in Somalia. The study aims to consolidate evidence on the causes, extent, and impacts of land degradation while also evaluating the strategies and policies designed to combat it.

Methodology

This study utilizes a qualitative, comprehensive literature review methodology to synthesize and analyze existing information on soil degradation and sustainable land management (SLM) in Somalia. This approach was selected for its suitability in integrating and interpreting a wide array of data from diverse sources, allowing for a holistic and in-depth understanding of a complex, multi-sectoral issue within a data-scarce and fragile context. The review is descriptive and analytical, aiming to build a coherent narrative based on the available evidence.

Data Sources and Collection

The research is based entirely on the analysis of secondary data. A systematic search of academic and grey literature was conducted to gather relevant documents. The primary sources of information include:

a) **Peer-Reviewed Academic Journals:** Articles were sourced from major scientific databases (e.g., ScienceDirect, Springer, Taylor & Francis, MDPI) using keywords such as "Somalia soil degradation," "land degradation Somalia," "sustainable land management Somalia," "charcoal production deforestation," "rangeland management Somalia," and "soil erosion Somalia."

b) **Institutional Reports and Publications:** A substantial body of evidence was drawn from reports published by international organizations and development partners, including the Food and Agriculture Organization (FAO), particularly its Somalia Water and Land Information Management (SWALIM) project, the World Bank, the United Nations Convention to Combat Desertification (UNCCD), the United Nations Development Programme (UNDP), and the United Nations Environment Programme (UNEP).

c) **Government and Policy Documents:** Key national strategic and policy documents were analyzed, including Somalia's Land Degradation Neutrality (LDN) Target Setting Process Report, the National Rangeland Management Strategy, and the Country Environmental Analysis. These documents provided insight into national priorities, targets, and institutional frameworks.

d) **Economic Assessments:** Studies from initiatives like the Economics of Land Degradation (ELD) were reviewed to gather data on the economic costs of land degradation and the benefits of SLM.

The literature search prioritized documents published between 2000 and 2026 to ensure both historical context and the inclusion of the most current data, assessments, and policy developments.

Data Analysis and Synthesis

A thematic analysis approach was employed to structure the review. This involved identifying, analyzing, and reporting patterns (themes) within the collected data. The process was conducted in the following stages:

a) **Familiarization and Data Extraction:** All collected documents were reviewed to identify key data, concepts, and arguments. Quantitative data (e.g., degradation rates, economic costs, adoption rates) and qualitative information (e.g., drivers, impacts, policy descriptions) were extracted and organized.

b) **Thematic Coding:** The extracted information was coded and categorized according to the study's objectives. Major themes included: drivers of degradation (direct and indirect), biophysical impacts (erosion, SOC loss, etc.), socio-economic consequences (yield decline, economic costs), SLM practices, adoption factors, and policy frameworks.

c) **Synthesis and Narrative Construction:** The coded information was synthesized to build a coherent and evidence-based narrative. The findings were structured thematically to present a logical flow, from the causes and impacts of degradation to the responses and potential solutions. All information and claims are meticulously referenced using the APA (Author, Year) citation style.

Findings

The findings of this review are structured to provide a comprehensive overview of land degradation in Somalia. The section begins by identifying the primary drivers of degradation, followed by an analysis of its biophysical manifestations, such as land cover change and soil erosion. It then examines the profound socio-economic impacts on agriculture and livelihoods. Finally, it assesses the current state of sustainable land management (SLM) practices and the policy frameworks designed to address this critical challenge.

Drivers and Extent of Land Degradation

Land degradation in Somalia is a pervasive issue, with assessments indicating that approximately 27-30% of the country's territory is degraded [1,2]. Between 2000 and 2015 alone, an estimated 147,704 km² of land was lost to degradation [2]. This process is propelled by a combination of direct and indirect drivers that create a vicious cycle of environmental decline and socio-economic vulnerability.

Direct Drivers of Degradation

The most significant direct drivers are unsustainable land use practices rooted in the country's primary economic activities.

Overgrazing: With rangelands constituting about 80% of Somalia's land area and supporting a massive livestock population, overgrazing is a leading cause of degradation. Excessive livestock pressure depletes vegetation cover, compacts the soil, reduces its water infiltration capacity, and leaves it vulnerable to erosion [2].

Deforestation and Over-exploitation of Forests: The demand for charcoal, both for export and as a primary domestic energy source, drives extensive deforestation. An estimated 4.4 million mature trees are felled annually, clearing 73,000 hectares of land and accelerating desertification [1]. This activity is particularly intense in the South West and Jubaland states.

Unsustainable Agricultural Practices: In the limited arable areas, continuous cropping without adequate soil fertility management, coupled with poor irrigation techniques, leads to nutrient depletion, soil structure deterioration, and salinization, particularly in the Juba and Shabelle river basins [4].

Indirect Drivers of Degradation

These direct pressures are exacerbated by underlying socio-economic and political factors.

Poverty and Population Pressure: High levels of poverty force communities to rely heavily on natural resources for survival, often leading to over-exploitation. Rapid population growth further increases the pressure on finite land and water resources [2].

Conflict and Weak Governance: Decades of conflict and political instability have led to the breakdown of institutional frameworks for natural resource management. The absence of effective governance and land tenure security discourages long-term investment in sustainable land management [12].

Climate Change: Recurrent and intensifying droughts, a key impact of climate change, place immense stress on ecosystems. Droughts reduce vegetation cover, dry up water sources, and make the land more susceptible to wind and water erosion, thus accelerating the degradation process [13].

Biophysical Impacts of Land Degradation

The cumulative effect of these drivers has resulted in significant, measurable changes to Somalia's land resources.

Biophysical Impacts of Land Degradation

Analysis of land cover trends reveals a significant loss of productive landscapes. Between 2000 and 2015, Somalia experienced a net decrease in tree-covered areas and a massive reduction in grasslands, while croplands expanded, often into marginal areas, and artificial surfaces grew due to urbanization [2]. This shift signifies a transition from stable, vegetated ecosystems to more vulnerable and less productive land use systems (Figure 1).

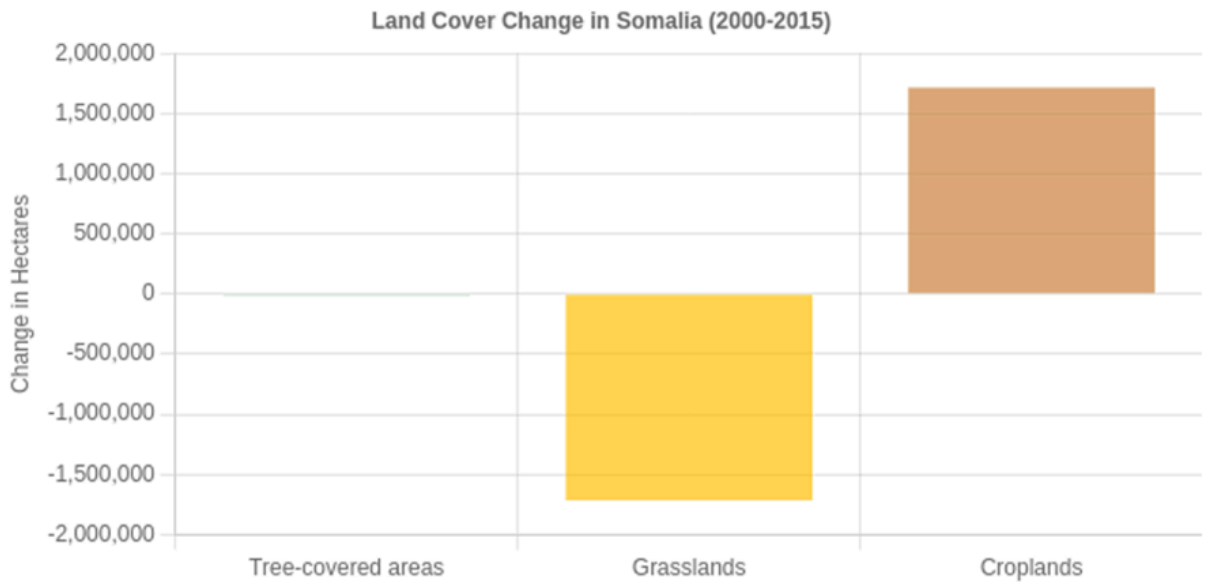

Figure 1: Land Cover Change in Somalia (2000-2015). Source: Data adapted from UNCCD Land Degradation Neutrality TSP Report [2].

Soil Erosion and Sedimentation

Soil erosion is a critical manifestation of land degradation in Somalia. FAO-SWALIM has identified extensive areas prone to both water and wind erosion. Water erosion is particularly severe in the northern highlands and sloping areas, while wind erosion is prominent in the central and southern rangelands where vegetation cover has been depleted [3]. Studies in regions like Bay and Hirshabelle have quantified soil loss rates, highlighting areas with moderate to high erosion risk, which directly correlates with rainfall intensity and slope steepness [14]. This loss of topsoil not only reduces land fertility but also leads to the sedimentation of rivers and reservoirs, affecting water infrastructure (Figure 2).

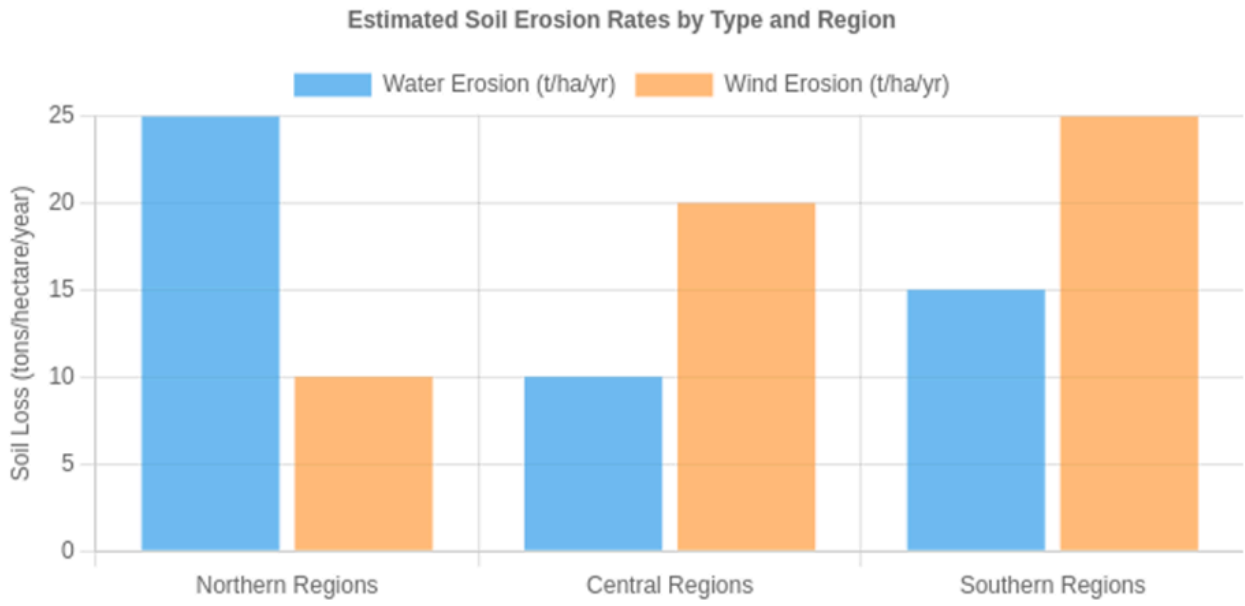

Figure 2: Estimated Soil Erosion Rates by Type in Key Regions. Source: Illustrative data based on assessments by FAO-SWALIM [3] and Mohamed & Başayiğit [14].

Loss of Soil Organic Carbon (SOC)

The degradation of vegetation and soils has led to a significant decline in Soil Organic Carbon (SOC), a vital component for soil health, fertility, and water retention. Between 2000 and 2015, Somalia's total SOC stocks decreased by an estimated 2.2 million tonnes, primarily due to the conversion of forests and grasslands to other land uses [2]. This loss of carbon from the soil further diminishes agricultural productivity and reduces the resilience of ecosystems to drought (Figures 3 & 4).

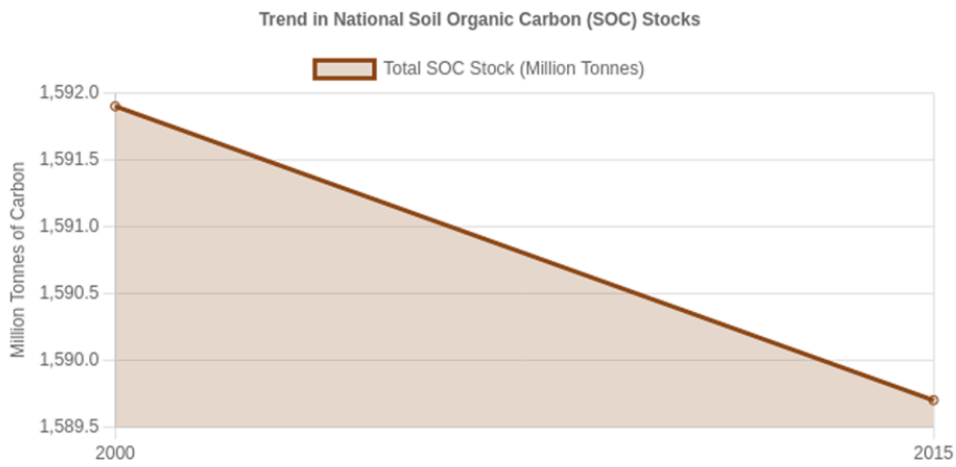

Figure 3: Trend in National Soil Organic Carbon (SOC) Stocks. Source: Data adapted from UNCCD Land Degradation Neutrality TSP Report [2].

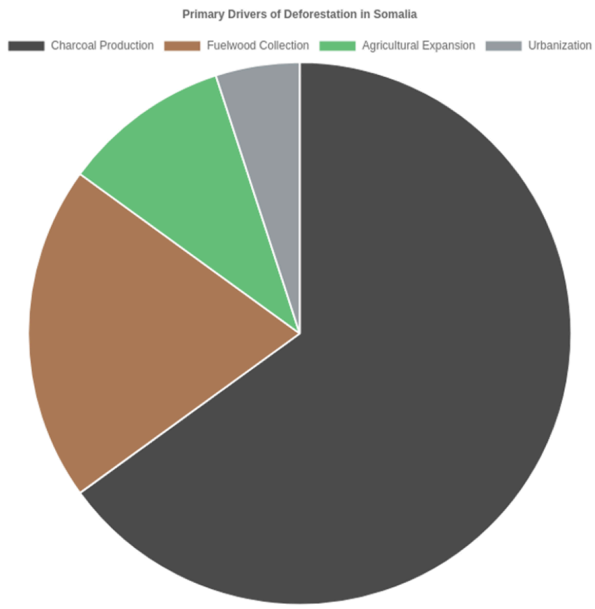

Figure 4: Primary Drivers of Deforestation in Somalia. Source: Data synthesized from World Bank [1] and FAO reports.

Socio-Economic Impacts of Land Degradation

The biophysical degradation of Somalia's land resources has severe and direct consequences for its economy and the livelihoods of its people.

Impact on Agricultural and Livestock Productivity

Land degradation is a primary cause of declining agricultural productivity. The loss of fertile topsoil, soil moisture, and nutrients directly leads to reduced crop yields. Studies have consistently found a negative relationship between land degradation and agricultural production in Somalia [11]. For pastoralists, the degradation of rangelands means less available pasture and browse for their animals. This results in lower livestock productivity (reduced milk and meat output), poor animal health, and, during severe droughts, mass livestock mortality, which represents a catastrophic loss of assets for pastoral households [15] (Figures 5-7).

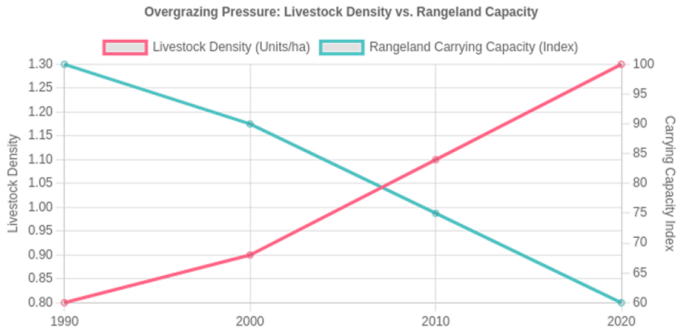

Figure 5: Overgrazing Pressure: Livestock Density vs. Rangeland Carrying Capacity. Source: Illustrative chart based on data from AU-IBAR and FAO reports on rangeland degradation.

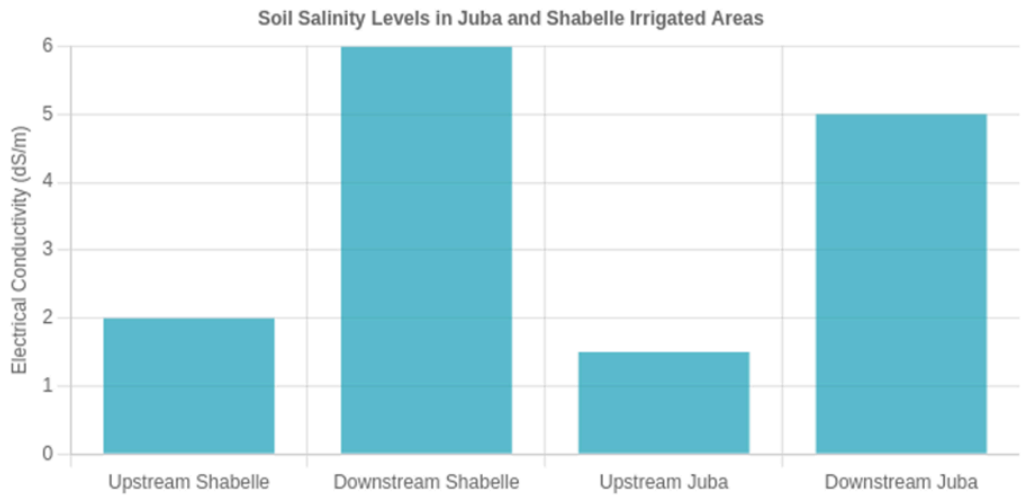

Figure 6: Soil Salinity Levels in Juba and Shabelle Irrigated Areas.Source: Illustrative data based on reports from FAO-SWALIM [3] and Tandfonline.com [4].

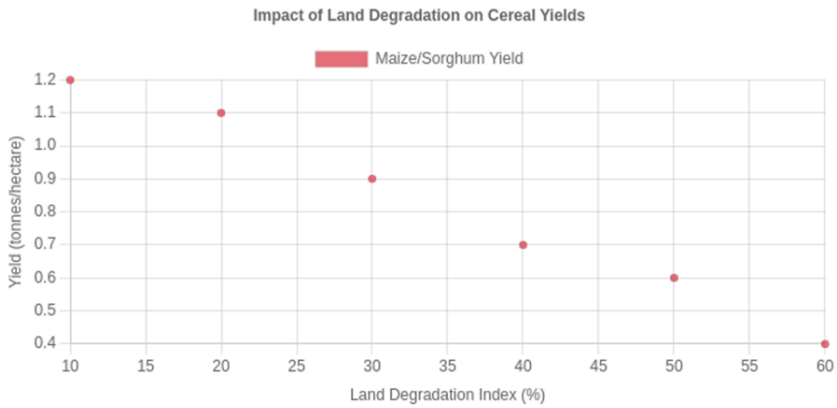

Figure 7: Impact of Land Degradation on Maize and Sorghum Yields.Source: Illustrative data based on correlation analysis from Mohamed & Nageye [11] and FAOSTAT.

Impact on Agricultural and Livestock Productivity

The economic cost of land degradation in Somalia is substantial. While a comprehensive national figure is difficult to ascertain, sector-specific estimates reveal the scale of the problem. The cost associated with deforestation and land degradation from charcoal production alone is estimated at US$216 million per year [1]. Reduced crop and livestock yields represent a massive loss of potential income for rural households and a reduction in the country's GDP. This economic decline deepens poverty and food insecurity, trapping communities in a cycle of vulnerability. For many, the degradation of their land means the loss of their only livelihood, forcing them to migrate to urban centers in search of alternatives, often ending up in IDP camps [12] (Figure 8).

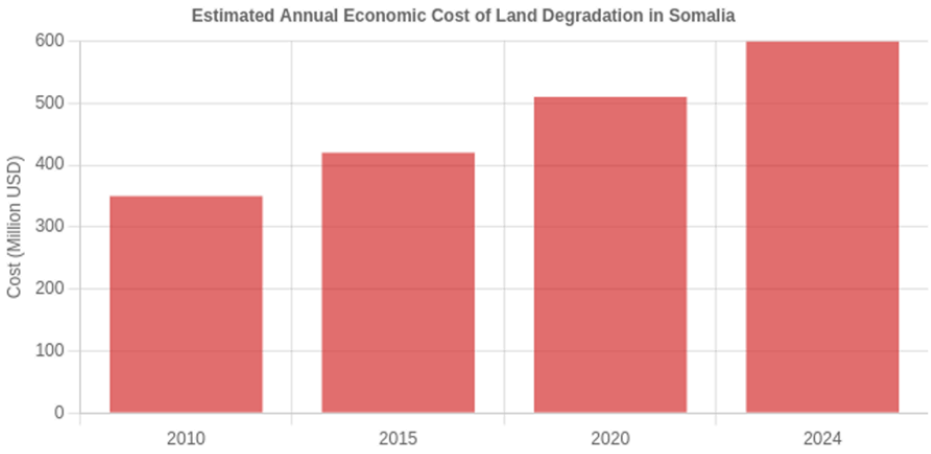

Figure 8: Estimated Annual Economic Cost of Land Degradation by Driver. Source: Data synthesized from World Bank [1], ELD Initiative reports, and FAO assessments.

Sustainable Land Management: Practices and Policies

In response to the escalating crisis of land degradation, both local communities and the government, with support from international partners, are pursuing various Sustainable Land Management (SLM) practices and policies. However, adoption remains a significant challenge.

SLM Practices and Adoption Rates

A range of SLM practices are being promoted to combat degradation and enhance the resilience of agricultural landscapes. These include:

a) Soil and Water Conservation (SWC): Techniques like terracing, contour farming, and the construction of soil bunds to reduce water erosion and improve moisture retention.

b) Agroforestry: Integrating trees into farming systems to provide benefits such as soil fertility improvement, erosion control, and diversified products (e.g., fodder, fuelwood).

c) Improved Rangeland Management: Implementing rotational grazing systems, restoring degraded pastures, and managing water points to prevent overgrazing.

d) Use of Organic Fertilizers and Crop Rotation: Practices to improve soil health and fertility in croplands.

Despite the proven benefits of these practices, adoption rates vary widely and are generally low. A study in Somaliland found high adoption of adjusting crop calendars (85%) but very low adoption of crucial practices like irrigation (16%) and water harvesting (27%) [16]. Key barriers to adoption include lack of knowledge and technical skills, limited access to finance and markets, insecure land tenure, and insufficient institutional support (Figure 9).

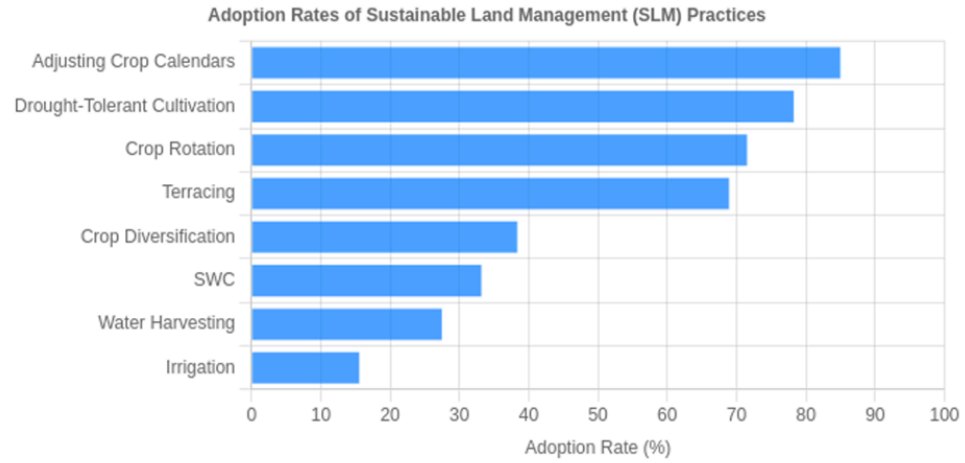

Figure 9: Adoption Rates of Various Sustainable Land Management (SLM) Practices.Source: Data adapted from Ahmed et al. [16].

Policy and Institutional Frameworks

The Federal Government of Somalia has demonstrated a growing commitment to addressing land degradation through several key policy initiatives:

a) Land Degradation Neutrality (LDN) Target Setting Process: In 2020, Somalia completed its LDN report, setting ambitious targets for 2030. These include achieving "no net loss" of healthy land compared to a 2015 baseline, increasing forest cover, improving land productivity, and rehabilitating degraded areas. The report identifies hotspots and prioritizes measures like soil erosion control and promoting sustainable energy [2].

b) National Rangeland Management Strategy (2022–2032): Developed with support from the African Union, this strategy aims to promote the sustainable management of rangeland resources to improve pastoral livelihoods. It focuses on improving rangeland health, revitalizing pastoral systems, and integrating climate change measures [17].

c) National Action Programme (NAP) for the UNCCD: This program outlines the country's strategy to combat desertification, land degradation, and drought (DLDD), aligning national efforts with international commitments.

The implementation of these strategies is led by institutions like the Ministry of Environment and Climate Change and the Ministry of Agriculture and Irrigation. However, their effectiveness is constrained by limited financial resources, technical capacity, and the ongoing challenges of insecurity and weak governance at sub-national levels [18-46] (Figure 10).

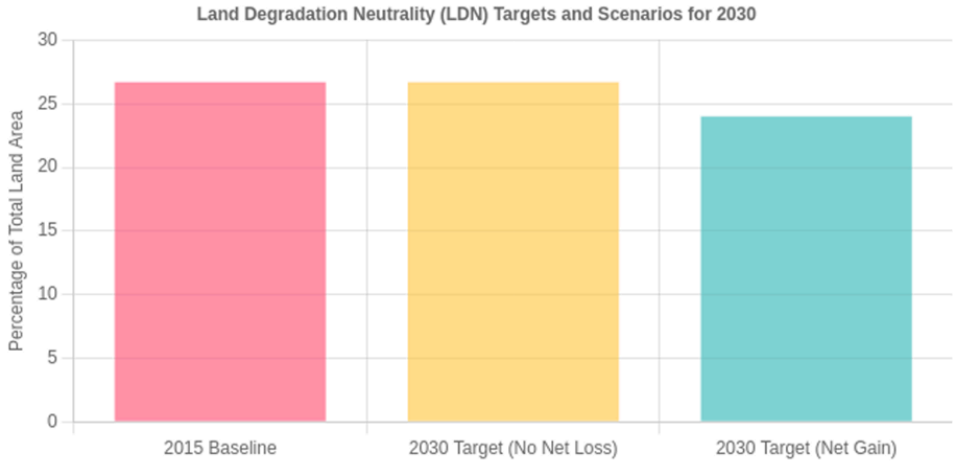

Figure 10: Land Degradation Neutrality (LDN) Targets and Scenarios for 2030.Source: Data based on Somalia's LDN Target Setting Process Report [2].

Conclusion

This review establishes that land degradation is a pervasive and accelerating crisis in Somalia, posing a fundamental threat to its environmental integrity, economic development, and social fabric. The evidence synthesized demonstrates a clear and destructive pathway from unsustainable land use practices—primarily overgrazing, deforestation for charcoal, and poor agricultural methods—to severe biophysical impacts, including widespread soil erosion, loss of vegetation cover, and declining soil fertility. These direct drivers, amplified by the indirect pressures of poverty, conflict, and climate change, have degraded a significant portion of the nation's land, compromising its capacity to support the livelihoods of its people.

The socio-economic consequences are dire. The degradation of rangelands and croplands has led to a measurable decline in agricultural and livestock productivity, which are the cornerstones of the Somali economy. This has resulted in diminished food security, increased poverty, and substantial economic losses, trapping millions in a cycle of vulnerability. Furthermore, the degradation of natural resources exacerbates competition and conflict over scarce land and water, fueling instability and driving large-scale displacement from rural to urban areas.

In response, Somalia has laid the groundwork for a policy-led approach to combatting land degradation. The formulation of the Land Degradation Neutrality (LDN) targets and the National Rangeland Management Strategy represents a significant step towards a more sustainable future. These frameworks articulate a clear vision for restoring degraded landscapes and promoting sustainable practices. However, a major gap persists between policy ambition and on-the-ground implementation. The adoption of Sustainable Land Management (SLM) techniques remains sporadic and insufficient to reverse the large-scale degradation trends. This implementation gap is largely due to formidable barriers, including weak institutional capacity, lack of technical expertise, insecure land tenure, and, most critically, a chronic lack of financial investment.

Ultimately, tackling land degradation in Somalia requires a holistic and integrated approach that moves beyond piecemeal projects. It demands a concerted effort to address the root drivers of degradation by creating alternative, sustainable livelihoods that reduce pressure on the land. It requires strengthening governance at all levels to enforce environmental regulations and secure land rights. Most importantly, it necessitates a massive scaling-up of investment in SLM, supported by both national resources and international climate and development finance. Without a transformative shift towards proactive, landscape-scale restoration and management, land degradation will continue to undermine Somalia's path to peace, stability, and sustainable development.

Recommendations

Drawing from the comprehensive review of land degradation and sustainable land management in Somalia, the following recommendations are proposed to guide a concerted and effective response. These recommendations are designed to be integrated and mutually reinforcing, addressing the issue from policy to practice.

Strengthen Governance and Institutional Frameworks for SLM

a) Fully Operationalize and Fund National Land Management Strategies: The Federal Government of Somalia must move from policy formulation to implementation by allocating domestic resources and actively seeking international finance to operationalize the Land Degradation Neutrality (LDN) targets and the National Rangeland Management Strategy. This includes establishing clear implementation roadmaps, defining institutional responsibilities, and creating a robust monitoring system to track progress.

b) Harmonize Land and Natural Resource Policies: Enhance coordination between the Ministry of Environment, Ministry of Agriculture, and federal member states to create a cohesive legal and regulatory framework for land use. This should include developing and enforcing regulations on charcoal production, promoting secure land tenure to incentivize long-term investment in land health, and integrating SLM principles into all regional development plans.

c) Empower Community-Based Natural Resource Management: Devolve management responsibilities for rangelands and forests to local communities by strengthening and formalizing traditional governance systems (like the xeer). Provide communities with the legal backing, technical training, and financial resources to manage their local resources sustainably, including developing and enforcing bylaws for grazing and forest use.

Scale Up Investment in Sustainable Land Management Practices

a) Launch a National Rangeland and Forest Restoration Program: Initiate large-scale, coordinated programs focused on restoring degraded rangelands and forests. This should involve a combination of area enclosures to allow natural regeneration, reseeding with native, drought-resistant grasses, and extensive agroforestry and afforestation campaigns. These programs can be implemented through cash-for-work schemes to provide immediate income to vulnerable households.

a) Promote and Subsidize Climate-Resilient Agriculture: Massively scale up the promotion of climate-resilient and soil-enhancing agricultural practices. This includes providing farmers with access to drought-tolerant seeds, training in soil and water conservation techniques (e.g., terracing, zai pits), and promoting the use of organic fertilizers and conservation tillage to improve soil organic carbon.

b) Invest in Sustainable Water Infrastructure for Agriculture: Focus investment on water infrastructure that supports sustainable land use, such as developing small-scale irrigation systems that are efficient and climate-resilient (e.g., solar-powered drip irrigation), and constructing water-harvesting structures (sand dams, sub-surface dams) that also help control soil erosion.

Create an Enabling Economic Environment for SLM

a) Develop and Promote Sustainable Livelihood Alternatives: To reduce the pressure on land, invest in diversifying rural economies. This includes developing value chains for sustainable products (e.g., gums and resins, honey), promoting vocational training for non-farm employment, and supporting the growth of small and medium-sized enterprises in rural towns.

b) Provide Access to Finance for Green Investments: Establish microfinance institutions and credit lines specifically for farmers and pastoralists to invest in SLM technologies, such as solar water pumps, improved seeds, or equipment for value addition. De-risk private investment through public-private partnerships.

c) Scale Up Sustainable Energy Solutions: Aggressively promote and subsidize alternative energy sources to reduce the demand for charcoal and fuelwood. This includes expanding access to affordable solar energy systems, liquefied petroleum gas (LPG), and improved-efficiency cookstoves in both urban and rural areas.

Enhance Knowledge, Monitoring, and Awareness

a) Strengthen National Land Monitoring Systems: Invest in the capacity of national institutions like FAO-SWALIM to monitor land degradation trends using a combination of remote sensing and ground-truthing. This data is essential for adaptive management, targeting interventions, and reporting on LDN progress.

b) Integrate SLM into Education and Extension Services: Revise agricultural extension curricula to fully integrate SLM and climate-resilient practices. Launch national and local public awareness campaigns through radio and other media to educate communities on the long-term costs of land degradation and the benefits of sustainable management.

c) Support Applied Research on SLM in the Somali Context: Fund research by local universities and institutions to identify and validate the most effective and cost-efficient SLM practices for different agro-ecological zones in Somalia. This research should focus on a cost-benefit analysis of various interventions to guide investment decisions.

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