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REVIVING ANCIENT INDIAN KNOWLEDGE SYSTEMS (AIKS) TO MITIGATE PERENNIAL FLOODING IN NORTHEAST INDIA: A SOCIO-ECOLOGICAL PARADIGM SHIFT

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ABSTRACT

The Northeast region of India (NEI), characterized by the Brahmaputra and Barak river systems, faces catastrophic annual flooding that destabilizes the economy, environment, and social fabric. Despite decades of modern engineering interventions—primarily embankments and large-scale dams—the frequency and intensity of floods remain unabated. This research paper explores the potential of Ancient Indian Knowledge Systems (AIKS) and indigenous ethno-hydrological practices as viable, sustainable alternatives or supplements to modern structural interventions. By analyzing Vedic hydrological principles, Kautilyan resource management, and the traditional wisdom of indigenous tribes (such as the Apatani and Mising), this paper argues for a transition from "flood control" to "flood adaptation." The study concludes that an integrated framework combining modern technology with AIKS can foster long-term resilience in the Brahmaputra basin.

Keywords: Brahmaputra Basin, Ancient Indian Knowledge Systems (AIKS), Flood Adaptation, Ethno-Hydrology, Northeast India (NEI), Socio-Ecological Resilience, Traditional Ecological Knowledge (TEK)

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1. INTRODUCTION

Northeast India (NEI) represents one of the most geologically volatile and ecologically sensitive landscapes globally, situated at the confluence of the Himalayan and Indo-Burmese tectonic plates. This region is defined primarily by the Brahmaputra River, a wandering, braided mega-river characterized by its extreme hydrological variability and massive sediment flux (Dixit et al. 2023). The Brahmaputra ranks among the highest in the world in terms of specific discharge and sediment yield, carrying an estimated 400 million tons of suspended sediment annually (Goswami, 1985; Sarma, 2005; Goswami, 2005). This high sediment load is a product of the young, friable Himalayan mountains and intense seasonal monsoons, which concentrate nearly 80% of the annual rainfall between June and September (Bookhagen, & Burbank, 2010; Andermann, et al. 2012).

The contemporary flood regime of the Brahmaputra was fundamentally reshaped by the Great Assam Earthquake of 1950 (8.6 magnitude). This seismic event caused massive landslides in the eastern Himalayas, depositing an unprecedented volume of debris into the river system (Poddar, 1952; Kingdon-Ward; 1953; Saikia, 2019). Consequently, the riverbed underwent significant aggradation, rising by several meters in various reaches, which reduced the channel’s carrying capacity and triggered a phase of chronic instability and bank erosion (Barua et al., 2013).

In response to this perennial instability, the post-colonial state adopted a "command-and-control" water management paradigm. This approach has been predominantly structural, characterized by the construction of over 4,000 kilometers of embankments designed to confine the river within a fixed corridor (Das, 2012). Moreover, the contemporary developmental agenda has pivoted toward the construction of mega-dams in the Arunachal Himalayas, framed as multi-purpose projects for flood moderation and hydroelectric generation. However, scholars argue that these technocratic interventions ignore the "fluvial metabolism" of the river. Embankments, while providing temporary protection, prevent the natural enrichment of floodplains with nutrient-rich silt and lead to the gradual elevation of the riverbed through sediment entrapment (Saikia, 2019).

The long-term consequence of this structural fixation has been the emergence of "breach floods." When embankments inevitably fail due to hydrostatic pressure or poor maintenance, the resulting deluge is far more catastrophic than natural flooding, as water is released with greater velocity onto densely populated land (Lahiri, 2023). Moreover, the proposed mega-dams in this high-seismic zone (Zone V) pose significant downstream risks, including the threat of dam-induced seismicity and the alteration of the river’s hydrograph (Mahanta, 2006). Thus, the reliance on rigid infrastructure in a fluid and seismic landscape has paradoxically heightened the vulnerability of the region’s socio-ecological systems.

There is an urgent need to revisit Ancient Indian Knowledge Systems (AIKS). Historically, Indian civilizations did not view floods as "disasters" but as "resources" that rejuvenated the soil. From the hydrological insights in the Rigveda to the sophisticated water management systems of the Apatani tribe in Arunachal Pradesh, ancient wisdom offers a template for living with water rather than fighting it. This paper examines how reviving these traditional systems can mitigate the current flooding crisis in NEI.

2. HISTORICAL AND GEOGRAPHICAL CONTEXT OF THE BRAHMAPUTRA BASIN

The Brahmaputra-Yarlung Tsangpo river system represents one of the most geomorphologically dynamic and hydrologically complex river basins in the world. Spanning approximately 580,000 square kilometers, the basin is a transboundary entity encompassing the Tibetan Plateau in China, the Himalayan kingdom of Bhutan, the floodplains of Northeast India, and the deltaic reaches of Bangladesh (Goswami, 1985). In the Indian context, the river enters through the Eastern Himalayas and flows through the narrow, 720-kilometer-long alluvial valley of Assam. This region is characterized by an exceptionally high drainage density and a "braided" channel morphology, a result of the river’s massive sediment load and the tectonic instability of the Himalayan orogeny (Immerzeel, 2008).

Climatologically, the basin is situated within one of the world’s most intense precipitation zones. The South Asian Monsoon, funnelled through the geography of the Assam valley, meets the vertical barrier of the Meghalaya Plateau. This results in the Cherrapunji-Mawsynram belt acting as a primary catchment area, delivering some of the highest recorded annual rainfalls globally—often exceeding 11,000 mm (Dhar & Nandargi, 2000). Consequently, the river’s peak discharge during the monsoon months (June to September) creates a perennial state of hydrological crisis for the downstream riparian populations.

Historically, the indigenous communities of the Brahmaputra valley, such as the Mising and the Ahoms, did not view the river as a hostile force but rather as a source of fertility and transport. They developed a "symbiotic" relationship with the flood cycle, practicing "flood-conditioned" agriculture and utilizing Traditional Ecological Knowledge (TEK) to design stilt houses (Chang Ghors) and adaptive cropping patterns that thrived on the nutrient-rich silt deposits (Saikia, 2019). Pre-colonial water management was largely decentralized and community-oriented, focusing on "living with the river" rather than attempting its total containment (Singh, 2002).

The paradigm shift toward centralized, high-modernist engineering occurred during the British colonial era. The colonial administration viewed the river as a "wild" and "unruly" entity that hindered permanent settlement and land revenue collection (D'Souza, 2006). By categorizing seasonal inundation as a "natural disaster" rather than a biological necessity, the British introduced structural interventions—such as embankments—designed to "tame" the river for the security of tea plantations and timber extraction (Whitehead, 2010). This colonial legacy persists in contemporary management policies, where the reliance on heavy infrastructure often overrides the ecological wisdom of indigenous practices, exacerbating the vulnerability of the region's socio-ecological systems.

3. THEORETICAL FRAMEWORK: ANCIENT INDIAN KNOWLEDGE SYSTEMS (AIKS) AND HYDROLOGICAL WISDOM

The contemporary water crisis, characterized by erratic precipitation patterns and depleted aquifers, necessitates a transdisciplinary approach that integrates modern engineering with Ancient Indian Knowledge Systems (AIKS). The hydrological wisdom embedded in Vedic and post-Vedic literature offers a sophisticated ecological framework that emphasizes harmony, cyclic replenishment, and decentralized governance. This framework is particularly relevant for the Brahmaputra basin and North East India (NEI), where colonial and post-colonial "gray infrastructure" has often disrupted delicate riverine ecosystems.

3.1. VEDIC HYDROLOGY AND ATMOSPHERIC SCIENCE: THE COSMIC CYCLE

The foundations of Indian hydrological thought are rooted in the Vedas, which conceptualize water not merely as a commodity but as a primordial element (Ap) essential for the sustenance of Rta (cosmic order). Rigvedic hymns provide a remarkably accurate description of the hydrological cycle. Rigveda (1.164.51) states: "Samaname tadu daka m uccaityava ca dhibhih / Gham janyanti pavajanya agnim janyanti rodasi," which translates to the process of water moving upward through evaporation and returning as rain through the agency of the sun and wind (Kalyanaraman, 2017). This "Solar-Hydrological" link characterizes the Vedic understanding that the sun (Aditya) draws moisture from the earth and stores it in the atmosphere until the seasonal cycles trigger precipitation.

Additionally, the Atharvaveda elaborates on the classification of waters into various categories: Kupyah (well water), Dhanvanyah (desert water), and Nadyah (river water), demonstrating an early taxonomic approach to water resources. This scientific observation reached its zenith in the 6th century CE with Varahamihira's Brihat Samhita. In the chapter titled Dakargalam (Science of Underground Water), Varahamihira outlines a comprehensive system of "bio-indicators" for groundwater detection. He posits that certain floral species, such as the Jamun (Syzygium cumini), Arjuna (Terminalia arjuna), and Bilva (Aegle marmelos), serve as physiological markers for high water tables (Prasad, 2003).

In the context of the flood-prone North East India, reviving these principles of Vrikshayurveda (ancient botany) offers a sustainable alternative to embankment-heavy flood control. Rather than relying on concrete levees that sever the connection between the river and its floodplains, AIKS advocates for the creation of extensive riparian buffer zones. Utilizing indigenous species identified in the Brihat Samhita can naturally stabilize riverbanks through complex root systems while simultaneously recharging the groundwater—a process far more resilient to the tectonic and alluvial volatility of the Brahmaputra valley than rigid human-made structures.

3.2. KAUTILYAN PRINCIPLES OF RESOURCE MANAGEMENT: DECENTRALIZATION AND NATURAL FLOW

While the Vedas provided the scientific basis, Kautilya's Arthashastra (c. 4th Century BCE) established the socio-political and economic framework for water governance. Kautilya viewed water as a state-protected resource but advocated for a management model that was fundamentally decentralized and community-driven. He introduced the concept of Setubandha (construction of dams and enclosures), but with a crucial caveat: the state must provide land, tools, and technical oversight, while the daily maintenance and operational control remain with local cooperatives (Rangarajan, 1992).

A pivotal tenet of Kautilyan hydrology is the preservation of "Natural Drainage" (Prakriti-vaha). Kautilya warned against the obstruction of natural watercourses, suggesting that any construction—be it a dam, bridge, or settlement—must not impede the flow of the river or the spillways of wetlands. This principle is poignantly relevant to modern Assam, where the construction of linear infrastructure (highways and railways) has frequently ignored the natural "slopes" and "beels" (wetlands) of the landscape. These modern "developmental" barriers act as artificial blockages, exacerbating the severity of flash floods by trapping water in localized pockets and preventing it from reaching its natural drainage basins (Sarma, 2021).

Moreover, Kautilya established a system of "water pricing" (Udaka-bhaga) based on the method of extraction, ensuring that water intensive-agriculture remained economically accountable to the availability of the resource. This reflects an early understanding of what modern economists call the "tragedy of the commons." By integrating Kautilyan principles, modern regional planning in NEI can transition from a "top-down" engineering approach to a "bottom-up" hydrological model. This involves empowering local Panchayats to manage traditional water bodies like the Dong system of the Bodo community, which echoes Kautilya's vision of decentralized, gravity-based irrigation that respects the topography of the land.

The integration of AIKS into modern hydrological frameworks offers a paradigm shift from "controlling" nature to "partnering" with it. The Vedic insights provide the atmospheric and botanical science required for ecological restoration, while Kautilyan ethics provide the governance structures necessary for equitable and sustainable water distribution. By acknowledging these ancient wisdoms, contemporary policy-makers can develop a "Hydrological Renaissance" that protects the unique ecological integrity of the North East Indian landscape.

4. INDIGENOUS KNOWLEDGE SYSTEMS (IKS) IN NORTHEAST INDIA

Northeast India is a biodiversity hotspot inhabited by over 200 distinct ethnic groups, each having evolved unique ecological epistemologies to navigate the region's volatile hydro-climatological conditions. As climate change intensifies the frequency and magnitude of the South Asian monsoon, the limitations of modern embankments and concrete dams have become evident. In contrast, IKS emphasizes "living with the river" rather than attempting to subjugate it (Hazarika, 2006). These practices represent an integrated approach to natural resource management, combining hydrology, architecture, and agronomy to build community resilience.

4.1. THE APATANI SYSTEM: INTEGRATED HYDRO-AGROECOLOGY

In the Ziro Valley of Arunachal Pradesh, the Apatani tribe has developed a globally recognized model of "wet rice cultivation" that functions as a sophisticated water-retention system. Unlike the destructive shifting cultivation (jhum) practiced in some upland areas, the Apatani system is sedentary and permanent, utilizing the valley's topography to manage heavy monsoonal runoff.

The technical core of this system lies in the use of gravity-fed channels. Water is diverted from mountain streams and distributed across stepped terrace fields through a network of bamboo and wooden pipes. Each plot features an intricate set of inlets and outlets (locally known as hubos), allowing for the meticulous regulation of water depth (Kala, 2011). This serves a dual purpose: first, it facilitates the simultaneous farming of rice and fish, where fish excreta serve as natural fertilizer; second, during periods of peak precipitation, the interconnected terrace fields act as "retention ponds." By slowing the velocity of surface runoff and increasing the "time of concentration," the Apatani system prevents the flash flooding of downstream tributaries, effectively acting as a decentralized flood-control mechanism (Dollo et al., 2010).

4.2. MISING TRIBE: THE "CHANG GHAR" ARCHITECTURE

The Mising community of the Brahmaputra Valley demonstrates an exemplary model of climate-adaptive architecture through their traditional Chang Ghars. These stilt-elevated dwellings reflect a profound understanding of fluvial dynamics, respecting the geomorphological necessity of the river's floodplain. In contrast to ground-level concrete structures that obstruct water flow and intensify localized damage, the Chang Ghar's design ensures hydraulic permeability. By allowing floodwaters to transit freely beneath the living quarters, these structures safeguard the household's socio-economic continuity, permitting activities like weaving and livestock maintenance to persist during inundation (Das, 2012a). Moreover, the utilization of indigenous materials—specifically bamboo and thatch—provides a modular flexibility that rigid "grey" infrastructure lacks (Saikia, 2014). This indigenous engineering approach facilitates rapid repair and relocation, positioning the Chang Ghar as a resilient, low-impact alternative to modern urban construction in ecologically volatile riparian zones.

4.3. BAMBOO CHECK DAMS

In the montane catchments of Northeast India, particularly within Meghalaya and Nagaland, indigenous communities employ sophisticated bio-engineering techniques to regulate sediment flux and mitigate erosion. The deployment of bamboo and boulder check dams represents a refined, localized mode of hydro-engineering. Unlike conventional rigid masonry, these permeable structures possess a unique mechanical elasticity; they are designed to dissipate the kinetic energy of mountain torrents rather than imposing an absolute obstruction. This inherent porosity facilitates sediment filtration while maintaining hydrological continuity, thereby preventing the accumulation of hydrostatic pressure—a common precursor to the catastrophic failure of modern concrete dams (Tiwari et al., 2010).

By stabilizing upstream gullies and curbing the siltation of the Brahmaputra and Barak river systems, these indigenous interventions directly address the drivers of riverbed aggradation, which exacerbates flood risks in the Assam plains (Khumlianlal, 2013). These practices—alongside the hydrological precision of the Apatani and the flood-resilient architecture of the Mising—affirm that Indigenous Knowledge Systems (IKS) are not static traditions but adaptive, site-specific scientific methodologies.

As global environmental governance increasingly prioritizes Nature-based Solutions (NbS), there is an urgent imperative to mainstream these indigenous practices into India's formal disaster management frameworks. Validating IKS as a legitimate scientific paradigm necessitates a transition from the "command and control" engineering model toward an "eco-centric" development philosophy. Such a shift respects the complex hydro-social cycles of the region, fostering a more resilient and ecologically integrated approach to landscape management.

5. COMPARATIVE ANALYSIS: MODERN ENGINEERING VS. AIKS

Northeast India's hydrological landscape, defined by the Brahmaputra and Barak basins, faces escalating instability under conventional "structuralist" management. This top-down engineering paradigm, focused primarily on containment, has proven increasingly inadequate, as evidenced by catastrophic breaches and systemic ecological decline. Consequently, contemporary academic discourse is shifting toward Ancient Indigenous Knowledge Systems (AIKS) and Traditional Ecological Knowledge (TEK) as necessary alternatives. By evaluating the limitations of modern engineering against the inherent adaptability of indigenous practices, this analysis asserts that AIKS offers a more resilient, sustainable, and culturally resonant framework. Such a transition is vital for navigating the complex hydrological realities of the Anthropocene while preserving the region's socio-ecological integrity.

5.1. PHILOSOPHICAL DIVERGENCE: CONTROL VS. COEXISTENCE

The fundamental rift between modern engineering and AIKS lies in their ontological perception of water. Modern engineering, rooted in the Enlightenment's "Command and Control" philosophy, views the river as a hydraulic machine that must be "tamed" to protect human capital (Baruah, 2012). This manifests in the construction of massive embankments and multipurpose mega-dams designed to confine the river to a fixed channel.

Conversely, AIKS is built upon the philosophy of "Flood Adaptation" or "Living with the River." Indigenous communities in the Brahmaputra valley, such as the Mising and the Bodos, perceive the river as a living entity. Flooding is not viewed as a "disaster" but as a rejuvenating pulse of the ecosystem. As noted by Saikia (2019), AIKS focuses on adjusting human habitation and agriculture to the river's rhythmic ebbs and flows rather than attempting to alter the river's geomorphological trajectory.

5.2. STRUCTURAL AND ECOLOGICAL COMPARISON

The divergence between modern engineering and Indigenous Knowledge Systems (AIKS) is starkly reflected in their spatial applications. Contemporary strategies favor "hard" infrastructure; however, embankments often trigger "hydro-social" paradoxes. By obstructing minor seasonal flows, such structures accelerate siltation and elevate riverbeds, paradoxically increasing the risk of catastrophic breaches (Mishra, 2001).

Conversely, AIKS prioritizes "soft," nature-based interventions. The Mising community's Chang-Ghar (stilt houses) accommodate inundation, while the Bodo Dong system employs localized canals to manage irrigation and groundwater (Agarwal & Narain, 1997). Unlike rigid barriers, these traditional practices preserve the ecological connectivity between rivers and wetlands (Beels). This approach protects biodiversity and utilizes floodplains as natural "sponges," effectively mitigating hydraulic pressure through environmental resilience rather than structural resistance.

Table 1

Table 1 Extended Comparison of Water Management Paradigms

Feature	Modern Structural Approach AIKS	Indigenous Approach
Philosophical Goal	Flood Control (Elimination of risk)	Flood Adaptation (Resilience/Coexistence)
Primary Structures	Embankments, Mega-Dams, Spurs	Wetlands, Riparian Buffers, Stilt Architecture
Ecological Impact	High: Habitat fragmentation, loss of fish migratory paths	Low: Maintains river-floodplain connectivity
Cost Dynamics	Capital intensive; Requires high-tech maintenance	Low cost; Community-driven/Labor-intensive
Sustainability	Short-term (High risk of "structural failure")	Long-term (Self-regenerating and adaptive)
Knowledge Base	Top-down (Technocratic/Bureaucratic)	Bottom-up (Traditional Ecological Knowledge)
Response to Silt	View as a nuisance (leads to bed rising)	View as a resource (natural nutrient/fertilizer)
Climate Resilience	Low: Rigid structures fail under extreme events	High: Flexible systems absorb climate shocks
Social Inclusion	Marginalizes local riverine communities	Empowers local communities and stewards

5.3. SILT MANAGEMENT: ASSET VS. LIABILITY

One of the most striking differences lies in the treatment of sediment. The Brahmaputra carries one of the highest sediments loads in the world. Modern engineering views this silt as a management liability because it chokes reservoirs and raises riverbeds inside embankments. In contrast, AIKS views silt as "Gold." The traditional agricultural calendar in NEI is synchronized with the deposition of Olu (fertile silt), which naturally replenishes soil nutrients without the need for chemical fertilizers (Sarma & Phukan, 2004). By allowing controlled flooding, AIKS ensures the continued productivity of the floodplains.

5.4. SOCIO-ECONOMIC CONSIDERATIONS

Modern structural interventions are often characterized by high capital expenditure and a reliance on external expertise, often leading to a "maintenance crisis" in post-colonial states. Conversely, AIKS is decentralized. The maintenance of Dongs or the reconstruction of Chang-Ghars is a community-led effort, fostering social cohesion and reducing dependency on state machinery. This "Bottom-up" approach aligns with the Sendai Framework for Disaster Risk Reduction, which emphasizes the role of local and indigenous knowledge in building resilience.

While modern engineering provides essential tools for urban protection and large-scale energy needs, its application in the fragile eco-sensitive zones of Northeast India has reached a point of diminishing returns. The path forward lies in a transdisciplinary synthesis: integrating the precision of modern hydrological modeling with the wisdom of AIKS. Recognizing the river's right to its floodplain—a core tenet of indigenous knowledge—is no longer a romanticized notion but a scientific necessity for the sustainable management of NEI's water resources.

6. INTEGRATING AIKS INTO MODERN POLICY: THE HYBRID MODEL

The escalating frequency of catastrophic flooding in the Brahmaputra valley necessitates a departure from purely techno-centric engineering interventions. Modern flood management has historically relied on "hard" infrastructure, such as embankments and geo-bags, which often disrupt natural fluvial processes and cause long-term ecological degradation. To address this, a "Hybrid Model" is proposed—a synthesis of Ancient Indian Knowledge Systems (AIKS) and contemporary environmental science. AIKS, rooted in millennia of observational data and metaphysical reverence for nature, offers a blueprint for Nature-Based Solutions (NbS) that can be integrated into the National Water Policy and regional disaster management frameworks.

6.1. NATURE-BASED SOLUTIONS (NBS) AND "BEEL" RESTORATION

The Brahmaputra valley features an extensive network of beels—perennial wetlands and oxbow lakes—which historically served as natural flood-mitigation reservoirs. Rooted in Assamese Indigenous Knowledge Systems (AIKS), these ecosystems align with the Vedic concept of Pushkarinis (sacred tanks). Ancient treatises such as the Mayamatam and Kautilya's Arthaśāstra categorize these water bodies as vital state assets, mandating rigorous protection against pollution and encroachment (Shamasastry, 1915).

Contemporary environmental policy must transcend the perception of wetlands as "wastelands," instead reclassifying them as essential hydro-infrastructure (Mishra, 2017). By implementing restorative measures—specifically desilting and clearing illegal encroachments—these water bodies can function as a "sponge city" mechanism. This approach utilizes the wetlands' natural capacity to sequester monsoon runoff, thereby alleviating hydro-geomorphological pressure on the river's main channel and harmonizing traditional ecological wisdom with modern urban resilience strategies.

6.2. BIO-SHIELDING AND RIPARIAN FORESTRY: THE PRINCIPLES OF VRIKSHAYURVEDA

Current erosion control measures often involve non-biodegradable geo-synthetic bags and concrete boulders, which are frequently undermined by the river's high kinetic energy. AIKS offers a more resilient alternative through the principles of Vrikshayurveda (the science of plant life). Ancient texts such as Surapala's Vrikshayurveda emphasize the selection of specific flora for soil stabilization and moisture retention (Sadhale, 1996).

A "Green Embankment" program would replace artificial barriers with a multi-layered canopy of native riparian species. Table 2 outlines the comparative advantages of this hybrid approach.

Table 2

Table 2 Comparison of Conventional Engineering vs. AIKS-Inspired Bio-Shielding

Feature	Conventional Engineering (Hard)	AIKS-Inspired Bio-Shielding (Soft)
Materials	Geo-bags, Concrete, Steel	*Bambusa balcooa*, Vetiver grass, *Terminalia arjuna*
Sustainability	Low (Degrades over time, non-biodegradable)	High (Self-regenerating and carbon-sequestering)
Ecological Impact	Disrupts riparian habitats	Enhances biodiversity and creates corridors
Soil Binding	Mechanical/Surface level	Deep biological binding (Vetiver roots reach 3-4m)
Cost	High capital and maintenance costs	Low cost; community-maintained

The use of Bambusa balcooa (native bamboo) and Chrysopogon zizanioides (Vetiver grass, known in Sanskrit as Ushira) is particularly effective. Vetiver's complex root system acts as a "biological nail," binding the alluvial soil of the Brahmaputra floodplains far more effectively than rigid structures (Lavania, 2003).

6.3. COMMUNITY-LED DECENTRALIZED GOVERNANCE: THE SABHA SYSTEM

A significant flaw in modern flood management is the top-down, centralized approach which often ignores local topography and temporal nuances. AIKS advocates for a decentralized governance model, reminiscent of the ancient Sabha and Samiti systems. These local assemblies were responsible for the maintenance of village commons, including irrigation canals and embankments.

Modernizing this involves the creation of village-level "Water Committees" empowered by the 73rd and 74th Constitutional Amendments. These committees leverage Traditional Ecological Knowledge (TEK)—such as the "Mising" community's knowledge of stilt-house (Chang Ghar) construction and seasonal river shifts. By involving local elders and indigenous experts, policy ensures that data-driven modern science is tempered by historical site-specific wisdom. This decentralization fosters a sense of "common property resource" (CPR) management, reducing the reliance on inefficient state bureaucracies (Singh, 1994).

The revival of Ancient Indian Knowledge Systems in the context of the Brahmaputra valley is not a regression to the past, but a progression toward a more resilient future. The Hybrid Model—combining the structural insights of Vrikshayurveda, the water management principles of the Arthaśāstra, and the democratic spirit of the Sabha—offers a sustainable, cost-effective, and culturally resonant path to mitigating the perennial crisis of flooding.

7. CHALLENGES IN REVIVING AIKS

1) Documentation Gap and Epistemological Erosion: The primary hurdle is the "knowledge-action gap" created by the oral nature of indigenous wisdom. In NEI, knowledge regarding soil porosity, seasonal river behavior, and biological indicators of floods is transmitted through folklore, proverbs, and practice (Agrawal, 1995). As the younger demographic migrates to urban centers for economic opportunities, the intergenerational chain of transmission is breaking. Without formal documentation, this tacit knowledge disappears with the elders (Maffi, 2005). Furthermore, the colonial and post-colonial emphasis on "formal science" has historical delegitimized indigenous observations, labeling them as "superstitious" rather than empirical, which discourages their inclusion in modern disaster management frameworks.
2) Anthropogenic Alterations and Land Use Changes: The efficacy of AIKS is predicated on a specific landscape. However, the topography of NEI has undergone drastic transformations. Massive deforestation in the catchment areas of Arunachal Pradesh and Bhutan has increased sediment loads, rendering ancient desilting techniques less effective. Unplanned urbanization in cities like Guwahati has paved over natural "beels" (wetlands) and traditional drainage channels (Deka, 2019). Consequently, many ancient hydrological strategies are no longer viable because the physical environment they were designed for no longer exists. The disconnect between traditional spatial planning and modern "concrete-heavy" development has created a landscape that is hostile to indigenous water-management logic.
3) Bureaucratic Inertia and the Engineering Paradigm: Perhaps the most significant barrier is the entrenched "contractor-engineer nexus." Flood management in India has historically favored structural interventions—primarily embankments and spurs. These projects are capital-intensive and provide lucrative opportunities for a network of contractors and bureaucrats (Baruah, 2021). Indigenous solutions, which often involve low-cost, nature-based interventions, do not provide the same "rent-seeking" opportunities. This bureaucratic inertia fosters a reliance on "hard" engineering solutions that often exacerbate flooding by trapping water in the hinterlands and preventing natural silt deposition.

8. POLICY RECOMMENDATIONS

To leverage the resilience inherent in Ancestral and Indigenous Knowledge Systems (AIKS), a multi-dimensional policy recalibration is imperative. This strategic shift moves beyond mere acknowledgment toward the formal institutionalization of indigenous wisdom across governance sectors.

First, educational frameworks must bridge the divide between standardized curricula and local ecological intelligence. By embedding Traditional Ecological Knowledge (TEK) into the state school systems of Northeast India, authorities can cultivate place-based environmental stewardship. For instance, incorporating the Zabo irrigation system or the hydrological functions of native flora ensures AIKS remains a functional science rather than an archival curiosity. This pedagogical integration also facilitates intergenerational knowledge transfer, positioning elders as active contributors to formal learning environments.

Second, housing policies must incentivize traditional resilient architecture. The Chang Ghar, or stilt-house design typical of the Mising and Deori communities, remains a pinnacle of flood-adaptive engineering. Current state-led housing schemes often prioritize concrete structures that exacerbate heat stress and lack long-term flood resilience. Policy should pivot toward granting subsidies or insurance discounts for elevated, permeable designs that reflect indigenous expertise. Such "incentivized adaptation" aligns modern urban planning with local hydro-morphological realities, ensuring human safety without disrupting natural water cycles.

Third, flood governance must transition from "flood control" to a "flood management" paradigm, drawing inspiration from the "Room for the River" philosophy. This approach mirrors historic agricultural practices in the Brahmaputra valley by legalizing controlled flooding zones. By designating specific wetlands for seasonal overflow, governance can facilitate soil rejuvenation through natural siltation while mitigating downstream pressure on embankments. This requires a robust legal framework for dynamic land-use zoning that treats floodplains as transient spaces rather than static property.

Finally, fiscal support should be directed toward ethno-hydrological research. This interdisciplinary frontier synthesizes geospatial technologies—such as GIS and satellite imagery—with local oral histories to reconstruct traditional drainage networks. By validating indigenous observations with empirical meteorological data, policymakers can develop more nuanced early warning systems and sustainable infrastructure master plans.

9. CONCLUSION

The annual inundation of the Brahmaputra River basin in Northeast India represents a profound epistemological impasse, transcending the boundaries of a mere hydrological phenomenon to signify a deeper "crisis of knowledge." For decades, the state's response to this seasonal volatility has been anchored in a Western, techno-centric paradigm that prioritizes "command and control" through structural interventions. However, the recurring collapse of large-scale embankments along the Brahmaputra underscores the inherent inadequacy of rigid structural engineering in managing a river defined by sediment discharge, seismic volatility, and complex braided dynamics. These techno-centric interventions often fail because they perceive the watercourse as a static hydraulic machine rather than a dynamic geomorphological entity. Consequently, a fundamental paradigm shift is required—one that moves beyond the hubristic ambition to "tame" the hydrologic cycle in favor of the nuanced, hydro-social insights offered by Ancient Indian Knowledge Systems (AIKS).

AIKS advocates for a holistic framework centered on the philosophy of "living with the river," wherein floodplains are respected as integral ecological extensions rather than mere territory for urban reclamation. This perspective is exemplified by the indigenous practices of the Mishing and Deori communities. Through stilt-based architecture and seasonal migratory patterns, these tribes align their socio-economic activities with the river's natural pulse. Instead of viewing inundation as a singular catastrophe, they recognize floods as vital regenerative forces that deposit nutrient-dense silt, thereby sustaining regional biodiversity and agricultural fertility.

Integrating this "Loka-Vidya" (folk knowledge) with contemporary hydrological modeling represents a sophisticated strategy for climate resilience rather than a regressive retreat into nostalgia. Such a synthesis allows for the formulation of adaptive management policies that respect the river's agency. By transitioning from a reactive disaster-response mindset to a proactive, resilience-based philosophy, India can move toward a sustainable model of coexistence. Ultimately, by valuing indigenous wisdom and the Brahmaputra's inherent rhythms, the region can transform the "River of Sorrow" into a vital source of prosperity. This evolution ensures that water management is not a battle against nature, but a collaborative endeavor that fosters regional stability and long-term ecological health. Such synthesis redefines the nexus of tradition and modernity.

CONFLICT OF INTERESTS

None.

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