Innovations in Nature-Based Solutions for Urban Flood Management in the Global South

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INTRODUCTION

Urban flooding has grown to be a major issue for many communities worldwide in recent years. Cities' rapid growth due to population growth and bustling development isn't the only issue, however it plays a significant role. Unusual weather patterns and rising sea levels brought on by climate change are making matters worse by making floods more regular and powerful. Communities must therefore take swift action and develop better planning in order to lessen the harm that these issues may cause. It's critical to comprehend how flood dangers are evolving in urban areas, not only to safeguard residents but also to maintain the safety of vital infrastructure and local economy (Rubinyi & Eisenberg, 2023). Strong and proactive flood management strategies are crucial in urban areas, as demonstrated by past flood disasters and the growing effects of climate change (Chang et al., 2024).

Traditional flood control techniques, such as dams, levees, flood barriers, dredging, and setting aside floodplains, have long been important for managing rising water levels and protecting communities from flood damage, but they have limitations, including the potential for high construction and maintenance costs, adverse environmental effects, and potential inefficiency in areas with rapid development or limited resources. As a result, traditional solutions are becoming less effective in addressing today's more frequent and severe flood threats (Corporation, 2025).

As the risk of floods increases, more individuals are considering nature-based solutions (NBS) as a viable and environmentally responsible answer. Restoring rivers, wetlands, or forests are examples of how to use nature to reduce the risk of flooding. Nature-based solutions are actions that collaborate with nature to address social, economic, and environmental issues in a more flexible and long-lasting manner, according to the United Nations Environment Assembly. The objective is to improve flood control, irrigation, and wastewater systems in order to safeguard both people and the environment. Although they might not provide instant fixes, nature-based solutions benefit communities in the long run by keeping them safe, balanced, and better equipped to handle challenges in the future (Asian Development Bank, 2022). NBS works with nature, in contrast to conventional flood control methods that usually depend on substantial infrastructure. According to The Australian National University (2024), they allow the land to naturally regulate water, reducing the risk of floods, fostering flourishing ecosystems, and protecting the local people.

To gain a more comprehensive understanding of this issue, this study seeks to explore recent innovations in nature-based solutions for urban flood control, with a particular focus on their application and effectiveness in selected countries within the Global South—namely the Philippines, Bangladesh, and Brazil. By examining these case studies, the research aims to highlight context-specific strategies and insights that can inform more sustainable and resilient flood management approaches in similarly vulnerable regions.

CORE DISCUSSION

Flooding has become a regular concern for many people living in fast-growing cities, especially in the Global South. As urban populations increase and climate change leads to more unpredictable weather, communities are facing greater risks—often without enough resources to cope. This section delves deeper into the reasons

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why some areas are particularly at risk and how, in situations when conventional approaches are insufficient, nature-based alternatives are providing fresh hope.

Urban Flooding and the Global South

Flooding is one of the most significant climate-related hazards to cities in the Global South, especially in informal settlements where inhabitants are most vulnerable (Bhanye, 2025). More and more people are settling in flood-prone areas—often without fully understanding the risks involved. A 2021 study published in Nature found that between 2000 and 2015, the number of people living in areas at risk of flooding grew by 58 to 86 million, which is significantly higher than earlier estimates had suggested. At the time, this rise was about twice as fast as the pace of population growth worldwide. Researchers found that many communities are growing into high-risk regions without proper security, particularly in susceptible locations, based on satellite data. These results point to a serious weakness in the way communities are preparing for the increasing probability of flooding, particularly as extreme weather events become more frequent due to climate change (Nugent, 2021).

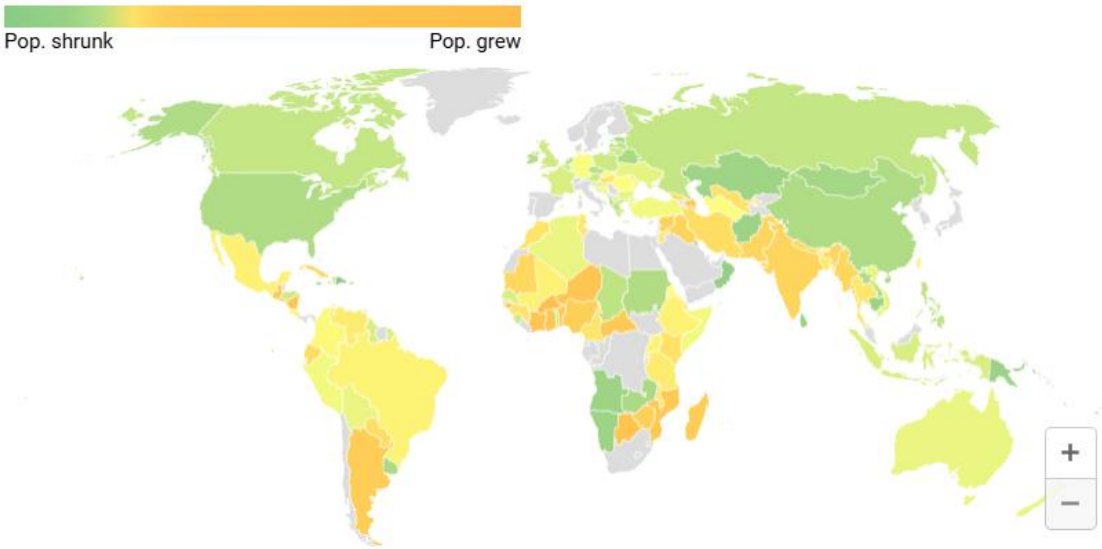

Figure 1.1 Changes in proportion of population exposed to floods between 2000–2015. Note. Source: Cloud to Street (2021).

According to research, flood hazards are growing faster in many parts of South and Southeast Asia. For example, by 2015, approximately 20 million people lived in flood-prone areas in Pakistan's Indus River basin, a 36% increase since 2000; over 134 million people were at risk of flooding in the Ganges-Brahmaputra basin, which includes Bangladesh and India; and over 33 million people were impacted in the Mekong basin, which includes China, Vietnam, Laos, and Cambodia. Significant increases were also seen in Southern Africa, Western Africa, and Central America. “When coupled with inadequate infrastructure and other socioeconomic problems, rapid urbanization and a lack of affordable housing often push people to live informally in high-risk areas, making countries in the Global South particularly vulnerable to flooding,” said researcher Beth Tellman, Chief Scientist and Co-Founder of Cloud to Street (Nugent, 2021; Tellman et al., 2021; Watts, 2023; Satterthwaite, 2022).

Nature-based Solutions: Definition and Benefits

An approach to flood management known as "nature-based solutions" (NBS) uses natural features and processes, or mimics them, to manage flood risk and increase the resilience of ecosystems and communities. It differs from traditional, engineered "gray" infrastructure, such as dams, levees, and concrete channels. Nature-based solutions are not one-size-fits-all solutions or quick fixes; rather, they are part of a larger, long-term approach that supports community well-being, strengthens ecosystem resilience, and helps areas adapt more effectively—paving the way for greener and more sustainable development. Instead of working against nature,

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue IX September 2025

these techniques work with it. For example, planting trees along the beach or restoring mangroves can help protect people from strong waves and eventually fortify the land. Communities can find solutions that truly meet their needs by combining these natural methods with conventional infrastructure. Their contributions to environmentally friendly flood control, waste-water treatment, and irrigation modifications make communities safer, greener, and more comfortable places to live (Endo et al., 2022).

Global scholarship highlights a persistent tension between reliance on "grey" infrastructure and the growing promise of NBS. While traditional approaches together with levees and dams provide instant flood protection, they often lack flexibility and generate high protection prices (Corporation, 2025). NBS, via assessment, supply multifunctional advantages from water law to biodiversity assist and network well-being by positioning them not merely as ecological options but as vital complements within hybrid resilience techniques (Endo et al., 2022; The Australian National University, 2024).

The benefit of these kind of solutions lies when maintenance and repairs are factored in, nature-based solutions over time are frequently more affordable than conventional infrastructure. Along with preventing floods, they may also help with animal construction projects, filter water, store carbon, and provide green areas for people to enjoy. These natural systems are more adaptable than concrete structures because they can better adapt to variations in the weather and temperature. In addition, compared to large-scale construction projects, they usually cause less pollution and environmental harm to extensive construction projects. Essentially, nature-based flood control methods provide a comprehensive and sustainable approach to water management by utilizing the innate strength of robust ecosystems to build resilient habitats and societies.

Innovative Examples of Nature-based Solutions

Many countries in the Global South have to deal with smaller budgets than wealthier ones, which can afford high-tech infrastructure or large flood barriers. In a more cost-effective, environmentally responsible, and inclusive way, nature-based solutions can aid in flood management. By preserving agricultural and fishing lands, enhancing the environment, and defending villages, they benefit people. Most significantly, the local population is not viewed as powerless by these solutions. Rather, they empower them, include them in decision-making, and assist them in confidently and proudly caring for their own land and future. It alters the focus from passive victims of climate change to proactive environmental stewards.

Bangladesh: Community-built Flood Canals

A great way to catch rainwater is to dig a large hole in the ground. In a similar vein, one can increase the amount of space available to absorb floodwater that would otherwise destroy houses, businesses, and livelihood by reestablishing canal systems, especially in low-lying locations. Canals have lock systems that allow us to regulate water flow and divert it away from people, unlike lakes or ponds. Because canals may be connected to existing storm-water management systems or sewers to further lessen the danger of flooding, canal restoration is very helpful in towns and cities when it comes to controlling floods. In certain situations, the canal water can be channeled to other places and then reintroduced into neighboring rivers to replenish evaporated water in the summer or in arid region (Buckingham Canal Society, 2024). Similarly, Canal & River Trust (n.d.) defined canals as artificial channels that cut across natural drainage paths. In certain places, they might assist reduce the risk of floods with the correct investment. To prevent homes and businesses from flooding, they can stop drainage, lower flows, and even reroute water away from neighborhoods and vulnerable structures. A number of our river features, such as locks, sluices, and weirs, may also be altered to enhance flood risk management.

In Bangladesh's heavily populated delta areas, canals built by the local populace have long been essential to water management. They reduce the risk of floods during the monsoon season by draining fish and other aquatic resources that sustain livelihoods and, in certain places, provide water for household consumption. They support local agriculture and food security by providing irrigation during the dry months. Besides their practical use, these canals provide habitat for fish, shrimp, and other aquatic life, which are important food and income sources for many families, and they are important for maintaining biodiversity and the delicate balance of the wetland ecosystem. They also often serve as community centers where people gather, share knowledge,

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue IX September 2025

and build relationships, and they are vital to the physical landscape and the social and cultural fabric of the area, making them an important part of environmental health and community well-being.

To ensure these canals' lifespan and capacity to handle the region's particular environmental difficulties, local people collaborate to construct, maintain, and manage them using traditional knowledge that has been passed down through the years. The canals are so unique because of this collaboration. Many people rely on these canals for their water requirements, especially when it is hard to obtain other sources, making them essential to everyday life. The canals also preserve the health of the nearby wetlands, which support a range of plants and animals and preserve environmental balance, by naturally removing pollutants.

Figure 1.2 Gazir Canal in Nehalpur village, Jashore, Bangladesh restored to flow through local dredging efforts in March 2023.

Note. Source: Solidaridad Network (n.d.).

Philippines: Mangrove-based Buffer Zones

From shrubs to tall trees, mangroves are salt-tolerant trees that have adapted to live in brackish and salty water conditions; they can be found along sheltered tropical mudflats or wetlands, or in association with estuaries and lagoons, and they can also extend inland along rivers, streams, and their tributaries. Mangroves require calm seas and fine silt to anchor to in order to develop themselves (Bohol Philippines, n.d.). Not only do they protect coastlines, but their fallen leaves break down over time into microscopic particles called detritus, which attract nutrient-rich microscopic organisms: fish, crabs, shrimp, and many other marine animals consume the nutrient-rich layer these microscopic organisms form on the leaf fragments, making them vital to the marine food web.

Mangrove trees are vital to local residents' daily life in addition to providing hurricane defense for coastal communities. Their sturdy wood is highly valued for use in traditional medicine, home construction, and even the making of charcoal. The tangled roots reduce erosion, flood damage, and wave damage in addition to preserving the shoreline by retaining the soil and capturing silt. They also take this action to save the habitats of seagrass beds and coral reefs in the area. Not to mention the mangroves' unrealized tourism potential. Exploring the vast biodiversity in locations like Bicol and Palawan while snorkeling through their meandering roots offers tourists both educational opportunities and a reliable source of revenue for the local inhabitants (Viray-Mendoza, 2017).

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue IX September 2025

When the devastating Typhoon Rai slammed Siargao Island in 2021, for example, more than 8,000 hectares of mangrove forests broke the energy of the waves and protected coastal people, contributing to a low fatality rate, wetland specialists believe. Under similar circumstances, Negros Occidental, a sugar-producing province in the Philippines, has faced constant threats from typhoons and floods. In response, the province chose to work with nature by creating the country's first coastal greenbelt in 2022—wide strips of mangroves and beach trees that help shield communities from storms and erosion. The concept of utilizing greenbelts to save the coastline is not new; in fact, as early as 2007, the International Union for Conservation of Nature acknowledged the advantages of employing them to combat problems like wind and sea erosion. A national policy that would designate coastal greenbelt zones according to the degree of risk from storm surges, tsunamis, and other hazards—while concurrently promoting the conservation of coastal biodiversity—is presently under consideration because the Philippines is regularly struck by natural disasters (Quodala, 2025).

Figure 1.3 A Mangrove Conservation Area in Talibon Bohol

Note. Source: Bohol Philippines (n.d.)

Brazil: Rain Gardens and Urban Wetland Parks

Even before it became the primary financial center of Brazil, São Paulo was known as the "country of drizzle," or terra da garoa, because of its frequent and gentle showers. However, during the second half of the 20th century, when the population rapidly swelled to about 12 million, temperatures rose due to an increase in concrete and human activity. This warming has drastically altered the city's environment, intensifying the once-gentle drizzles and making storms more lethal. Heavy rains have killed people and caused outages in previous years. By the end of the century, São Paulo may have twice as many rainy days due to the possibility of global temperatures increasing by 2°C or more. Rainfall over 50 mm per day, which was previously uncommon, has increased in frequency, indicating a significant change from the mild rains the city was accustomed to.

To prevent water from collecting, curbside gardens with green shrubs have been constructed on side streets. They have been placed along busy streets, such as 23 of May Avenue, where prairie grass is currently peeking

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue IX September 2025

over the railings of the median. Existing parks at the base of hills and on slopes are being redesigned, excavated, and replanted with plants that can better absorb water that flows down from higher elevations. Additionally, gardens have been crammed into areas that are vulnerable to flooding, like concrete stairwells, where they are frequently spaced out next to steps, and crammed into congested streets as vagas verdes, or green parking areas, which may have a few bushes or a small tree.

São Paulo's city hall started its own official program and accelerated it, taking inspiration from New York City, which has put thousands of rain gardens in place. In 2017, there were just 23 gardens; today, there are 337, and by the end of the year, there should be 400. Plots are excavated into sidewalks or streets to a depth of approximately 1.2 meters (3.9 feet), and then filled with compost-rich soil, debris, and plants that are slightly below the pavement. The mini-gardens can help reduce local air temperatures and are highly absorbent because of the porous soil and rock layers. City planners often point to other positive, harder-to-measure effects of a little greenery on an urban environment, such as improved mental health (Rosati & Millan, 2024). By mimicking the ability of a natural absorber to remove pollutants,Whether in a forest or meadow, rain gardens may capture runoff up to 30% to 40% more efficiently than regular grass. In a rain garden, rainfall is collected, held, and then released gently into the soil to reduce and purify the surge of runoff following a large storm in a fast, tidy, and natural way. Rain gardens are a great approach to mitigate the impact of impermeable surfaces and contaminated runoff because they are inexpensive, low-tech, eco-friendly, and aesthetically pleasing.

Figure 1.4 Urban Rain Garden Adjacent to Bixiga Arches, São Paulo, Brazil

Note. Source: Rosati & Millan (2024)

Aside from rain gardens, Fortaleza, Brazil’s environmental recovery plan relies heavily on the preservation and use of wetlands. The newly developed Rachel de Queiroz Park is built within one of the city’s flood-prone conservation areas, using the natural drainage system as a key design feature. A network of green sports fields, nestled between walkways linking lagoons and marshes, also helps improve the water quality of the Riacho Cachoeirinha. After hydrological studies showed that nine connected ponds and lagoons would provide the finest water filtration system, the park was established. Decanting and phytoremediation—a technique whereby microorganisms on the soil's surface and on aquatic plants' roots aid in water purification—would be used in the ponds. The residents' mood and degree of satisfaction have been greatly improved by the new park. There are playgrounds, sports courts, a dog park, an amphitheater, and trails that wind between the park's ponds. The park has a track that offers a safe space for walking and exercising, as well as a reading nook and an outdoor gym. Making the park a pleasant site for people to utilize was given special attention in order to prevent it from being used for trash disposal again. Durable and sustainable playground equipment, eucalyptus

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue IX September 2025

wood arbors, and bio-synthetic seats on concrete bases for seating were all part of an initiative to furnish the park sustainably (Cowan, 2022).

Figure 1.5 Parque Rachel de Queiroz Integrated with Wetlands in Fortaleza, Brazil

Note. Source: Cowan (2022)

All these nature-based solutions done in some countries in the Global South are low-cost and replicable. The community-built canals in Bangladesh are often dug manually by local residents using basic tools, requiring little to no heavy machinery or high-tech engineering. Maintenance is also minimal and often community-led. Any flood-prone rural or peri-urban area with available land and community involvement can implement similar systems. Because it uses local knowledge and labor, it doesn't rely on external expertise or expensive materials. Because magroves naturally grow along coastlines and do not need constant maintenance once established, magrove-based buffer zones in the Philippines are inexpensive. The seedlings can be obtained locally, and many tropical coastal regions have the characteristics necessary to maintain mangroves. Local volunteers or fishermen frequently carry out planting campaigns. Similar tactics can be used by communities in Asia, Africa, and Latin America through local collaborations with native species. In Brazil, rain gardens and urban wetland parks absorb and filter storm water using natural materials like plants, soil, and existing terrain. Advanced infrastructure is not needed for construction, and continuing upkeep is comparable to caring for a garden or park. Any city that has room for green infrastructure can use these ideas. They're modular (may be big or small), making them easy to scale in both wealthy and resource-limited cities

Comparative analysis of NBS Cases

To synthesize insights from the three case studies, Table 1 provides a comparative overview. It highlights the key success factors, barriers, and transferability of community-built canals, mangrove buffer zones, and urban rain gardens/wetlands. This comparison clarifies how locally specific initiatives can nonetheless yield generalizable essons for other contexts in the Global South.

Bangladesh	Community-built flood canals	Local knowledge, low-cost manual labor, community ownership	Encroachment, weak policy integration	High – adaptable to peri-urban Asia & Africa

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue IX September 2025

Philippines	Mangrove buffer zones	Strong cultural/ecological value, coastal defense, local participation	Governance failures, overlapping jurisdiction	High – tropical coastal regions
Brazil	Rain gardens & wetland parks	Integrated into urban planning, health co-benefits, modular design	Land-use conflicts, weak financing	High – cities with green space

Table 1. Comparative analysis of NBS cases in Bangladesh, the Philippines, and Brazil, showing success factors, barriers, and transferability

A Conceptual Model for Scaling NBS in Urban Flood Management

While the comparative table identifies commonalities and differences across cases, it does not show the dynamic relationships between enabling conditions, strategies, and outcomes. To address this, a conceptual model is proposed.

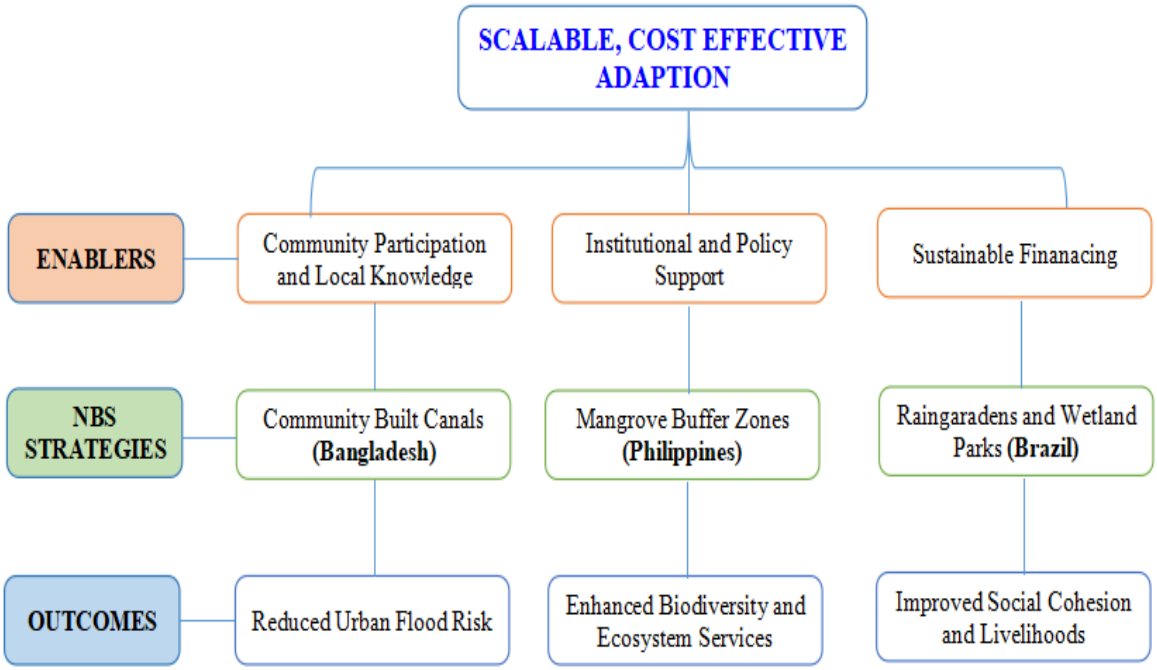

Figure 2. Conceptual model (author's own) illustrating how enabling factors drive the effectiveness and scalability of NBS strategies for urban flood management in the Global South

To synthesize the case study findings, this study proposes a conceptual model that flows downward from enabling factors to strategies, then to outcomes, and finally to scalable adaptation (Figure 2).

At the top level, the model emphasizes the overarching goal of scalable, cost-effective adaptation. Achieving this requires alignment across multiple tiers.

The first tier below identifies the enabling factors: community participation and local knowledge, institutional and policy support, and sustainable financing mechanisms. These elements provide the foundation that determines whether NBS projects can be initiated, maintained, and scaled. The second tier highlights the NBS strategies documented in this study: community-built canals in Bangladesh, mangrove buffer zones in the Philippines, and rain gardens and wetland parks in Brazil. These represent locally tailored interventions that address specific flood risks. The third tier presents the outcomes generated by these strategies, including reduced urban flood risk, enhanced biodiversity and ecosystem services, and improved social cohesion and livelihoods.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue IX September 2025

By showing the flow from enablers to strategies to outcomes, the model underscores that sustainable adaptation is not the result of isolated interventions but of systems built on participation, governance, and financing. This downward framework makes clear how context-specific measures contribute to the broader resilience agenda in the Global South.

Barriers and Challenges

Nature-based solutions show great promise for assisting communities in adapting to climate change while also restoring ecosystems. However, implementing these ideas is not always easy, particularly in many sections of the Global South. In many areas, those who attempt to apply nature-based solutions frequently encounter actual issues, such as a lack of financing, ambiguous regulations, or a lack of official backing. They even handle land disputes occasionally. Regretfully, the planning process frequently excludes those who are most affected by climate change. To ensure the success of nature-based initiatives, it is essential to directly address these challenges and identify practical, context-specific solutions.

Policy and Funding Gaps

Despite their obvious benefits for climate resilience and disaster mitigation, community-built flood canals in Bangladesh, mangrove buffer zones in the Philippines, and urban green infrastructure such as rain gardens and wetland parks in Brazil continue to face significant implementation challenges due to fragmented policies, inconsistent funding mechanisms, and inadequate integration into national development plans. In Bangladesh, community-led canal restoration efforts are frequently undermined by formal planning frameworks, making local projects subject to neglect or disruption (World Bank, 2025). Given the effectiveness of mangrove-based fortifications in the Philippines, repair and maintenance are hampered by overlapping jurisdiction and a lack of national funds (Oceana, 2023). Brazil's efforts to incorporate nature-based solutions such as rain gardens into urban planning are also hindered by a lack of long-term funding, maintenance concerns, and institutional coordination (Rosati & Millan, 2024). Addressing these gaps is critical to scaling up these low-cost, locally adapted solutions throughout the Global South.

Informal Settlements and Land-use Conflicts

While conflicts over fishpond development, land reclamation, and inadequate coastal land-use governance undermine mangrove buffer zones in the Philippines, unplanned informal urban growth into designated green infrastructure zones in Brazil makes it difficult to implement rain gardens and wetland parks despite their proven benefits for flood mitigation, and in Bangladesh, informal settlements frequently encroach on community-built flood canals, reducing their drainage capacity and increasing flood vulnerability (A.M. et al., 2022; Eco-Business/Thomson Reuters Foundation, 2025; Mendes et al., 2023).

Need for Local Participation

Through community-built flood canals, local involvement is crucial to flood risk management in Bangladesh, particularly in char-land areas where local citizens are empowered by community-based organizations to carry out and maintain localized flood adaptation measures (Huq et al., 2021). Local fishermen and people's organizations are frequently at the forefront of planning, planting, and protecting mangroves for both ecological and livelihood benefits; in the Philippines, involving coastal communities in the restoration and stewardship of mangrove buffer zones has produced more effective, long-term results (Israel et al., 2004; Primavera & Esteban, 2008). Similar to this, community involvement is essential to the success of wetland parks and urban rain gardens in Brazil, like those in São Paulo and Rio de Janeiro, where locals work together to co-design, maintain, and raise awareness, improving social cohesion and environmental resilience (Mendes et al., 2023; Rosati & Millan, 2024). The incorporation of local perspectives enhances the longevity and design of nature-based solutions in these nations.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue IX September 2025

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

This study examined progressive nature-primarily based solutions (NBS) for city flood management in Bangladesh, the Philippines, and Brazil. Each case demonstrates that domestically grounded, low-price, and ecologically adaptive tactics can effectively address urban flooding. Despite differences in geography and socio-political context, several common success elements emerged: reliance on nearby understanding, lively community participation, modular scalability, and integration with urban and ecological systems. At the identical time, barriers consisting of fragmented policy frameworks, insecure financing, and land-use conflicts limit the capacity of NBS to be scaled and institutionalized. A primary contribution of this take a look at is the conceptual version for scaling NBS (Figure 2), which illustrates the downward float from permitting elements (participation, institutional support, financing) to strategies (community-constructed canals, mangrove buffer zones, rain gardens and wetland parks), to results (flood danger discount, biodiversity gains, social blessings), and in the end to scalable, fee-powerful edition. By synthesizing training throughout the 3 case studies, the model presents a transferable framework for policymakers and practitioners within the Global South to manual NBS adoption beyond isolated pilot projects.

Recommendations

Based at the findings, the subsequent guidelines are proposed:

Develop Comparative Frameworks for Scaling

Move beyond case-by using-case descriptions with the aid of codifying move-slicing lessons into toolkits and hints that assist replication of NBS across various socio-political contexts inside the Global South.

Institutionalize NBS in Policy and Planning

Incorporate NBS into countrywide climate version techniques, city development plans, and land-use regulations. Pilot tasks should be handled as stepping stones toward formal adoption instead of stand-alone tasks.

Strengthen Long-time period Financing Mechanisms

Establish innovative investment units in which includes green bonds, climate version funds, and public–private partnerships that no longer best allow initial implementation but also cover ongoing protection and community stewardship.

Promote Inclusive and Community-led Design

Empower nearby communities, indigenous information holders, and grassroots corporations to co-design and manipulate NBS. This improves social legitimacy, ensures cultural suit, and complements long-term sustainability.

Position NBS in Global Debates on Infrastructure

Reframe NBS no longer as alternatives however as complements to conventional “gray” infrastructure. This twin framing can appeal to broader political and economic support while highlighting the multifunctional co-blessings of NBS, such as weather resilience, biodiversity, and social equity.

In conclusion, NBS provide not only a possible but also a sustainable pathway to cope with urban flooding in vulnerable areas. Unlike conventional “grey” infrastructure, which often addresses risk in isolation, NBS deliver multiple co-benefits; from flood risk reduction to biodiversity enhancement and community well-being. By conventionalizing the enabling conditions identified in Figure 2 and embedding them into policy, financing, and community-led practice, cities in the Global South can move from reactive flood control toward proactive,

resilient, and socially just adaptation. Such a transition will require sustained political will, innovative financing, and genuine community participation. If governments, development partners, and local stakeholders can align around these priorities, NBS will no longer be seen as experimental add-ons but as essential components of mainstream urban planning. Ultimately, embracing nature rather than resisting it offers the Global South a unique opportunity: to build cities that are not only safer from floods but also greener, healthier, and more equitable for generations to come.

REFERENCES

1. A.M., M.E.H., W.G., M.A.F., H.G.A., et al. (2022). Impact of canal encroachment on flood and economic vulnerability in northern Bangladesh. Sustainability, 14(14), Article 8341. https://doi.org/10.3390/su14148341
2. Asian Development Bank. (2022, May 12). How nature-based solutions can help reduce flood risks. Development Asia. https://development.asia/explainer/ how-nature-based-solutions-can-help-reduce-flood-risks
3. Bhanye, J. (2025, July 1). A review study on community-based flood adaptation in informal settlements in the Global South - Discover Sustainability. SpringerLink. https://link.springer.com/article/10.1007/s43621-025-01449-6
4. Bohol Philippines. (n.d.). Bohol Philippines Travel Guide: Welcome to the Worlds Natural Wonder. https://www.bohol-philippines.com/mangrove-forests.html
5. Buckingham Canal Society. (2024, December 20). Tackling urban flooding by restoring our canals. https://www.buckinghamcanal.org.uk/blog/2024/12/20/tackling-urban-flooding-by-restoring-our-canals/
6. Canal & River Trust. (n.d.). Mitigating and managing floods. https://canalrivertrust.org.uk/things-to-do/canal-and-river-wildlife/nine-ways- canals-can-fight-climate-change/mitigating-and-managing-floods
7. Chang, L.-C., Chen, G., Edamo, M. L., Eini, M., Fahad, M. G. R., Giglou, A. N., Hu, D., Huang, H., Ibrahim, O. A., Liao, K.-W., Motamedi, M. H., Museru, M. L., Pizzileo, S., Unnithan, S. K., Zhang, D., Baky, M. A. A., Alshammari, E., Amoussou, E., Apel, H., … Dehrashid, F. A. (2024, August 29). Enhancing flood risk assessment in urban areas by integrating hydrodynamic models and machine learning techniques. Science of The Total Environment. https://www.sciencedirect.com/science/article/abs/pii/S0048969724060157
8. Corporation, B. I. (2025, May 28). Choosing the right flood control methods. BEIJING IWHR CORPORATION. https://www.bic-iwhr.com/news/choosing-the-right-flood-control-methods.html
9. Cowan, L. (2022, August 31). Rachel de Queiroz Park preserves the wetlands in Brazil. Inhabitat. https://inhabitat.com/rachel-de-queiroz-park-preserves-the-wetlands-in-brazil/
10. Eco-Business / Thomson Reuters Foundation. (2025, June 4). Philippines uses mangrove buffer zones to protect its coastlines. Eco-Business. https://www.eco-business.com/news/philippines-uses-mangrove-buffer-zones- to-protect-its-coastlines/
11. Endo, I., Sagara, J., & Wesenbeeck, B. van. (2022, May 12). Philippines: How nature-based solutions can help reduce flood risks. Prevention Web.https://www.preventionweb.net/news/how-nature-based- solutions-can- help- reduce-flood-risks
12. Huq, N., Hugé, J., Boon, E., & Gain, A. K. (2021). Participatory flood management in Bangladesh: A case study of community-built flood protection. Sustainability, 13(4), 1942. https://doi.org/10.3390/su13041942
13. Israel, D. C. (2001, June). Review of methods for assessing community-based coastal resources management in the Philippines. Philippine Institute for Development Studies.https://pids.gov.ph/publication/discussion papers /review-of-methods-for-assessing-community-based-coastal-resources- management-in-the-philippines
14. Mendes, K., CatComm, & SFN stakeholders. (2023). Co-designing green infrastructure in Rio's informal settlements: Engaging local voices in urban resilience planning. RICS / Catalytic Communities. https://www.rics.org /news-insights/wbef/co-designing-green-infrastructure-in-the-slums-of-rio-de- janeiro

15. Nugent, C. (2021, August 4). Populations are growing in flood-prone areas. Time. https://time.com/6087389/flood-risk-population growth/
16. Oceana. (2023). Restore mangrove forests. Oceana Philippines. https://ph.oceana.org/our-campaigns/restore-mangrove-forests/
17. Primavera, J. H., & Esteban, J. M. A. (2008). A review of mangrove rehabilitation in the Philippines: successes, failures and future prospects. Wetlands Ecology and Management, 16(5), 345–358. https://doi.org/10.1007/s11273-008-9101-y
18. Quodala, Ma. I. (2025, May 29). Philippines uses mangrove buffer zones to protect its coastlines. Bilyonaryo Business News -. https://bilyonaryo.com/2025/05/29/ philippines-uses-mangrove-buffer-zones-to-protect-its-coastlines/nature/
19. Rosati, A., & Millan, L. (2024, April 4). Flooded São Paulo turns to rain gardens and green space to manage climate disaster. Bloomberg. https://www.bloomberg.com/features/2024-sao-paulo-flooding-rain-garden/
20. Rosati, A., & Millan, L. (2024, June 12). São Paulo's plan for a wetter future: Sponge-like rain gardens. Bloomberg Green. https://www.bloomberg.com /features/2024-sao-paulo-flooding-rain-garden/
21. Rubinyi, S., & Eisenberg, R. (2023, September 20). Decoding urban flood risk and democratizing risk assessment. World Bank Blogs.https://blogs.worldbank.org /en/sustainablecities/decoding-urban-flood-risk and-democratizing-risk assessment
22. Satterthwaite, D. (2022). Urban inequality and climate change: Flood risk in low income settlements. Taylor & Francis Online. https://doi.org/10.1080 /13600818.2022.2035874
23. Tellman, B., Sullivan, J. A., Kuhn, C., Kettner, A. J., Doyle, C. S., Brakenridge, G. R., ... & Slayback, D. A. (2021). Satellite imaging reveals increased proportion of population exposed to floods. Nature, 596(7870), 80–86. https://doi.org/10.1038/s41586-021-03695-w
24. The Australian National University. (2024, May 6). Developing nature-based solutions for flood resilience. ANU Institute for Climate, Energy & Disaste Solutions.https://iceds.anu.edu.au/research/research-stories/developing-nature- based- solutions-flood-resilience
25. Viray-Mendoza, V. (2017, November 22). Mangrove forests in the Philippines. Maritime Review. https://maritimereview.ph/mangrove-forests-in-the- philippines/
26. Watts, J. (2023, July 10). Poorer countries face bigger climate flood risks, study shows. The Guardian. https://www.theguardian.com/environment/2023/jul/10/ climate-flood-risk-global-south
27. World Bank. (2025, May 14). World Bank supports Bangladesh in flood risk reduction and recovery. https://www.worldbank.org/en/news/press- release/2025/05/14/world-bank-supports-bangladesh-in-flood-risk-reduction- and- recovery