Global Panel on Agriculture and Food Systems for Nutrition

Working Paper

Implications of Environmental Degradation for Food System Resilience in Sub-Saharan Africa*

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1 Introduction

Attaining global food security, nutritional diversity and resilience is bedevilled by several challenges including environmental degradation and climate change impacts. This is particularly worrisome for economies and governments in sub-Saharan Africa (SSA), where millions of households directly rely on agro- and land-based livelihoods. In this review, we highlight various ways in which food security and nutrition resilience are threatened by environmental degradation and we offer possible suggestions for ensuring more sustainable food systems resilience.

2 Sub-Saharan Africa – a region of high vulnerability

Sub-Saharan Africa is characterised by diverse cultural, historical, and socio-political contexts. The region accounts for approximately 14% of the world's total population. Several studies and global reports have identified the region as the most vulnerable to the changing climate.[1–3] This vulnerability arises from a combination of the continent's exposure to climate risks, the development pathways it has taken (grounded in historical patterns of resource extraction), and the region's very low adaptive capacity linked to acute levels of poverty and low infrastructural development.[1,3] The recent World Food Programme (WFP) 2025 Global Outlook suggested that over 170 million people face acute food insecurity across Sub-Saharan Africa.[4] The situation has been heightened by recent world events including the Russia-Ukraine war and other ongoing conflicts, and the ravaging effects of the COVID-19 pandemic. Access to sustainable, healthy diets is a major challenge with one in three persons in the region reported to be malnourished.[5]

Weak institutional and policy frameworks, market volatility, political volatility, and rapid urbanisation continue to undermine the protection of environmental resources, food system resilience and food sovereignty in the region. Other factors such as weak economic growth, gender inequality, high inflation, and low investment in irrigated agriculture, research and climate services have also been reported as major hurdles in sustaining food and nutrition security.[6]

3 Environmental degradation defined

Environmental degradation is defined as the deterioration of the environmental quality arising from human activities and processes including improper land use and land management practices, and cutting down of trees and the resultant undermining of biodiversity and the benefits nature provides to people. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) reported a significant decline in ecosystem services in Africa, where millions of households are heavily reliant on natural resource-based livelihoods.[7] This degradation trajectory looks set to continue under a business-as-usual approach.

3.1 Drivers of environmental degradation in sub-Saharan Africa

Human factors including poor agricultural practices, desertification, deforestation, and rapid population growth have been highlighted as key drivers of environmental degradation. These drivers occur against a background of colonial exploitation and resource extraction, leaving a complex legacy of political interests and power imbalances that influence property rights, how natural resources are managed and which societal groups 'win' and 'lose' today.

Unsustainable agricultural practices have been cited as a major driver of environmental degradation worldwide.[8] While acknowledging the immense increases in agricultural growth in sub-Saharan Africa compared to many other parts of the world, it is estimated that about 74% of the growth in agriculture has come through clearing of new areas rather than increases in yield.[9] This is despite advances in sustainable land management practices alongside technological developments such as precision irrigation, hybrid and drought tolerant crops and improved pest control measures. Jayne et al. (2019) report that the size distributions of farms in many African countries are changing rapidly and the majority of farmland in Africa is now medium-scale rather than small-scale.[10] The share of cropped area which is medium-scale farms (5-100 hectares) is around 50% in Ghana while in countries like Tanzania and Zambia, medium-scale farms account for 40% of the country's marketed agricultural produce.[10]

Using data from 41 African countries between 1996 and 2019, Ssekibaala and Kasule (2023) examined the poverty-environmental degradation nexus.[11] They found a cyclical relationship, suggesting that an increase in poverty leads to an increase in environmental degradation, especially in deforestation. Baloch et al. (2020) noted that endemic poverty compromises the survival options of the poor, and this induces them to over-exploit environmental resources at rates incompatible with long-term sustainability as immediate survival needs take priority over long-term environmental quality.[12] It has been suggested that poverty in the form of a lack of access to more sustainable alternatives drives the poor to engage in environmentally damaging behaviour, resulting in reduced soil and land productivity. Ultimately this degradation affects yields and food security.[13,14] Others have challenged the "downward spiral hypothesis" where the poor are viewed as agents of environmental degradation, arguing that this view may be too simplistic.[15] They point towards economic, social, and institutional failures as drivers of environmental degradation. While the poor may be the proximal agents of degradation, often their actions are shaped by demand for goods and services from elsewhere. As an example, shifts towards high value cash crops can introduce new vulnerabilities as traditional livelihood safety nets are lost.

3.2 Current trends in environmental degradation in Africa

The rate of environmental degradation across Africa is a cause for alarm. A 1995 report by the Food and Agriculture Organization (FAO) of the United Nations and the United Nations Environmental Programme (UNEP) on land degradation in Africa revealed serious levels of desertification, especially among the countries north of the equator.[16] Across semi-arid West Africa, the report suggested that the combination of climate change and poor land management were expanding desert margins by an annual rate of 5 km. A more recent report suggested that the Sahara Desert is now expanding southwards at a rate of 48 km per year.[17] This land degradation and soil erosion results in a reduction in the production potential of 20 million tons of grain and affects 1.5 billion people, many of whom are already in vulnerable situations. [18,19] The IPCC has highlighted the complexity of the relationship between climate change and land degradation and notes the essential role of groundwater and soil water in North and West Africa in supporting net primary productivity. [20]

The rate at which forest loss is occurring is a major concern as forests provide a vital source of food and livelihoods for millions in the region, as well as presenting a critical safety net during times of crop failure. Mapulanga and Naito (2019) note that sub-Saharan Africa experienced rapid

deforestation of approximately 3.4 million ha/year between 2000 and 2010, while in 1990, the average annual decline in forest area was 0.45% compared to 0.60% for the period 2010 to 2018.[21,22] According to a report by the UN FAO, the rate of deforestation increased to 7.2 million hectares per year between 2010 and 2020.[23,24] Despite some uncertainties, the trajectory points in the same direction: toward extensive and rapid forest loss. The FAO estimate that over 10 million hectares around the Saharan must be restored each year to achieve land degradation neutrality by 2030.[25]

4 Understanding food security and food system resilience

The definition of food security has evolved over the years but generally denotes a situation where individuals possess the physical, social and economic access to sufficient and nutritious food that meet their dietary preferences and requirements. Food systems are social–ecological systems, comprising the activities involved in food production, processing and packaging, distribution and retail, and consumption.[26] Resilience thinking can contribute to addressing the complexity associated with food security and sustainable food systems.[27] Food system resilience denotes the ability of a food system to maintain its essential functions and productivity while providing adequate and nutritious food to the population, in the face of shocks and stressors.[28] Thus, a resilient food system is capable of buffering disruptions that may be occasioned by external factors including environmental and non-environmental challenges. International organisations including the FAO and the International Food and Policy Research Institute (IFPRI) have put the need for resilience at the forefront of their activities. Much of the focus has been on resilience in agricultural production, with close links to natural resource management.

5 Impacts of environmental degradation on African food security

There are several pathways through which environmental degradation compromises food systems resilience. Environmental degradation has destroyed farmlands, reducing the land area available for crop production, leading to reduced yields. Between 2015 and 2023, land degradation caused a loss of 163 million hectares in sub-Saharan Africa.[29] Declining production of major food crops including staples has serious repercussions for food availability and stability, particularly when higher prices compromise poorer households' ability to access food.[30] Inadequate access to nutritious food has serious effects on the social, physical, and cognitive well-being of individuals and can disrupt social balance.

Increasing temperatures and erratic rainfall patterns associated with anthropogenic climatic changes decimate food systems by directly impacting soil fertility, and thereby crop yields and food production, food-nutrient composition and bioavailability.[3,31] The dramatic loss of biodiversity due to environmental degradation is also eroding genetic diversity, which is critical for the continued improvement of crop varieties and livestock breeds.[3,32] These changes can significantly reduce the availability of vital macro- and micronutrients in the global food supply, as biodiversity loss and ecosystem degradation weaken soil quality and hinder crop growth. [31,33]

Environmental degradation also affects water resources.[34] Many people in SSA suffer from malnutrition and other health risks related to contaminated or insufficient safe water which adversely impact on human health.[35] The World Bank estimates that by 2017, of the 660 million

people who were without safe drinking water globally, 323 million (representing 46%) lived in SSA.[36] Polluted water can contaminate foods such as vegetables, particularly in a context of weak governance and enforcement around vegetable production. The lack of safe water coupled with poor sanitation and sewerage systems allow the outbreak and spread of infectious diseases such as cholera and dysentery.[37] This can lead to retarded growth and other developmental challenges for infants and young children.[38]

There is also feedback and interaction between environmental degradation and soil health. Environmental degradation can exacerbate vulnerabilities to other climatic and non-climatic stressors in most parts of Africa. For example, degraded soils may have lower cation exchange capacity and less soil organic carbon, and therefore reduced ability to retain water and other essential nutrients. This can worsen the vulnerabilities of smallholder farmers who may be cultivating such lands, who not only lose out from lower yields, but are also more exposed to other environmental risks.

Different socioeconomic groups are affected in different ways by environmental degradation and its impacts on food and nutritional security. Women, the youth, elderly and migrant farmers can often be disproportionately affected because of their lack of productive resources and capital assets needed to address the effects of environmental degradation.[39] For example, customary land tenure arrangements in many African countries exclude women from ownership of productive lands and decision-making, leaving them more vulnerable to the adverse impacts of environmental and land degradation and climate change effects. In turn, this can affect their capacities to adapt.

6 Improving food system resilience in sub-Saharan Africa

Against the background of adverse impacts of environmental degradation on food system resilience, several ways forward to tackle these challenges are highlighted.

6.1 Transformation in food systems

Feeding an increasing global population in a sustainable and ethical manner in a world characterised by climate changes and rapid environmental degradation requires substantial transformation in the way food systems are organised. Falcon et al. (2022) estimated that global food demand will increase by 50-60% increase between 2019 and 2050.[40] This will be a huge challenge and no one-size-fits-all approach or policy will be sufficient to achieve it. Stringer et al. (2020) offer different development and adaptation pathways for farmers to address climate change effects and other non-climatic stressors, recognising that different types of farmers are starting with very different resources, capabilities and needs in adapting their farming system to be more sustainable.[41] For smallholders, there is the need to ensure inclusive and sustainable agri-food system transformation.[42]

6.2 Sustainable food production systems and practices

With millions of low-income households relying on land-based livelihoods for subsistence, it becomes increasingly important for governments and development agencies to embrace and promote sustainable agricultural practices and strategies that support both food security and environmental quality. Sustainable agricultural practices such as climate smart agricultural interventions and agroforestry practices are critical to ensuring food security, nutrition resilience and self-reliance

within the agricultural sector while promoting environmental stewardship.[43,44] Urgent challenges remain in ensuring an equitable approach, particularly when technological advances in irrigation, digital agriculture and gene edited crops are considered. In parts of sub-Saharan Africa where large-scale, intensive agri-production occurs, these technologies are often more accessible to large multinationals. Here, inequalities in food security can be exacerbated. Even the most productive small-scale farmers will find it difficult to exit poverty given their small plot sizes and for some farmers, their best chance to achieve food security will instead require an exit from agriculture.[41]

6.3 Functioning and institutional frameworks

Weak institutional and policy frameworks and a lack of proper coordination among different state and non-state agencies have been cited as key drivers of food systems challenges. There is an urgent need to provide the proper architecture that allows state and non-agencies to function effectively in addressing bottlenecks in the African food system. Community-based natural resource management such as communal grazing has been shown to reduce degradation, while more secure land tenure can spur farmer investments in sustaining environmental quality. This is particularly important to view through a gender lens as women often experience insecure tenure and marginalisation in decision-making.

6.4 Nature-based solutions for addressing food systems challenges

Nature-based solutions (NbS) have emerged from the search for innovative solutions to manage natural systems in a way that can balance the benefits for both nature and society and are defined as 'actions to protect, sustainably manage, and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits'.[45,46] Studies have highlighted the potential of NbS to restore biodiversity, while also contributing to the management of sustainability challenges relating to climate change and urbanisation.[47,48] It has also been reported that NbS can improve psychological, mental and nutrition-related health outcomes.[49] Smallholders should be empowered to manage natural regeneration efforts at the local level. Additionally, local knowledge on pollinators and natural enemies possessed by smallholder farmers and ecologists should be properly harnessed to address food system resilience and nutritional challenges.

6.5 Promoting digital technologies for sustainable agriculture

There is emerging evidence on the use of digital technological such as big data, the Internet of Things, and artificial intelligence for the promotion of agricultural productivity.[50,51] However, the use of digital technologies is limited in many parts of Africa. This poses significant challenges in addressing the lower productivity arising out of the combination of climatic and non-climatic stressors. There is an urgent need to address deficits in digital technologies to address environmental degradation challenges. Farmers should be seen as critical participants in the digital economy and the necessary infrastructure provided to facilitate this, while ensuring that existing inequalities are not exacerbated and that new ones are not created. Bronson and Knezevic (2016) have argued that there is a risk of reproducing current power imbalances, to the benefit of large corporations, while Carolan (2017) suggests that digital technologies could lead to a loss of autonomy and knowledge and promote high capital agriculture. [52,53]

6.6 Adopting a nexus approach

Recognising the adverse effects of environmental degradation on food security, there is a need to adopt a nexus approach that ensures the utilisation of water and land resources for food production do not necessarily comprise environmental integrity but rather promote synergies and co-benefits. It is particularly important to ensure that policies are coherent in addressing possible trade-offs while promoting synergies. Antwi-Agyei et al., (2017) offer examples of how these could be achieved, including strengthening of national institutions such as Ghana's Environmental Protection Agency to provide appropriate mechanisms to ensure effective collaboration amongst climate-sensitive sectors and by nominating "climate champions" in sector ministries.

6.7 Knowledge sharing on agricultural innovations

Addressing food systems and nutritional challenges requires a strong community and well-functioning civil society that provides resources and knowledge-sharing on agricultural innovations. This can be done through peer learning mechanisms such as farmer-to-farmer learning. The presence of well-developed social support systems and civil society requires the creation of an enabling informational sharing infrastructure for sharing information on agricultural practices and knowledge.[54]

6.8 Empowering local smallholder farmers

Food systems in Africa remain dominated by smallholders. These farms are characterised by traditional farming practices with little mechanisation. It is therefore important that local farmers are empowered by having ready access to farm inputs at a subsided price. Mechanisms should also be put in place for local smallholders to access credit facilities and be supported with technical assistance in addressing challenges associated with farming in a region characterised by change.[55] Aside from the provision of digital technologies that can help bolster food production, improve environmental quality and transform rural development, access to timely climate information through digital platforms is also important and should be vigorously pursued.[56,57]

6.9 Building nutrition resilience through 'forgotten' indigenous food crops

Current projections suggest that extreme events will compound already precarious food systems and nutrition resilience challenges across Africa. One important way of addressing these challenges will be the adoption and promotion of 'forgotten' food crops that are well adapted to grow in nutrient deficient soils and thrive in the face of extreme weather.[58] These 'forgotten' food crops have the potential to contribute to the provision of healthy diets for a fast-growing population and could help contribute to more climate-resilient and nutrient-sensitive food production.

7 Concluding remarks

Addressing food security and ensuring nutrition resilience are critical to the health and well-being of people across Africa. There are serious challenges that need to be surmounted, particularly if SDG 2 (Zero Hunger) is to be achieved. This paper has emphasised the extent of climate change and environmental degradation challenges. It has also highlighted the drivers of environmental degradation with emphasis on deforestation, and poverty.

Environmental degradation adversely impacts African food system resilience through several pathways and mechanisms and links closely to biodiversity losses and climate change effects. Notable among our recommendations to improve food system resilience and enhance environmental quality are the need to transform the food supply, adopt sustainable food production systems and practices, adopt nature-based solutions, widen the uptake of sustainable digital technologies, and to adopt a nexus approach to maximise synergies and reduce trade-offs in sectoral planning by governments. The need to promote knowledge sharing on agricultural innovation, empower local smallholder farmers, and incorporate knowledge on "forgotten" food crops that can grow in nutrient deficient soils of many African food production systems is also critically important.

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