Scientific Research Timelines Journal (2025), 3(2):12-16
Online Bimonthly Publication Frequency
https://scientificrtj.com/

Review Paper **Open Access**

CLIMATE CHANGE-INDUCED FLOODING AND ITS IMPACT ON AGRICULTURAL PRODUCTIVITY: STRATEGIES TOWARD ACHIEVING SDG 2 (ZERO HUNGER)

Imran Raheemi[1*]
[1]*Disaster Management, Sharq Institute of Higher Education, Afghanistan*

[*]**Corresponding authors e-mail:** raheemiimran@gmail.com

ABSTRACT Climate change is speeding up the frequency of extreme weather, and flooding has become one of the most harmful threats to agriculture and global food security. When farmlands flood, crops are destroyed, transportation routes are blocked, and soil nutrients are washed away, all of which decrease productivity and cause economic difficulties. Evidence from various regions emphasizes the severity of the problem. For example, major floods in rural Afghanistan have caused significant drops in household food security, while repeated flooding in Nigeria has damaged farm infrastructure, eroded fertile topsoil, and led to higher food prices. Worldwide, estimated yield losses from flood events are about 4% for soybeans, 3% for rice, 2% for wheat, and 1% for maize, resulting in substantial financial losses. To maintain food production amid worsening climate pressures, farming communities must improve their resilience. Climate-smart practices like better water management and flood-tolerant crop varieties can help reduce risks. Microbial and biotechnological innovations further support this by improving plant growth in waterlogged conditions. Investments in rural roads, storage facilities, and market access are crucial for reducing disruptions. Additionally, better flood prediction tools and strong policy support can help farmers adapt faster. Collectively, these strategies will be essential for achieving Zero Hunger and safeguarding global food security in a changing climate.

Keywords: *Climate; Hunger; Sustainability; Management; Food*

INTRODUCTION

Agriculture and climate change are closely connected, each significantly impacting the other. Variation in rainfall and temperature are two ways climate change influences agriculture. These changes can lead to reduced crop yields, increased risks of crop failures, and long-term declines in agricultural productivity. This relationship is complex and varies across different agricultural systems and regions. For instance, climate change directly and indirectly affects agriculture in sub-Saharan Africa, influencing both crop productivity and land use. Additionally, greenhouse gas emissions from farming practices such as fertilizer application and deforestation help drive climate change. To enhance resilience and sustainability in agricultural systems, integrated strategies for adaptation and mitigation, like climate-smart agriculture, are essential, given the reciprocal nature of this relationship (Abebaw, 2025). By 2030, Sustainable Development Goal 2 (SDG 2), "Zero Hunger," aims to eradicate hunger, attain food security, enhance nutrition, and advance sustainable agriculture. Since achieving food security requires addressing poverty, health, education, gender equality, climate change, and sustainable resource management, this target is linked to other SDGs (Thapa, 2021). SDG 2 has five goals, such as eliminating hunger and malnutrition, increasing small-scale farmers' productivity by twofold, and ensuring resilient and sustainable food production systems (Lipper et al., 2020). SDG 2 has shown inconsistent progress and faces many obstacles. While some nations have improved agricultural productivity and reduced hunger, others still face enduring inequality and resource limitations (Pájaro et al., 2022). A major obstacle to reaching SDG 2 is the current state of the global food system, which is neither sustainable nor healthful. Effective progress is further hampered by the "Missing Middle" between food production and consumption, as well as between global objectives and local execution. To systematically accomplish the many goals of SDG 2, policies and investments must take these trade-offs and synergies into account as described in Fig. 1 (Veldhuizen et al., 2020).

Table 1: Agricultural areas affected by floods

Increased Frequency and Intensity of Floods

Increased atmospheric moisture brought on by climate change increases the amount of rainfall that occurs during the monsoon season. As a result, extreme precipitation events become more frequent and stronger, which exacerbates severe flooding. Over the past few decades, there has been a recorded increase in the frequency and intensity of heavy rainfall events, which has resulted in catastrophic flooding across South Asia. It is anticipated that this pattern will continue, increasing the risk of flooding. There are notable increases in the daily-scale variability of precipitation during the South Asian monsoon. Extreme regional floods may result from both more frequent dry spells and more intense wet spells (Fiaz et al., 2025). Details of the agricultural areas affected by flooding are presented in Table 1.

Region	Impact	Details	References
Pakistan (Khyber-Pakhtunkhwa province)	Severe	Floods from 2010 to 2018 have significantly impacted rural mountainous agriculture, particularly in the Malakand division, leading to loss of livelihood, economic degradation, and increased poverty	(Khayyam & Munir, 2022)
Burkina Faso	Persistent	Flooding in 2009 had long-lasting effects on agricultural production, affecting multiple seasons	(Dossa et al., 2023)
China (Yangtze River)	Increasing	Agricultural floods have increased in frequency and area over the past 50 years, particularly affecting the middle and lower reaches of the Yangtze River	(Wu et al., 2019)
India (Bihar and Assam)	Severe	Recurrent monsoon floods severely impact agricultural land, with significant crop losses and economic hardship for farmers	(Kumar et al., 2023)
Mozambique (Sofala Province)	Severe	Cyclone Idai in 2018/2019 caused extensive flooding, severely impacting maize and rice crops	(Bofana et al., 2022)
Ghana (Sudan Savannah agroecological zone)	Annual	Recurrent annual floods lead to food insecurity and force farmers to adapt through alternative livelihoods	(Baeribameng Yiran et al., 2022)
USA (Midwest and Northeast)	Persistent	The Midwest experiences significant agricultural damage from floods, while the Northeast is vulnerable to increased precipitation and flooding affecting fruit and vegetable growers	(Delaney, 2023)
Iran (Golestan Province)	Significant	Floods affect major crops like wheat, rice, barley, and rapeseed, with substantial crop-specific damage	(Parvar & Salmanmahiny, 2025)
Vietnam (Vu Gia-Thu Bon basin)	High risk	Annual average risk of flood damage to agricultural production is significant, with indirect and intangible risks accounting for a large portion	(Nga et al., 2018)
Turkey (Berdan Plain)	Severe	Flood events in the Berdan Plain result in significant agricultural land flooding, impacting crop production	(Güvel et al., 2022)
UK (Lincolnshire)	Long term	Coastal flooding leads to long-term soil salinity issues, affecting agricultural productivity	(Gould et al., 2020)
Croatia (Northern Pannonian region)	Frequent	Floods frequently impact agricultural fields, particularly during the plant germination phase	(Senko et al., 2022)
Iowa, USA	High risk	Frequent flooding events cause substantial economic losses, particularly affecting corn, soybean, and alfalfa crops	(Yildirim & Demir, 2022)

Factors Contributing to Increased Flooding

Sea Surface Temperature (SST) Variations

Rainfall distribution and monsoon intensity are impacted by variations in the South Atlantic Ocean sea surface temperature (SASST). Increased frequency of Arabian Sea cyclones, which can interfere with moisture transfer to the Indian landmass and impact monsoon strength and floods, is associated with rising SASST (Hari et al., 2021).

Anthropogenic Aerosols

Rainfall patterns are significantly altered by aerosols. More intense weather and flooding result from increased aerosol loading, especially from local sources, which lowers wet-event frequency and increases dry-event frequency (Singh et al., 2019).

Greenhouse Gas Emissions

One of the main causes of climate change is the increase in greenhouse gas emissions, which raises SST and atmospheric moisture, intensifying monsoon rainfall and flooding (Fiaz et al., 2025).

Regional Impacts and Vulnerabilities

Because of their geographic location and dependence on important river systems like the Ganges, Brahmaputra, and Meghna, Bangladesh, India, and Pakistan are especially susceptible to rising flooding. According to future forecasts, rising temperatures will make floods more likely, which will have an impact on infrastructure, public health, and agriculture (Mirza, 2011). Urban flooding is made worse by growing impermeable surfaces and rapid urbanization. Due to heavy precipitation, riverine floods, and sea level rise, cities like Kolkata are at serious risk of flooding (Manandhar et al., 2023). Afghanistan and Nigeria are also affected by floods every year.

Current Strategies to Enhance Flood Resilience in Agriculture

To lessen the detrimental effects of flooding brought on by climate change, agricultural systems are depending more and more on integrated resilience strategies. A key strategy that encourages methods capable of maintaining productivity, adjusting to climatic fluctuation, and lowering greenhouse gas emissions is climate-smart agriculture, or CSA. Improved water conservation techniques that increase infiltration and lower runoff, strategic crop diversification to incorporate climate-resilient species, and sustainable intensification to increase soil fertility and optimize resource usage are important CSA components. Carbon sequestration, biodiversity, and ecological stability are further supported by agroforestry and improved livestock management (Akinsemolu et al., 2024). Creating crop types that can withstand flooding is a crucial adaptation tactic in areas where protracted flooding interferes with seasonal food supply. Submergence-tolerant rice cultivars like Swarna-Sub1, which sustain yields under transient flooding circumstances, are significant developments (Dar et al., 2013). The introduction of cultivars that can maintain development under anaerobic stress while maintaining desired agronomic features is still being accelerated by modern breeding and molecular biotechnology (Mano & Nakazono, 2021). Engineering solutions are also very important. Water management and flood mitigation are supported by resilient irrigation and drainage systems, such as dual-purpose rainwater collection networks (Mugume et al., 2017). Integrated solutions that combine drainage upgrades with irrigation improve overall water use efficiency and reduce secondary soil problems like salinity (Adhikari et al., 2009). Concurrently, farm-level adaptation prioritizes the use of geospatial technology and climatic information services for risk assessment and early warning alerts (Goswami et al., 2024). Timely decision-making during flood disasters is also increasingly supported by digital technologies like data-driven forecasting and Internet-of-things monitoring systems (Karthiyayini et al., 2025).

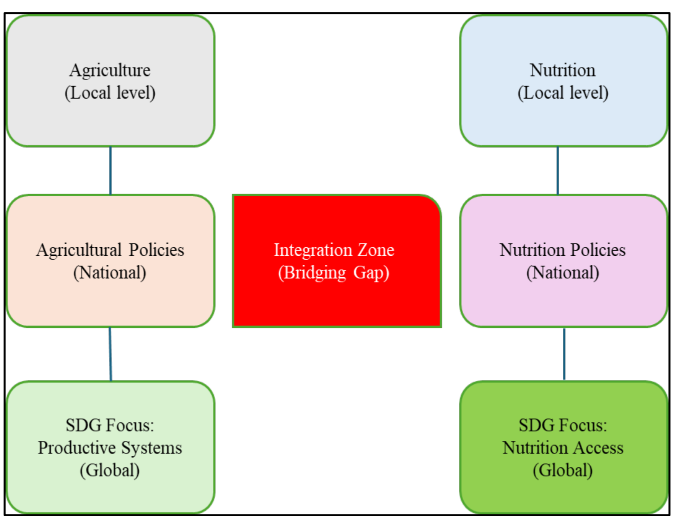

Figure 1. Conceptual framework linking agriculture and nutrition for achieving SDG-2 under climate change and flood resilience challenges.

Governance and Community-Level Actions Toward SDG 2

CSA-aligned policies are essential for hastening the transition to zero hunger. Farmers are encouraged to adopt climate-resilient practices and technologies through government support through incentive schemes (Lipper et al., 2014). Comprehensive flood-risk planning combined with agricultural growth enhances advisory services and fortifies national resilience frameworks (Kenyon et al., 2008). Sustainable land and water usage is facilitated by conservation agriculture and diverse agro-ecosystems, such as crop-livestock or rice-fish systems (Ndjadi et al., 2021). Furthermore, improved financial accessibility and multi-stakeholder cooperation guarantee that innovations are distributed fairly to farming communities (Sanjeevi et al., 2025).

CONCLUSION

Climate change-driven flooding continues to threaten rural communities, agricultural productivity, and progress toward achieving Sustainable Development Goal 2: Zero Hunger. Creating resilient food systems requires strong governance, active community participation, innovative technology, and consistent policy support. Adaptation works best when global strategies align with local knowledge, allowing institutions at all levels to coordinate disaster response and climate planning effectively. In flood-vulnerable regions, collaboration among government agencies is crucial for improving services and strengthening long-term resilience. Community involvement plays a key role in designing solutions that people trust and can adopt. When local expertise is acknowledged and residents are empowered to lead preparedness efforts, adaptation strategies become more inclusive and effective. Educational programs, especially those targeting youth, help build awareness and encourage future generations to engage in resilience planning. New technologies also offer valuable tools for safeguarding agriculture. Remote sensing, IoT-based field monitoring, and predictive models support better decision-making and faster responses to flood risks. Continued interdisciplinary research that integrates environmental science, agriculture, and social development is needed to advance climate-smart innovation. Policy frameworks must evolve to provide financial assistance, subsidies, and guidance that enable farmers to transition toward more resilient practices. International collaboration and shared learning will remain vital for protecting food systems.

REFERENCES

Abebaw, S. E. (2025). A Global Review of the Impacts of Climate Change and Variability on Agricultural Productivity and Farmers' Adaptation Strategies. In Food Science and Nutrition, 13(5).

Adhikari, B., Verhoeven, R., & Troch, P. (2009). Appropriate rehabilitation strategy for a traditional irrigation supply system: A case from the Babai area in Nepal. Water Science and Technology, 60(11), 2819–2828.

Akinsemolu, A. A., Onyeaka, H. N., & Tamasiga, P. (2024). Climate-smart agriculture as a possible solution to mitigate climate change impact on food security in Sub-Saharan Africa. In Food and Energy Security, 13(1).

Baeribameng Yiran, G. A., Atubiga, J. A., Kusimi, J. M., Kwang, C., & Owusu, A. B. (2022). Adaptation to perennial flooding and food insecurity in the Sudan savannah agroecological zone of Ghana. Environmental Research, 214.

Bofana, J., Zhang, M., Wu, B., Zeng, H., Nabil, M., Zhang, N., Elnashar, A., Tian, F., da Silva, J. M., Botão, A., Atumane, A., Mushore, T. D., & Yan, N. (2022). How long did crops survive from floods caused by Cyclone Idai in Mozambique detected with multi-satellite data. Remote Sensing of Environment, 269.

Dar, M. H., De Janvry, A., Emerick, K., Raitzer, D., & Sadoulet, E. (2013). Flood-tolerant rice reduces yield variability and raises expected yield, differentially benefitting socially disadvantaged groups. Scientific Reports, 3.

Delaney, S. (2023). Who to Call after the Storm?: The Challenge of Flooding due to Climate Change for Fruit and Vegetable Growers in the Northeast United States. Environment and Society: Advances in Research, 14(1), 62–83.

Fiaz, A., Rahman, G., & Kwon, H. H. (2025). Impacts of climate change on the South Asian monsoon: A comprehensive review of its variability and future projections. In Journal of Hydro-Environment Research, 59.

Goswami, J., Senpakapriya, V., Goswami, C., Sarma, K. K., & Aggarwal, S. P. (2024). Disaster Preparedness and capacity building for Resilience in Agriculture. International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences - ISPRS Archives, 48(5), 17–22.

Gould, I. J., Wright, I., Collison, M., Ruto, E., Bosworth, G., & Pearson, S. (2020). The impact of coastal flooding on agriculture: A case-study of Lincolnshire, United Kingdom. Land Degradation and Development, 31(12), 1545–1559.

Güvel, Ş. P., Akgül, M. A., & Aksu, H. (2022). Flood inundation maps using Sentinel-2: a case study in Berdan Plain. Water Supply, 22(4), 4098–4108.

Hari, V., Pathak, A., & Koppa, A. (2021). Dual response of Arabian Sea cyclones and strength of Indian monsoon to Southern Atlantic Ocean. Climate Dynamics, 56(7–8), 2149–2161.

Karthiyayini, J., Jain, A., Prasad, K. S., Abedi, T. A. A. U., Prasanna, Y., & Murugesan, K. (2025). Flood Prediction and Adaptive Farming Solutions Using IoT, Machine Learning, and Remote Sensing for Climate-Resilient Agriculture. 2025 International Conference on Intelligent Control, Computing and Communications, IC3 2025, 777–782.

Kenyon, W., Hill, G., & Shannon, P. (2008). Scoping the role of agriculture in sustainable flood management. Land Use Policy, 25(3), 351–360.

Khayyam, U., & Munir, R. (2022). Flood in mountainous communities of Pakistan: how does it shape the livelihood and economic status and government support? Environmental Science and Pollution Research, 29(27), 40921–40940.

Kumar, H., Kumar, R., Dutta, S., Singh, M., & Kr Karwariya, S. (2023). Utilizing machine learning algorithm, cloud computing platform and remote sensing satellite data for impact assessment of flood on agriculture land. In CURRENT SCIENCE, 125(8).

Lipper, L., DeFries, R., & Bizikova, L. (2020). Shedding light on the evidence blind spots confounding the multiple objectives of SDG 2. Nature Plants, 6(10), 1203–1210.

Lipper, L., Thornton, P., Campbell, B. M., Baedeker, T., Braimoh, A., Bwalya, M., Caron, P., Cattaneo, A., Garrity, D., Henry, K., Hottle, R., Jackson, L., Jarvis, A., Kossam, F., Mann, W., McCarthy, N., Meybeck, A., Neufeldt, H., Remington, T. Torquebiau, E. F. (2014). Climate-smart agriculture for food security. In Nature Climate Change 4(12), 1068–1072.

Manandhar, B., Cui, S., Wang, L., & Shrestha, S. (2023). Urban Flood Hazard Assessment and Management Practices in South Asia: A Review. In Land, 2(3).

Mano, Y., & Nakazono, M. (2021). Genetic regulation of root traits for soil flooding tolerance in genus zea. Breeding Science, 71(1), 30–39.

Mirza, M. M. Q. (2011). Climate change, flooding in South Asia and implications. Regional Environmental Change, 11(SUPPL. 1), 95–107.

Mugume, S. N., Gomez, D., Melville-Shreeve, P., & Butler, D. (2017). Multifunctional urban flood resilience enhancement strategies. Proceedings of the Institution of Civil Engineers: Water Management, 170(3), 115–127.

Ndjadi, S. S., Matendo, A. F., Mwinja, A. C., Mondo, J. M., Civava, R. M., & Mushagalusa, G. N. (2021). Integrated crop-livestock-aquaculture farming systems: Synergistic approaches for balancing agriculture's biophysical requirements and environmental supply: A systematic review. African Journal of Rural Development, 6(3), 167–190.

Nga, P. H., Takara, K., & Cam Van, N. (2018). Integrated approach to analyze the total flood risk for agriculture: The significance of intangible damages – A case study in Central Vietnam. International Journal of Disaster Risk Reduction, 31, 862–872.

Pájaro, R. E. M., Segrera, I. L., & Sierra, C. A. S. (2022). Sustainable development goals: the scenario of nations with emerging economies. Seminars in Medical Writing and Education, 1.

Parvar, Z., & Salmanmahiny, A. (2025). Assessing flood impacts on food security and climate trends using remote sensing. Theoretical and Applied Climatology, 156(8).

Sanjeevi, P., Karthikeyan, C., Nirmala, D. M., Vijayalakshmi, D., & Thirukumaran, K. (2025). Leveraging agricultural technologies for flood mitigation in coastal Tamil Nadu: Addressing challenges in agriculture. Plant Science Today, 12(2).

Senko, H., Pole, L., Mešić, A., Šamec, D., Petek, M., Pohajda, I., Rajnović, I., Udiković-Kolić, N., Brkljačić, L., Palijan, G., & Petrić, I. (2022). Farmers observations on the impact of excessive rain and flooding on agricultural land in Croatia. Journal of Central European Agriculture, 23(1), 125–137.

Singh, D., Bollasina, M., Ting, M., & Diffenbaugh, N. S. (2019). Disentangling the influence of local and remote anthropogenic aerosols on South Asian monsoon daily rainfall characteristics. Climate Dynamics, 52(9–10), 6301–6320.

Thapa, D. (2021). Sustainable Development Goals in IS Research: Opening the agenda beyond developing countries' research. Scandinavian Journal of Information Systems, 33, 97–102.

Dossa, L. I. K. E. T., Bashir, M. K., Hassan, S., & Mushtaq, K. (2023). Impact of climate change on agricultural production in Burkina Faso, West Africa. Journal of Global Innovations in Agricultural Sciences, 11(3), 319–332.

Veldhuizen, L. J., Giller, K. E., Oosterveer, P., Brouwer, I. D., Janssen, S., van Zanten, H. H., & Slingerland, M. M. A. (2020). The Missing Middle: Connected action on agriculture and nutrition across global, national and local levels to achieve Sustainable Development Goal 2. In Global Food Security, 24.

Wu, S., Cao, S., Wang, Z., Qu, X., Li, S., & Zhao, W. (2019). Spatiotemporal variations in agricultural flooding in middle and lower reaches of Yangtze River from 1970 to 2018. Sustainability (Switzerland), 11(23).

Yildirim, E., & Demir, I. (2022). Agricultural flood vulnerability assessment and risk quantification in Iowa. Science of the Total Environment, 826.

.