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MITIGATING SOIL EROSION AND ENHANCING AGRICULTURAL PRODUCTIVITY IN BOKI L.G.A., CROSS RIVER STATE, NIGERIA.

Uquetan, I. Uquetan; Itu, Prince-Charles O.; Amah, J Etim; Ochang, Marcel O. & Udousoro, Idorenyin L. Ozoh, Sylvanus Iwora
Department of Environmental Resource Management, University of Calabar, Calabar
Corresponding author: princecharlesominitu@gmail.com

Abstract

Soil erosion presents a significant environmental threat to agricultural productivity in Boki Local Government Area (L.G.A.), Cross River State, Nigeria. This study explores the challenges posed by soil erosion on farming activities and assesses the effectiveness of various mitigation strategies aimed at enhancing agricultural productivity in the Boki LGA. It was hypothesised that there is no significant relationship between the severity of erosion menace and the decline in agricultural productivity within the Boki Local Government Area (L.G.A). Employing the survey research design, the study integrates both qualitative and quantitative approaches to capture a comprehensive understanding of the issue. Data were collected through structured questionnaires administered to 384 farmers, interviews with agricultural officers, and community leaders, as well as the analysis of secondary data from government reports and satellite imagery. Geographic Information Systems (GIS) were utilized to map the most erosion-prone areas, identify patterns of land degradation, and evaluate the success of erosion control measures. The findings reveal that soil erosion significantly reduces agricultural productivity in Boki L.G.A. by degrading fertile land, reducing arable farmland, and diminishing crop yields. Erosion is exacerbated by steep slopes and heavy rainfall, particularly in areas with insufficient vegetation cover. The study further highlights the socio-economic impacts of erosion, including the displacement of farmers, loss of income, and increased food insecurity in the sampled communities. However, evidence from the field demonstrates that mitigation efforts such as reforestation, the use of contour farming, and soil conservation techniques have shown promise in controlling erosion and improving farmland conditions. The research concludes that sustainable land management practices and government intervention are critical in addressing the ongoing challenges of soil erosion in Boki L.G.A. The study recommends increased investment in soil conservation programs, capacity-building for farmers, and the implementation of community-led initiatives to enhance agricultural resilience in the face of erosion.

Keywords: Soil erosion; Agricultural productivity; Mitigation strategies; Geographic Information Systems (GIS); Sustainable land management.

1. Introduction

Agriculture remains a critical contributor to the global economy, accounting for approximately 4% of the world's GDP and providing employment for over 26% of the global workforce (Anderson, & Ponnusamy, 2023). Countries such as Brazil, India, and China have heavily invested in agriculture, significantly boosting their economies. For instance, Brazil's investment in soybean

production has made it the largest global exporter, contributing over $33 billion to its economy in 2020 (Raihan, Tanchangya, Rahman, & Ridwan, 2024). Similarly, India's Green Revolution transformed its agricultural sector, leading to food self-sufficiency and improved rural livelihoods. However, soil erosion poses a serious challenge to these agricultural gains. In China, soil degradation affects 40% of its farmland, leading to a 10-15% reduction in grain output (Yu, Bai, Zhao, Zeng, Wang, Wang, & Shi, 2024). In Nigeria, erosion in the southeast has resulted in the loss of fertile lands, undermining agricultural productivity despite substantial investments (Iwuchukwu, Ewuzie, Ajala, Ojukwu, Nnorom, Egbueri, & Ighalo, 2023).

Erosion, both natural and human-induced, poses a significant threat to agricultural productivity worldwide (Quinton, & Fiener, 2024). The impact of erosion on agricultural lands can be devastating, leading to loss of topsoil, reduced soil fertility, and decreased crop yields (Ekka, Patra, Upreti, Kumar, Kumar, & Saikia, 2023). Soil erosion removes the nutrient-rich top layer of soil, which is essential for plant growth and sustenance (Musa, Samuel, Adams, Abdulsalam, Nathaniel, Maude, & Tiamiyu, 2024). As a result, farmers may experience lower yields and struggle to maintain the productivity of their lands (Tesfaye, Lengoiboni, Zevenbergen, & Simane, 2023). Furthermore, erosion can alter the physical structure of the soil, leading to compaction and reduced water infiltration rates. This often time results in poor drainage, increased runoff, and soil moisture deficits, all of which can negatively affect crop growth and development. In areas prone to erosion, farmers face challenges in managing water resources effectively, leading to decreased agricultural productivity and increased vulnerability to droughts and other extreme weather events (Ndegwa, Gichimu, Mugwe, Mucheru-Muna, & Njiru, 2023).

Soil erosion has a profound impact on agricultural productivity across many African countries, reducing the fertility of farmland and leading to significant losses in crop yields (Junaid, & Gokce, 2024). In Ethiopia, for instance, an estimated 1.5 billion tons of soil are lost annually, resulting in an 8% reduction in crop yields, which exacerbates food insecurity (Mrabet, 2023). Similarly, in Nigeria, soil erosion in regions like southeastern Nigeria has led to the loss of nearly 30% of farmland, drastically reducing agricultural output and threatening rural livelihoods (Okenmuo, Ibeh, & Obalum, 2023). In Kenya, erosion affects approximately 72% of arable land, reducing productivity by up to 15% in heavily degraded areas (Feeney, Robinson, Thomas, Borrelli, Cooper, & May 2023). These figures highlight the severe threat soil erosion poses to agricultural sustainability in Africa, as it not only depletes soil nutrients but also limits the availability of productive land, leading to food shortages and economic instability.

Soil erosion is a pervasive issue across many states in Nigeria, with severe implications for agricultural activities. In the southeastern region, states like Anambra and Imo are particularly affected by gully erosion, which has led to the loss of thousands of hectares of arable land, significantly reducing agricultural productivity and threatening food security (Okoronkwo, Ozioko, Ugwoke, Nwagbo, Nwobodo, Ugwu, & Mbah, 2024). In the northern states such as Kano and Katsina, wind erosion, exacerbated by desertification, has degraded vast expanses of farmland, making it difficult for farmers to sustain crop yields (Akanwa, Banerjee, Jhariya, Muoghalu, Okonkwo, Ikegbunam, & Madukasi, 2023). In southwestern Nigeria, water erosion affects states like Oyo and Ogun, causing land degradation and loss of soil fertility, which further reduces crop

output (Iwuchukwu, Ewuzie, Ajala, Ojukwu, Nnorom, Egbueri, & Ighalo, 2023). The socio-economic losses associated with soil erosion are substantial, as farmers not only lose valuable land but also face declining incomes, displacement, and increased poverty. In Cross River State, for instance, erosion has led to significant population displacement and reduced access to agricultural land, resulting in heightened food insecurity and economic strain (Prince, Nzechie, Obiorah, Ehi, & Idakwoji, 2023). These regional variations in erosion types highlight the pressing need for targeted interventions to mitigate the socio-economic impacts of soil erosion on Nigeria's agricultural sector.

Agricultural activities play a vital role in Cross River State's economy, with a significant portion of the population engaged in farming. The state is known for its cultivation of diverse crops, including cocoa, oil palm, cassava, yam, maize, and rice, which are produced both for local consumption and export (Ndem, Walter, Ovat, Henry, & Peter, 2023). Cocoa production, in particular, positions Cross River as one of Nigeria's leading cocoa-producing states, contributing to foreign exchange earnings. Additionally, cassava farming supports numerous agro-processing industries, creating jobs and boosting the local economy. The socio-economic benefits derived from agriculture extend to improved livelihoods for residents, food security, and increased government revenue through taxes and export earnings (Owenda, 2024). However, despite these gains, soil erosion has increasingly impacted agricultural activities in the state. Severe erosion, particularly in areas like Boki and Obubra, has led to the loss of fertile farmland, reduced crop yields, and displacement of farmers, ultimately threatening the sustainability of agricultural production and its associated benefits.

This study examined the pressing issue of soil erosion in Boki Local Government Area (L.G.A.), an agricultural zone where agriculture is a primary source of livelihood. Boki L.G.A. is known for its fertile land and favorable climate, which support the cultivation of crops like cocoa, yam, and cassava. However, the growing incidence of soil erosion has increasingly threatened agricultural productivity in the area, leading to reduced farmland, lower crop yields, and heightened food insecurity. By assessing the impact of soil erosion in Boki, this study pry into the extent of land degradation and its socio-economic consequences for local farmers, many of whom are heavily reliant on agriculture for their livelihoods. Additionally, the study also made recommendations for mitigating the effects of erosion, such as sustainable land management practices, which are critical for preserving the agricultural potential of Boki LGA. Given that agriculture is a key driver of economic activity in Boki, understanding and addressing soil erosion is essential for ensuring long-term food security, economic stability, and sustainable development in the area.

2. Literature review

2.1 Impact of Soil Erosion on Crop Yields

Soil erosion is a critical environmental issue that adversely affects crop yields by removing the nutrient-rich topsoil essential for plant growth. Studies have consistently demonstrated that erosion leads to a significant decline in soil fertility, which directly impacts agricultural productivity. For instance, an analysis by Yadav, Singh, Babu, Madegowda, Singh, Mandal, & Kumar, (2024), found that soil erosion can reduce crop yields by up to 50% in severe cases, primarily due to the loss of essential nutrients

and organic matter. Furthermore, Musa, et al., (2001) highlight that continuous erosion not only depletes the soil of its nutrients but also disrupts the soil structure, leading to decreased water retention and reduced crop growth. These findings underscore the importance of effective soil conservation strategies to mitigate the adverse effects of erosion on crop yields.

Recent research continues to validate the detrimental impact of soil erosion on agricultural productivity. For example, a study by Hashimi, Kaneko, & Komatsuzaki, (2023), indicates that soil erosion significantly affects crop yields by decreasing soil depth and quality. The study emphasizes that the loss of topsoil can lead to a substantial decrease in the availability of nutrients necessary for crop growth, resulting in lower agricultural output. Additionally, the work of Ma, Wang, Wang, Zhao, & Jiang, (2023), supports these findings, showing that soil erosion is closely linked to decreased crop yields due to its negative effects on soil fertility and structure. These studies collectively highlight the urgent need for effective soil management practices to protect crop yields from the impacts of erosion.

2.2 Effects of Soil Erosion on Farmland Availability

Soil erosion significantly impacts farmland availability by reducing the area of arable land and affecting its productivity. According to a study by Zhang, Huang, Rong, Duan, Zhang, Li, & Guan, (2021), soil erosion leads to the loss of valuable topsoil, which reduces the effective depth of the soil profile and decreases the amount of land suitable for cultivation. The loss of arable land due to erosion has been reported to be a major concern in many agricultural regions, as it leads to decreased agricultural potential and increased competition for remaining farmland (Hossain, Krupnik, Timsina, Mahboob, Chaki, Farooq, & Hasanuzzaman, 2020). Moreover, a recent study by Golosov, Collins, Dobrovolskaya, Bazhenova, Ryzhov, & Sidorchuk, (2021) found that erosion-prone areas often experience a significant reduction in farmland availability, exacerbating the challenges faced by farmers in maintaining productive agricultural operations.

The impact of soil erosion on farmland availability is further compounded by the long-term consequences of land degradation. According to Sartori, Ferrari, M'Barek, Philippidis, Boysen-Urban, Borrelli, & Panagos, (2024), the progressive loss of arable land due to erosion can lead to a decline in food production and threaten food security, particularly in regions heavily dependent on agriculture. The study by Kumar, David Raj, Kalambukattu, & Chatterjee, (2023) supports this perspective, showing that erosion-induced land degradation results in reduced farmland availability, which in turn affects local agricultural practices and livelihoods. The cumulative effect of reduced farmland availability due to erosion underscores the necessity for sustainable land management practices to preserve and restore arable land.

2.3 Socio-Economic Impact of Soil Erosion

Soil erosion has significant socio-economic impacts, particularly in regions where agriculture is a primary livelihood source. Research by Rashmi, Karthika, Roy, Shinoji, Kumawat, Kala, & Pal, (2022) indicates that soil erosion leads to increased economic losses for farmers by diminishing crop yields and reducing overall agricultural productivity. The economic burden of erosion is evident in the increased costs associated with soil conservation measures and the loss

of income due to decreased farm outputs (Kucher, Kucher, Sysoieva, & Pohrishchuk, 2021). Furthermore, a study by Ogunniyi, Omotoso, Salman, Omotayo, Olagunju, & Aremu, (2021) highlights that soil erosion exacerbates poverty in rural areas by reducing agricultural income and increasing food insecurity, thus negatively affecting the socio-economic stability of farming communities.

The socio-economic impacts of soil erosion extend beyond individual farmers to broader community and national levels. According to a study by Wudil, Usman, Rosak-Szyrocka, Pilař, & Boye, (2022), soil erosion contributes to higher food prices and reduced food availability, which can lead to inflationary pressures and economic instability in regions heavily reliant on agriculture. Additionally, the work of Dekaraja, & Mahanta, (2021), reveals that soil erosion-induced land degradation often results in the displacement of communities and increased migration as individuals seek more viable agricultural lands or alternative livelihoods. These findings revealed the broader socio-economic implications of soil erosion and highlighted the need for comprehensive erosion management strategies to mitigate its adverse effects on communities and economies.

3. Materials and method

Boki Local Government Area (L.G.A.) is in the southwestern part of Cross River State, Nigeria, with geographical coordinates approximately between latitudes 5.55°N and 6.20°N, and longitudes 8.40°E and 9.00°E. The local government is distinguished by its varied topography, including lush rainforests, rolling hills, and fertile valleys. Boki L.G.A. benefits from a humid tropical climate with significant rainfall year-round, which is conducive to diverse agricultural activities. The area is renowned for its cultivation of crops such as cocoa, yams, cassava, and oil palm, which flourish in the rich soil and favourable climate. The fertile land and abundant rainfall make Boki a key agricultural hub, with farming being central to the livelihoods of many residents who rely on agriculture for their income and sustenance.

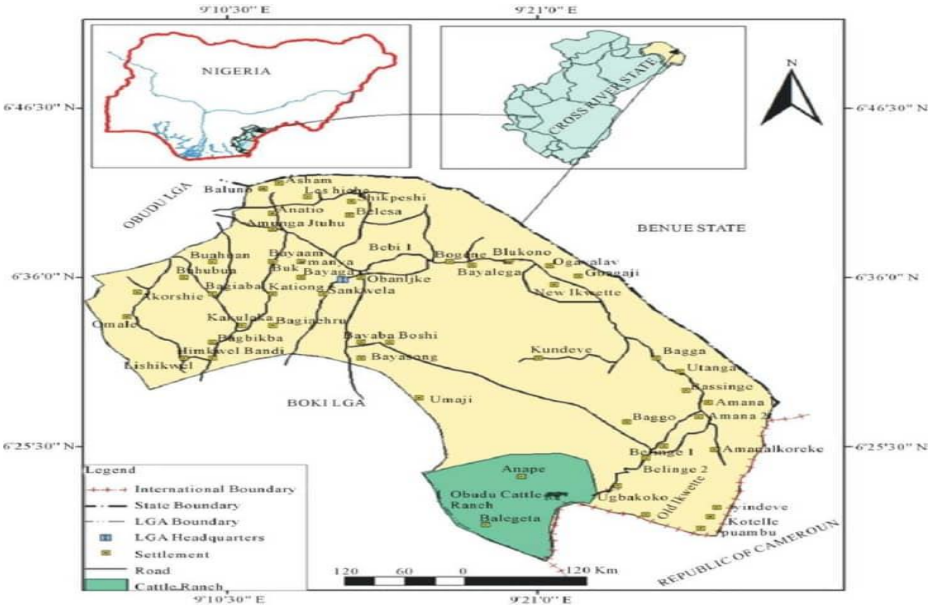

FIG.1: Map of Cross River State showing Boki L.G.A
Source: Cross River State Geographic Information Agency

A quantitative research design was adopted for this study and a survey-based approach was employed to collect data through structured questionnaires distributed to a sample of 384 farmers from various erosion-affected areas within Boki L.G.A. This approach facilitated the gathering of numerical data on soil erosion's effects on crop yields, farmland availability, and farmer livelihoods. Data analysis involved descriptive statistics to summarize the responses and inferential statistics to determine the relationship between soil erosion and agricultural productivity. The use of Geographic Information Systems (GIS) further supported the spatial analysis of erosion-prone areas and land degradation patterns (Creswell, 2014).

4. Results and Discussion

Results from the descriptive analysis of Tables 1,2 &3 present a detailed view of farmers' perceptions regarding the impact of soil erosion on agricultural productivity in Boki Local Government Area, in Cross River State. **Table 1** reveals that a significant portion of farmers (41.7%) perceive soil erosion as causing a substantial decrease in crop yields, while 31.3% report a moderate decrease. This saddening result revealed the pervasive effect of erosion on crop production, with most farmers acknowledging a reduction in yield quality and quantity. Further, the analysis of Table 2 shows that 37% of farmers believe soil erosion has severely reduced farmland availability and 35.4% report moderate reductions. These figures indicate that soil erosion is significantly affecting the amount of usable farmland, which can lead to reduced agricultural output and increased competition for remaining arable land. Details from the descriptive analysis of **Table 3** underscore the socio-economic consequences of soil erosion in Boki LGA. A notable 40.4% of farmers report a loss of income, and 33.8% experience increased food insecurity among others. These impacts reflect the broader economic strain caused by erosion, with significant implications for farmers' livelihoods and community stability.

The results from the descriptive analysis of Tables 1, 2, and 3 offer a clear view of the impact of soil erosion on agricultural productivity in Boki Local Government Area, Cross River State. The data reveal that soil erosion is perceived by farmers as having a substantial negative effect on crop yields, with many reporting a significant reduction in both the quality and quantity of their produce. Additionally, the analysis shows that soil erosion has notably decreased usable farmland availability, which has reduced agricultural output and heightened competition for the remaining arable land. The socio-economic consequences of soil erosion are also evident, as it contributes to income loss and increased food insecurity among farmers. These impacts highlight the broader economic strain caused by soil erosion, with significant implications for farmers' livelihoods and community stability.

Table 1: Impact of Soil Erosion on Crop Yields

Impact of Soil Erosion on Crop Yields	Frequency	Percentage (%)
Significant decrease in yields	160	41.7
Moderate decrease in yields	120	31.3
Slight decrease in yields	60	15.6
No impact on yields	44	11.4
Total	**384**	**100**

Source: Authors fieldwork, 2024

Table 2: Effects of Soil Erosion on Farmland Availability

Effects of Soil Erosion on Farmland Availability	Frequency	Percentage (%)
Severe reduction in farmland	142	37.0
Moderate reduction in farmland	136	35.4
Slight reduction in farmland	76	19.8
No reduction in farmland	30	7.8
Total	**384**	**100**

Source: Authors fieldwork, 2024

Table 3: Perceived Socio-Economic Impact of Soil Erosion

Perceived Socio-Economic Impact of Soil Erosion	Frequency	Percentage (%)
Loss of income	155	40.4
Increased food insecurity	130	33.8
Displacement of farmers	70	18.2
No significant socio-economic impact	29	7.6
Total	**384**	**100**

Source: Authors fieldwork, 2024

Discussion/findings

The data analysis of farmers' perceptions from Boki Local Government Area, Cross River State, reveals the far-reaching impacts of soil erosion on agricultural productivity and livelihoods. Table 1 shows that a significant majority (41.7%) of farmers attribute substantial decreases in crop yields to soil erosion, while 31.3% report moderate declines, highlighting the severe threat soil erosion poses to agricultural output. This degradation of soil quality and productivity affects the quality and quantity of crops produced, intensifying food insecurity in the area. Table 2 further emphasizes the problem, with 37% of farmers reporting severe reductions in available farmland, leading to increased pressure on the remaining arable land and potentially reducing agricultural output over time. In Table 3, the socio-economic consequences are evident, with 40.4% of farmers experiencing a loss of income and 33.8% facing heightened food insecurity, reflecting the broader economic strain and instability caused by erosion. These findings underscore the urgent need for effective soil conservation measures to mitigate the damaging effects of erosion on agriculture and improve the socio-economic well-being of farmers in the region.

5. Conclusion

In conclusion, the study revealed the severe impact of soil erosion on agricultural productivity in Boki Local Government Area. The findings indicate that soil erosion has led to substantial reductions in crop yields and decreased the availability of arable land. This not only hampers agricultural output but also intensifies competition for the remaining farmland, adversely affecting local farming activities. The negative effects on crop production are compounded by the broader socio-economic consequences, including loss of income and heightened food insecurity among farmers.

Mitigating soil erosion is critical to improving agricultural productivity and ensuring the stability of local economies in Boki L.G.A. The study highlights the urgent

need for effective soil conservation measures and sustainable land management practices. Implementing these strategies will be essential for mitigating the adverse effects of erosion, enhancing farmland conditions, and supporting the livelihoods of farmers in the region. Investing in erosion control and soil preservation will contribute to long-term agricultural sustainability and economic resilience in Boki L.G.A.

6. Recommendations

Based on the study findings, the following key recommendations are proposed to mitigate soil erosion and enhance agricultural productivity in Boki Local Government Area:

i. The farmers should adopt and promote soil conservation techniques such as contour farming, terracing, and the use of cover crops. These practices will help reduce soil erosion by stabilizing the soil and preventing runoff, thereby improving land productivity and sustainability.

ii. The rural residents should initiate reforestation and afforestation efforts in erosion-prone areas to restore vegetation cover. Tree planting and maintaining vegetative buffers will enhance soil stability, reduce erosion rates, and contribute to improved agricultural productivity.

iii. The Cross River State through Agricultural agencies should provide targeted training programs for farmers on best practices for soil management and erosion control. Education initiatives should focus on practical techniques for reducing soil erosion and optimizing land use, enabling farmers to better manage their agricultural activities and mitigate erosion-related challenges.

iv. Advocate for the implementation and enforcement of policies that support soil conservation and sustainable land management. The government should also offer financial incentives, technical support, and resources to assist farmers in adopting erosion control measures and improving agricultural practices.

References

Akanwa, A. O., Banerjee, A., Jhariya, M. K., Muoghalu, L. N., Okonkwo, A. U., Ikegbunam, F. I., ... & Madukasi, E. I. (2023). Climate-Induced Conflicts Between Rural Farmers and Cattle Herders: Implications on Sustainable Agriculture and Food Security in Nigeria. *Eco restoration for Sustainability*, 373-416.

Anderson, K., & Ponnusamy, S. (2023). Structural transformation away from agriculture in growing open economies. *Agricultural Economics*, *54*(1), 62-76.

Dekaraja, D., & Mahanta, R. (2021). Riverbank erosion and migration inter-linkage: with special focus on Assam, India. *Environmental Systems Research*, *10*, 1-10.

Ekka, P., Patra, S., Upreti, M., Kumar, G., Kumar, A., & Saikia, P. (2023). Land Degradation and its impacts on Biodiversity and Ecosystem services. *Land and Environmental*

Management through Forestry, 77-101.

Feeney, C. J., Robinson, D. A., Thomas, A. R., Borrelli, P., Cooper, D. M., & May, L. (2023). Agricultural practices drive elevated rates of topsoil decline across Kenya, but terracing and reduced tillage can reverse this. *Science of the Total Environment*, *870*, 161925.

Golosov, V. N., Collins, A. L., Dobrovolskaya, N. G., Bazhenova, O. I., Ryzhov, Y. V., & Sidorchuk, A. Y. (2021). Soil loss on the arable lands of the forest-steppe and steppe zones of European Russia and Siberia during the period of intensive agriculture. *Geoderma*, *381*, 114678.

Hashimi, R., Kaneko, N., & Komatsuzaki, M. (2023). Impact of no-tillage on soil quality and crop yield in Asia: A meta-analysis. *Land Degradation & Development*, *34*(4), 1004-1018.

Hossain, A., Krupnik, T. J., Timsina, J., Mahboob, M. G., Chaki, A. K., Farooq, M., ... & Hasanuzzaman, M. (2020). Agricultural land degradation: processes and problems undermining future food security. In *Environment, climate, plant and vegetation growth* (pp. 17-61). Cham: Springer International Publishing.

Iwuchukwu, F. U., Ewuzie, U., Ajala, O. J., Ojukwu, V. E., Nnorom, I. C., Egbueri, J. C., ... & Ighalo, J. O. (2023). A consideration of the climatic drivers, focal points and challenges of soil erosion, land degradation, landslides and landscapes in Nigeria. *Climate Change Impacts on Nigeria: Environment and Sustainable Development*, 449-477.

Iwuchukwu, F. U., Ewuzie, U., Ajala, O. J., Ojukwu, V. E., Nnorom, I. C., Egbueri, J. C., ... & Ighalo, J. O. (2023). A consideration of the climatic drivers, focal points and challenges of soil erosion, land degradation, landslides and landscapes in Nigeria. *Climate Change Impacts on Nigeria: Environment and Sustainable Development*, 449-477.

Junaid, M. D., & Gokce, A. F. (2024). Global agricultural losses and their causes. *Bulletin of Biological and Allied Sciences Research*, *2024*(1), 66-66.

Kucher, A., Kucher, L., Sysoieva, I., & Pohrishchuk, B. (2021). Economics of soil erosion: case study of Ukraine. *Agricultural and Resource Economics: International Scientific E-Journal*, *7*(4), 27-41.

Kumar, S., David Raj, A., Kalambukattu, J. G., & Chatterjee, U. (2023). Climate change impact on land degradation and soil erosion in hilly and mountainous landscape: sustainability issues and adaptation strategies. In *Ecological footprints of climate change: adaptive approaches and sustainability* (pp. 119-155). Cham: Springer International Publishing.

Ma, S., Wang, L. J., Wang, H. Y., Zhao, Y. G., & Jiang, J. (2023). Impacts of land use/land cover and soil property changes on soil erosion in the black soil region, China. *Journal of Environmental Management*, *328*, 117024.

Mrabet, R. (2023). Sustainable agriculture for food and nutritional security. In *Sustainable agriculture and the environment* (pp. 25-90). Academic Press.

Musa, I. O., Samuel, J. O., Adams, M., Abdulsalam, M., Nathaniel, V., Maude, A. M., ... & Tiamiyu, A. G. T. (2024). Soil Erosion, Mineral

Depletion and Regeneration. In *Prospects for Soil Regeneration and Its Impact on Environmental Protection* (pp. 159-172). Cham: Springer Nature Switzerland.

Ndegwa, J. K., Gichimu, B. M., Mugwe, J. N., Mucheru-Muna, M., & Njiru, D. M. (2023). Integrated soil fertility and water management practices for enhanced agricultural productivity. *International Journal of Agronomy*, *2023*(1), 8890794.

Ndem, B. E., Walter, M. H., Ovat, O. O., Henry, J. T., & Peter, L. M. (2023). Agricultural financing and economic performance in the Obudu local government area of cross River State, Nigeria. *Asian Journal of Agriculture and Rural Development*, *13*(1), 39-48.

Ogunniyi, A. I., Omotoso, S. O., Salman, K. K., Omotayo, A. O., Olagunju, K. O., & Aremu, A. O. (2021). Socio-economic drivers of food security among rural households in Nigeria: Evidence from smallholder maize farmers. *Social Indicators Research*, *155*, 583-599.

Okenmuo, F. C., Ibeh, K. G., & Obalum, S. E. (2023). The menace of widespread gully erosion in southeastern Nigeria: litho-anthropogenic history and management and policy issues. *Valedictorian Festschrift in Honour of Professor Peter Chinedum Nnabude*, 61-79.

Okoronkwo, D. J., Ozioko, R. I., Ugwoke, R. U., Nwagbo, U. V., Nwobodo, C., Ugwu, C. H., ... & Mbah, E. C. (2024). Climate-smart agriculture? Adaptation strategies of traditional agriculture to climate change in sub-Saharan Africa. *Frontiers in Climate*, *6*, 1272320.

Owenda, C. O. (2024). Socio-Economic Impact of Large-Scale Commercial Farming on Rural People's Livelihoods: The Case of Flower Farming in Central Uganda. *Open Journal of Social Sciences*, *12*(9), 50-74.

Prince, A. I., Nzechie, O., Obiorah, J., Ehi, O. E., & Idakwoji, A. A. (2023). Analyzing the critical impact of climate change on agriculture and food security in Nigeria. *Int. J. Agric. Earth Sci.*, *9*, 42023.

Quinton, J. N., & Fiener, P. (2024). Soil erosion on arable land: An unresolved global environmental threat. *Progress in Physical Geography: Earth and Environment*, *48*(1), 136-161.

Raihan, A., Tanchangya, T., Rahman, J., & Ridwan, M. (2024). The Influence of Agriculture, Renewable Energy, International Trade, and Economic Growth on India's Environmental Sustainability. *Journal of Environmental and Energy Economics*, 37-53.

Rashmi, I., Karthika, K. S., Roy, T., Shinoji, K. C., Kumawat, A., Kala, S., & Pal, R. (2022). Soil Erosion and sediments: a source of contamination and impact on agriculture productivity. In *Agrochemicals in Soil and Environment: Impacts and Remediation* (pp. 313-345). Singapore: Springer Nature Singapore.

Sartori, M., Ferrari, E., M'Barek, R., Philippidis, G., Boysen-Urban, K., Borrelli, P., ... & Panagos, P. (2024). Remaining loyal to our soil: a prospective integrated assessment of soil erosion on global food security. *Ecological Economics*, *219*, 108103.

Tesfaye, B., Lengoiboni, M., Zevenbergen, J., & Simane, B. (2023). Rethinking the Impact of Land Certification on Tenure Security, Land Disputes, Land

Management, and Agricultural Production: Insights from South Wello, Ethiopia. *Land*, *12*(9), 1713.

Wudil, A. H., Usman, M., Rosak-Szyrocka, J., Pilař, L., & Boye, M. (2022). Reversing years for global food security: A review of the food security situation in Sub-Saharan Africa (SSA). *International Journal of Environmental Research and Public Health*, *19*(22), 14836.

Yadav, D., Singh, D., Babu, S., Madegowda, M., Singh, D., Mandal, D., ... & Kumar, S. (2024). Intensified cropping reduces soil erosion and improves rainfall partitioning and soil properties in the marginal land of the Indian Himalayas. *International Soil and Water Conservation Research*, *12*(3), 521-533.

Yu, S., Bai, X., Zhao, J., Zeng, Y., Wang, Y., Wang, Z., ... & Shi, Z. (2024). The mismatch between provincial grain production and consumption increased cropland soil erosion in China. *Agriculture, Ecosystems & Environment*, *367*, 108999.

Zhang, L., Huang, Y., Rong, L., Duan, X., Zhang, R., Li, Y., & Guan, J. (2021). Effect of soil erosion depth on crop yield based on topsoil removal method: a meta-analysis. *Agronomy for Sustainable Development*, *41*, 1-13.