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Impact of Recurrent Floods on Assam's Agricultural Productivity

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Assam faces devastating annual floods that have become increasingly severe due to a combination of natural and human factors. The Brahmaputra and Barak River are the primary causes of monsoon flooding each year. Tropical monsoon climate naturally brings heavy rainfall, but deforestation and inadequate infrastructure worsen flood conditions in several districts of Assam. Agriculture bears the brunt of flood damage in Assam. Frequent floods cause major damage to crops and lead to severe soil erosion, making it harder for farmers to continue farming. Over the years, repeated flooding has forced many farmers to give up farming and livestock and look for other ways to earn a living.

Effective flood management requires both immediate and long-term solutions. Farmers are adopting flood-resistant rice varieties that withstand prolonged submergence, along with deep-water rice cultivation and raised bed farming techniques. Infrastructure improvements include better embankment maintenance through Protection Committees and enhanced drainage systems. Climate-resilient agricultural practices, early warning systems, and sustainable watershed management are essential for reducing flood vulnerability and protecting Assam's agriculture-dependent economy.

Primary Causes of Floods in Assam

The flooding in Assam results from a complex interplay of geographical, climatic, and human factors:

River System and Geography- The Brahmaputra and Barak River with more than 30 major tributaries causes the flood devastation in the monsoon period each year. The Brahmaputra River, while providing fertile alluvial soil that has sustained agriculture for centuries, simultaneously creates an environment where agricultural productivity faces constant threats from seasonal inundation.

Climate Change and Glacial Melting- The melting of glaciers and snow caps in the Tibetan Plateau due to global warming and climate change is causing increased water flow in the Brahmaputra River, impacting downstream regions like Assam with more frequent flood. This upstream melting contributes significantly to the increased water volume that overwhelms the river system during monsoon season.

Infrastructure and Human Activities- The state's flood management infrastructure has become inadequate over time. Since the 1950s, Assam has built 423 embankments along the Brahmaputra River and its tributaries. 295 of them have outlived their intended lifespan, causing regular breaches, damage, and destruction.

Environmental Degradation- Deforestation plays a crucial role in worsening flood conditions. According to experts, deforestation and uncontrolled hill-cutting are significant contributing factors, as trees and their root systems are essential for soil stability and water absorption, helping to prevent rapid runoff during heavy rains.

Agricultural Loss due to Flood in Assam

Floods represent the most severe recurring natural disaster in Assam, fundamentally undermining the state's agricultural foundation and threatening the livelihoods of millions of farmers. The state's unique geography makes it exceptionally vulnerable to flooding, with more than 3 million hectares—nearly 40% of total land—classified as flood-prone according to the National Flood Commission. This extensive flood vulnerability encompasses approximately 475,000 hectares of cropped land, predominantly dedicated to rice cultivation, which constitutes about 17% of the state's total cultivated area.

The economic devastation caused by floods on Assam's agricultural sector reaches staggering proportions, with recent data revealing unprecedented scales of destruction that threaten the state's food security. The 2022 floods, considered among the worst in recent decades, destroyed approximately 60,000 hectares of rice fields, resulting in direct economic losses estimated at Rs 250 crore. This catastrophic event wiped out roughly 25% of the total rice crop area, demonstrating how a single flooding episode can devastate food security and farmer incomes across multiple districts. The average annual loss due to floods in Assam amounts to approximately Rs 200 crore, with particularly severe years like 1998, 2004, and 2012 witnessing losses exceeding Rs 500 crore each. Beyond these immediate figures, the 2020 floods affected over 26 lakh people across 30 districts, destroying crops worth Rs 230 crore and affecting nearly 1.64 lakh hectares of agricultural land. The recurring nature of these losses creates a persistent financial burden that prevents farmers from investing in long-term improvements, modern equipment, or resilience-building measures, perpetuating a cycle of economic vulnerability that undermines agricultural development across the state.

Infrastructure damage and soil degradation in Assam create compounding effects that extend the impact of floods far beyond immediate crop destruction, fundamentally altering the agricultural landscape. The 2022 floods caused severe soil erosion across 15,000 hectares of farmland, stripping away fertile topsoil that represents decades of natural soil formation and organic matter accumulation. Additionally, flooding damaged approximately 400 kilometres of embankments, compromising critical flood protection systems that farmers and communities depend upon for agricultural security. River bank erosion, particularly along the mighty Brahmaputra, results in an annual average land loss of nearly 8,000 hectares, with the river's width expanding up to 15 kilometres in some stretches due to persistent lateral erosion. The Majuli island, once the world's largest river island, has lost nearly two-thirds of its original area due to continuous erosion, displacing thousands of farming families and destroying centuries-old agricultural practices.

The disruption of traditional farming practices and cropping patterns in Assam represents a fundamental transformation of agricultural systems that have evolved over centuries to match the region's unique ecological conditions. Unpredictable flood timing forces farmers to navigate severe disruptions in their cultivation schedules, often leading to delayed planting during crucial kharif seasons, premature harvesting to save whatever crops possible, or complete abandonment of agricultural plots when flooding persists beyond normal periods. The erratic nature of floods, sometimes followed by drought-like conditions within the same agricultural season, creates double burdens that make traditional rice-based farming systems increasingly untenable for subsistence farmers. Rice cultivation, which historically occupied 71.4% of Assam's gross cropped area in the late 1970s, declined to 65.9% by 2000, reflecting farmers' gradual but necessary shift away from flood-vulnerable crops toward more resilient alternatives like vegetables, pulses, and cash crops.

The long-term implications of recurring flood-induced agricultural productivity loss in Assam extend far beyond immediate economic calculations, fundamentally threatening the state's food security, cultural identity, and sustainable development trajectory. Recent studies indicate that without intervention, Assam could face a 15-20% decline in overall agricultural productivity by 2030 due to increased flood frequency and intensity. This recurring pattern of flood-induced agricultural losses will continue to undermine rural prosperity, threaten food security, and compromise the sustainability of farming communities across Assam, ultimately

challenging the state's ability to maintain its agricultural heritage while ensuring economic development and food security for future generations.

Control Measures

The recurring devastation of floods on Assam's agricultural sector necessitates comprehensive, multi-faceted approaches that combine immediate protective measures with long-term adaptive strategies. Addressing agricultural losses requires coordinated efforts spanning technological innovation, infrastructure development, policy reforms, and community-based resilience building. Crop diversification and the adoption of flood-tolerant varieties represent the most critical frontline defence against agricultural losses in Assam's flood-prone regions. Scientists at Assam Agricultural University (AAU) have developed submergence-tolerant rice varieties including Ranjit Sub-1, Bahadur Sub-1, and Swarna Sub-1, which can survive underwater for extended periods. Swarna-Sub1 rice, created by inserting the flood-resistant *Sub1* gene into the popular Swarna variety, demonstrates resilience to flood submergence for up to two to three weeks while providing higher yield potential. Beyond rice, farmers are increasingly adopting flood-tolerant crop varieties such as deep-water rice, and implementing raised beds or floating gardens for vegetable cultivation.

Infrastructure development and flood management systems form the backbone of sustainable agricultural protection in Assam, requiring substantial investment and coordinated planning across multiple government levels. The Water Resources Department has implemented flood management schemes focusing on rural sector development and protection of major townships in both Brahmaputra and Barak valleys, including schemes to relieve drainage congestion. However, no long-term measures have been implemented so far to mitigate the fundamental challenges, highlighting the need for comprehensive infrastructure overhaul. Essential infrastructure improvements include construction of modern embankments with adequate height and strength to withstand peak flood levels, development of efficient drainage systems that can rapidly remove excess water from agricultural fields, and creation of water retention structures that can store flood water for later agricultural use during dry periods. Additionally, early warning systems integrated with weather forecasting and river monitoring can provide farmers with sufficient time to implement protective measures, harvest crops prematurely if necessary, or relocate livestock and agricultural equipment to safer locations.

Financial protection mechanisms and policy interventions play crucial roles in ensuring that farmers can recover from flood-induced losses and maintain agricultural operations despite recurring disasters. The state government allocated Rs 1,000 crore in 2023 for financial assistance to farmers affected by floods, demonstrating significant commitment to farmer support. Crop insurance schemes provide critical safety nets, offering insurance coverage against crop losses due to natural calamities that enable farmers to recover and replant after flood events. The implementation of the National Mission for Sustainable Agriculture (NMSA) focuses on promoting sustainable agriculture through adaptation measures encompassing improved crop seeds, water use efficiency, pest management, improved farm practices, nutrient management, agricultural insurance, credit support, and market access. Enhanced credit facilities with flexible repayment terms during flood years, subsidized access to flood-tolerant seeds and farming inputs, and direct cash transfers for immediate relief can help farmers maintain their operations and invest in long-term resilience measures rather than merely surviving each flood season.

The long-term success of flood mitigation measures in Assam's agricultural sector requires integrated policy frameworks that coordinate efforts across departments, institutions, and governance levels while ensuring sustainable financing and implementation mechanisms. Comprehensive land use planning that designates appropriate areas for different types of agriculture based on flood risk assessment can optimize land utilization while minimizing exposure to flood damage. Investment in rural infrastructure including all-weather roads, storage facilities, and processing units can reduce post-harvest losses and maintain agricultural value chains during flood periods. The development of alternative livelihood

opportunities such as aquaculture, sericulture, and agro-processing can provide income diversification that complements traditional agriculture while utilizing flood-prone areas productively. Educational initiatives that train the next generation of farmers in modern techniques, climate adaptation strategies, and entrepreneurship can ensure continuity of agricultural development despite environmental challenges. Finally, establishing robust monitoring and evaluation systems can track the effectiveness of different interventions, enabling adaptive management that continuously improves flood mitigation strategies based on empirical evidence and changing conditions. Only through such comprehensive, coordinated approaches can Assam hope to break the cycle of annual agricultural devastation and build a resilient farming sector capable of sustaining rural livelihoods and food security despite the persistent threat of floods.

Conclusion

Floods in Assam represent a persistent existential threat to the state's agricultural production. While the Brahmaputra River system provides fertile alluvial soil, its unpredictable flooding patterns create cycles of devastation that prevent sustainable agricultural development. Addressing this crisis requires comprehensive intervention through flood-tolerant crop varieties, improved infrastructure, financial protection mechanisms, and community-based adaptation strategies to ensure Assam's agricultural resilience and rural prosperity.

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