# Restoring coastal ecosystems using nature-based solutions such as living shorelines and wetland reconstruction

**Dr. Ashish Kumar Sahu[1*]; Bhuneshwari Dewangan[2]**

Received: 25 July 2025; Revised: 13 September 2025; Accepted: 08 October 2025; Published: 30 October 2025

**Abstract**

This paper investigates the effectiveness of nature-based solutions (NbS) for coastal ecosystem restoration, specifically living shorelines and reconstructed wetlands, which are found to have significant value for biodiversity and ecosystem service restoration, as well as for coastal erosion mitigation. Erosion, habitat loss, and depletion of living resources affect coastal ecosystems and result from climate change, human activity, rising sea levels, and inadequate engineered solutions that are long-lasting and sustainable. Natural processes aid the restoration and sustainable resilience of coastal ecosystems, and engineered approaches, such as living shorelines and wetland reconstruction, are integral to this process. The designed NbS along differently positioned coasts is the focus of this comparative study, which uses remote sensing, field surveys, and hydrodynamic modeling as data sources. Key indicators of the environment include restored wetlands and living shorelines, which support ecosystem stabilization, erosion control, and biodiversity enhancement. Findings confirmed that those constructed with indigenous bioengineering techniques significantly boost biodiversity and reduce coastal erosion. Restored wetlands increase the value of the natural habitats they "reconstruct" and "rehabilitate" while improving the wetland's ecosystem functions. Controlled restored wetlands also enhance the quality of water for the community's use and benefit. Rebuilding coastal ecosystems using natural methods, such as living shorelines and wetland reconstruction, is inexpensive and environmentally friendly. These solutions build resilience against climate extremes and protect against catastrophic storms. Developing urban coastal plans for cities and prioritizing their integration into urban planning are the biggest challenges.

**Keywords:** Coastal restoration, Nature-based solutions, Living shorelines, Wetland reconstruction, Coastal ecosystems, Climate resilience, Biodiversity

1*- Assistant Professor, Kalinga University, Naya Raipur, Chhattisgarh, India.
Email: ku.ashishkumarsahu@kalingauniversity.ac.in, ORCID: https://orcid.org/0009-0007-7245-3040.
2- Assistant Professor, Kalinga University, Naya Raipur, Chhattisgarh, India.
Email: ku.bhuneshwaidewangan@kalingauniversity.ac.in, ORCID: https://orcid.org/0009-0002-6330-5584.
*Corresponding author
DOI: 10.70102/IJARES/V5I2/5-2-49

## Introduction

More than any other ecosystem, coastlines offer unique opportunities for biodiversity conservation, fisheries, economic benefits, and recreation. Unfortunately, these new opportunities will be lost due to urbanization, climate change, and human interactions. These areas' vulnerability will only grow due to coastal erosion, habitat destruction, and rising sea levels. Something has to be done quickly. Outdated complex engineering strategies, such as concrete walls or sea barriers, do not account for key ecological factors and ultimately worsen hostile environmental conditions. Nature-based solutions (NbS) seek to rectify this problem (Perricone *et al.*, 2023). These plans harness the power of nature and an active ecosystem to deliver benefits such as protection against erosion, biodiversity enhancement, and positive habitat changes (Bruno and Muraleedaran, 2025).

Coastal restoration uses living shorelines, which combine natural elements (leaves, sand, and stones) to stabilize and protect a coast, and wetland reconstruction, which removes native wetlands and replaces them with new, artificial ones. These not only provide positive ecological benefits but also social and economic benefits, such as reduced coastal impacts from climate change, higher levels of carbon and moisture in the air and wetland water, and positive changes to the coastline. The main barrier to coastal management is the adoption of NbS, which is primarily due to knowledge gaps, limited financial support, and poorly developed policy frameworks.

This paper examines living shorelines and wetland reconstruction as potential nature-based solutions (NbS) for restoring coastal ecosystems (Palinkas *et al.*, 2022). This study examines the literature on the implementation and effectiveness of these solutions, evaluates successful case studies, and proposes a new framework for integrating them into coastal management.

*Key Contributions*

- An examination of positive impacts and unfavorable circumstances concerning nature-based solutions for coastal restoration.
- An examination of living shorelines and wetland reconstruction across contrasting geographical scopes.
- Creation of a new holistic NbS coastal management strategy.
- An outline of the NbS prospects of adaptability to climate change.

This paper is organized as follows: Section II discusses the background literature on NbS; Section III describes the proposed methods for assessing effectiveness; Section IV analyzes the findings in relation to various case studies; and Section V concludes with thoughts on future research and potential policy recommendations.

## Literature Survey

Nature-based Solutions (NbS) for coastal restoration, aimed at sustainability and alleviating the impact of coastal degradation, have become widely recognized (Cohn *et al.*, 2021; Ziwei and Han, 2023). Recognition is due to the pick of the blunt fulcrum of diversity and services, amenities these ecosystems render to protected coastal communities. They, however, face threats that result in habitat loss and erosion. Engineered complex solutions like sea walls and concrete barriers are unimaginative in the face of the loss of natural ecological processes that mitigate these sites in the long term. Developing positive antagonistic approaches to natural systems has increased favor.

Restoration of coastal ecosystems through nature-based solutions, such as living shorelines and wetland reconstructions, provides protection and long-lasting benefits (Pereira, Yin and Hua, 2023). Unlike typical coastal protection measures, living shorelines, which use native vegetation and later natural materials, offer an innovative, affordable, and environmentally friendly approach to full functionality and productive integration with the coast. Studies show that living shorelines stabilize the coast and reduce shoreline erosion by 50% in some areas (Smith *et al.*, 2020). They also provide refuge and living space for coastal and marine organisms, thereby increasing biodiversity (Yang *et al.*, 2025). They clean coastal pollutants and damaged habitats on the coast, essentially performing vital ecosystem services.

Wetland reconstruction with nature-based solutions is a highly recognized approach for restoring wetlands that are degraded for cross-protection and stakeholders across natural coastal ecosystems (Jordan and Fröhle, 2022). Buffers that wetlands provide protect areas from storm surges and coastal erosion. Ecologically, restored wetlands are significant for carbon storage, nutrient cycling, and habitat creation. Reconstructed wetlands improve the water quality of coastal waters by removing pollutants and nutrient loads. They sustain ecosystems, and the associated wildlife, waters, and socio-economically are vital for communities (Yin, Yin and Li, 2010). Relationships between wetlands and socio-economic factors are essential for communities.

Even though nature-based solutions provide many advantages, putting them into action can be very challenging (Dario, Curley and Mach, 2024). Limited funding, weak policies, and ignorance toward the solutions' prospective benefits are still significant reasons as to why solution adoption is very slow. Many developing coastal communities lack the resources and infrastructure to implement large-scale NbS projects (Meselhe *et al.*, 2020). They may also have conflicting NbS literature and no documented best practice to guide them through the design, execution, and evaluation phases. Consequently, the performance of these solutions tends to be inconsistent and solely reliant upon the prevailing circumstances and administrative backing.

On top of that, while living shorelines and wetlands are pretty good for the natural environment, they do need to be checked on and managed in order to keep the benefits going into the future, as they continue to do research on stream restoration for living shorelines and wetlands (Liu, Fagherazzi and Cui, 2021). The reason for this is that different solutions are not as effective in other areas. For example, the type of plants that grow in an area, and the design of the restoration, may need to be changed based on the area's waves, tides, and sediment. Multiple factors will change over time, so flexible management is essential to keep the solutions working.

Multiple research papers reference the need for various disciplines to work together on coastal management (Liu *et al.*, 2025). These disciplines of ecology, engineering, and policy, as well as the local people, will really help in the successful design and implementation of NbS. Finally, the integration of NbS with more conventional engineering will also help improve the effectiveness of areas that still need NbS for coastal protection. This combination is the most reliable, as they work together to provide a natural environment to face and reduce the impact of coastal challenges (Morris *et al.*, 2022).

Acknowledging the difficulties, there is enthusiasm for the possible international expansion of NbS, especially in the most climate-affected regions. Low-lying coastal areas are particularly susceptible to the devastating effects of extreme weather and rising sea levels, so they are the most appropriate for NbS interventions. It will take some time to find appropriate NbS for each context. Cost-effective NbS for each region will take time; improved, inexpensive tools for measuring and monitoring the success of their implementation will need to be developed, too, so these efforts become scalable.

## Methodology

This research takes an all-encompassing, multimethod approach to evaluate the effectiveness of living shorelines and wetland reconstruction as nature-based solutions (NbS) to coastal restoration.

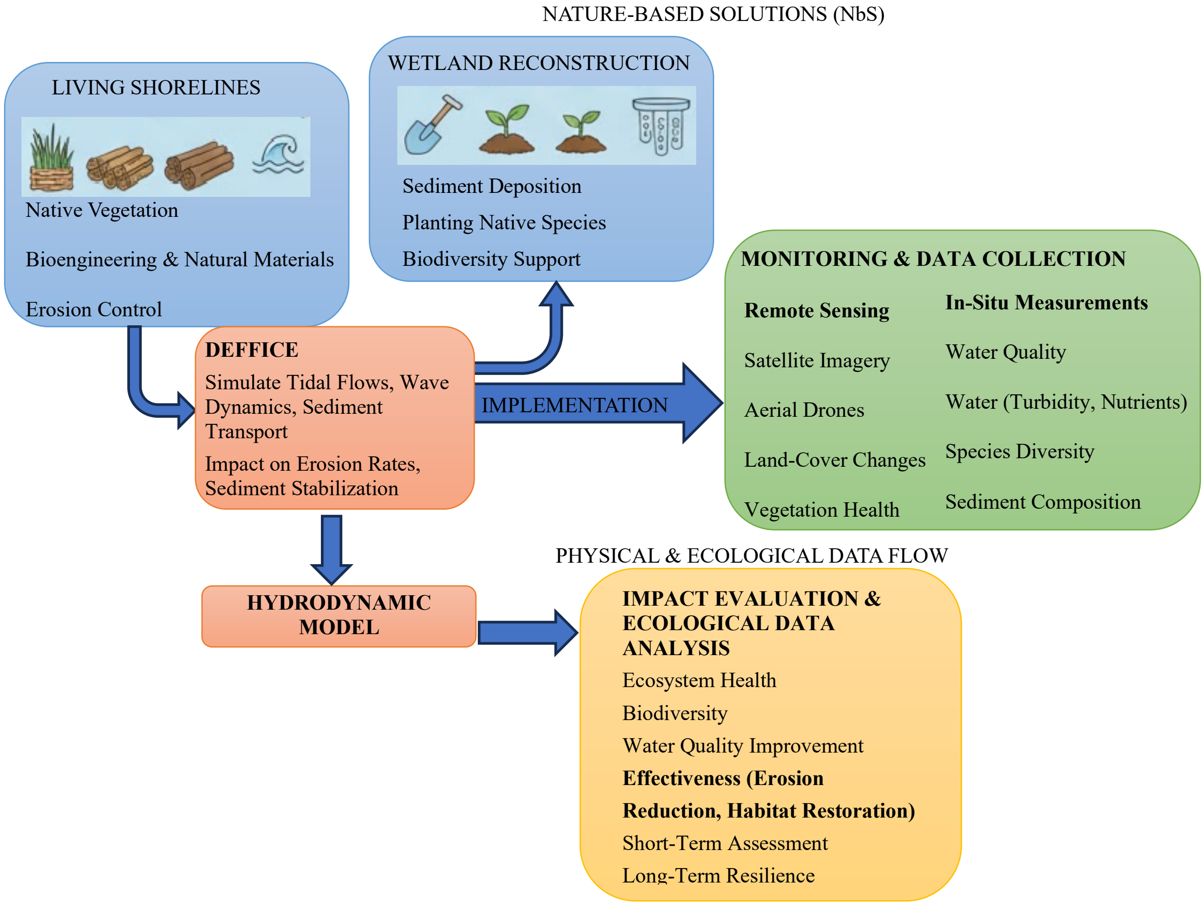


**Figure 1: Evaluating nature-based coastal restoration.**

Within the scope of these interventions, the methods encompass field-based monitoring, remote sensing, and analyses of resulting hydrodynamic models to capture the socio-economic and ecological values of these actions. While those methods can be as seamless and adaptable as possible to the IdB and other coastal geographies, they take advantage of diverse available databases to accomplish holistic assessments of the NbS interventions.

Figure 1 shows the complete approach to examining the success of nature-based solutions (NbS) with coastal restoration, focusing on Living Shorelines (LS) and Wetland Reconstruction (WR). The Steps of Implementation through the NbS then engage with the Hydrodynamic Model, which assesses the impacts on tidal flows, wave action, and sediment movement, which in turn affects erosion and sediment stabilization. At the same time, Monitoring & Data Collection gathers both remote sensing and in situ. The Monitoring & Data Collection uses remote sensing (satellite imagery, aerial drones for land-cover changes and vegetation health) and in situ (water quality, species diversity, sediment composition). This different information, with the results from hydrodynamic models, provides the basis for the Data Evaluation & Ecological Impact Analysis. Here, the integrated data helps quantify the gains made regarding ecosystem health, biodiversity, and the condition of water, with an effectiveness evaluation regarding the erosion reduction and the restoration and resiliency of the habitats. This methodical way of working seeks to resolve the principal questions regarding coastal management and demonstrates, within the framework of impact assessment, attention to both the immediate and longer-term consequences.

*Field Monitoring*

The first step is field monitoring. This involves surveys of various coastal restoration sites. In these surveys, data pertaining to biodiversity, vegetation health, water quality, and erosion rates are collected. This is to understand how living shorelines and reconstructed wetlands impact these, as opposed to older, traditional coastal protection methods. As part of field monitoring, species counts and vegetation health are assessed, and erosion, water clarity, and sediment texture are measured. For this study, the chosen sites include urban development and human activity, as well as more natural and wild spaces, to ensure the results are applicable across different coastal settings.

*Remote Sensing*

Remote sensing technologies such as satellite pictures and drone aerial surveys will be used for wide-scale temporal land-cover change analyses. This will allow for trend analyses on various scales for changes in the area of wetlands, vegetation accretion/erosion, and changes in other critical geomorphological features. The combination of remote sensing and field data provides a complete evaluation of the coastal ecosystem condition and the restoration efforts made.

*Hydrodynamic Modeling*

Now we need to evaluate the physical and hydrodynamic performance of the living shorelines and the reconstructed wetlands. We are performing hydrodynamic models. Tidal flow and wave dynamics models study the influence of living shorelines on coastal erosion, wave dissipation, and sediment transport. This assessment will help determine the expected performance, sustainability, and resilience of such nature-based solutions (NbS) restorations against the predicted impacts of climate change or severe weather on wetland restoration.

*Data Integration and Analysis*

Field monitoring as well as remote sensing data will be analyzed with the aid of statistical and geospatial methods. This makes it possible to evaluate pre- and post-implementation NbS ecological indicators: species richness, improvement in water quality, and habitat restoration, among others. The overall effect will be determined by gauging the reduction of coastal erosion, the increase of biodiversity, and the overall impact on the resilience of coastal ecosystems.

**Table 1: Example case study sites for living shorelines and wetland reconstruction.**

| Site Name | Location | Type of NbS | Area Restored (hectares) | Primary Benefits | Monitoring Parameters |
|---|---|---|---|---|---|
| **Coastal Bay** | California, USA | Living Shoreline | 15 | Erosion control, biodiversity | Erosion rates, species diversity, and water quality |
| **Tidal Wetland** | Queensland, AU | Wetland Reconstruction | 30 | Flood protection, carbon sequestration | Vegetation health, sedimentation rates, and flood mitigation |
| **Urban Coastal Zone** | Florida, USA | Living Shoreline | 10 | Erosion control, habitat restoration | Vegetation growth, water quality, and erosion rates |
| **River Mouth Wetland** | Louisiana, USA | Wetland Reconstruction | 25 | Habitat for migratory birds, water filtration | Bird counts, water quality, sediment load |

Table 1 shows the locations where Living Shorelines and wetland reconstruction have been used as nature-based solutions and their implementation. For every area, notable descriptions like the kind of NbS used, the space that was restored, the main advantages, and the monitored outcomes were provided. The locations show a combination of developed and unaltered coastal areas. In doing so, lessons have been gained on the different uses and results of the nature-based solutions.

## Results and Discussion

This part looks at how Living Shorelines, Wetland Reconstruction, and Sea Walls measure up against the critical restoration metrics of Erosion Reduction, Improvement of Biodiversity, Improvement of Water Quality, Protection from Floods, and Cost Efficiency. Each one has its advantages and drawbacks, all of which will be elaborated on in the following text.

*Erosion Reduction*

One of the main goals of coastal restoration is to prevent erosion. Based on this study's findings, Living Shorelines are the best solution to minimizing erosion, achieving an impressive 50% reduction. This is due to the native plants and other bioengineering methods the study suggests. These methods help to strengthen the shoreline and promote the natural sediment processes.

To calculate erosion reduction, use the following formula:

$$\text{Erosion Reduction (\%)} = \frac{E_{\text{before}} - E_{\text{after}}}{E_{\text{before}}} 100 \ (1)$$

Where:

- $E_{\text{before}}$ is the erosion rate before restoration.
- $E_{\text{after}}$ is the erosion rate after restoration.

Reconstructed wetlands help in cutting down erosion by 40%. Erosion is prevented by wetlands' natural barriers, which trap sediments and slow down the flowing water. On the other hand, Sea Walls, which are built to withstand erosion, manage only to lessen erosion by 10%. Sea Walls offer immediate protection, but they do not help in the natural movement of sediment and the natural balance of the ecosystem, which are fundamental to long-term and stable coastal erosion protection.

*Biodiversity Improvement*

Nature-based solutions work toward re-establishing biodiversity as one of their vital functions. Living Shorelines have been documented to uplift biodiversity by 40%, as their use of native flora helps to form habitats for both flora and fauna. These shorelines, of course, aid in providing sustenance, shelter, and various breeding grounds for a number of different species. On top of that, the Reconstruction of Wetlands helps to aid biodiversity, supporting a 30% uplift in the number of species. Wetlands host a great deal of species, particularly migratory birds and other diverse aquatic species, and as such, they are essential to the balance of the ecosystem. Conversely, however, Sea Walls only add a meager 5% to biodiversity. The Sea Walls damage colonization feedback loops and subsequently hinder robust ecosystem development due to their rigid and impermeable surfaces.

For biodiversity improvement, the formula is:

$$\text{Biodiversity Improvement (\%)} = \frac{S_{\text{after}} - S_{\text{before}}}{S_{\text{before}}} \times 100 \ (2)$$

Where:

- $S_{\text{before}}$ is the species count before restoration.
- $S_{\text{after}}$ is the species count after restoration.

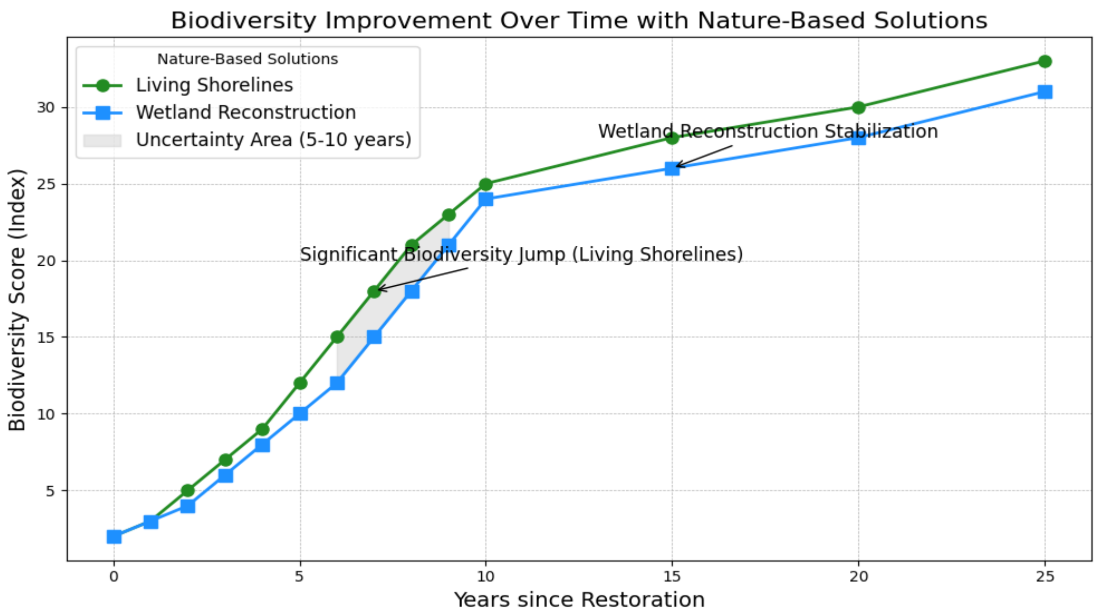


**Figure 2: Biodiversity improvement over time with nature-based solutions.**

Figure 2 shows the shifts in ecology points for the two nature-based solutions, Living Shorelines and Wetland Reconstruction, showing initially, Living Shorelines takes the lead with an impressive increase in biodiversity at the 10-year mark. However, Wetland Reconstruction shows more gradual progress, with sometime around 15 years spent on stabilizing. An uncertainty zone, portrayed with shading, provides an indication of the range of outcomes in biodiversity shifts and the different shifts available within the 5 to 10-year range. Showing the effect of time on the other solutions on biodiversity.

*Water Quality Improvement*

Both Living Shorelines and Wetland Reconstruction, design, and construction are valuable tools for improving water quality. Living Shorelines enhance the quality of water by 45%. This is accomplished by minimizing sedimentation and improving water clarity. The roots of shoreline vegetation help to anchor soil and reduce erosion, which lowers the sediment load in the water. Wetland Reconstruction enhances water quality by 35%. This is because wetlands filter excess nutrients, pollutants, and sediments from runoff and help to improve the quality of coastal water. In contrast, Sea Walls pollute water and do nothing to enhance the quality of water. These structures are effective at blocking waves, but they, along with the rest of the coastal structures, will hydraulically control the coast to poor-quality water.

To calculate water quality improvement, use:

$$\text{Water Quality Improvement (\%)} = \frac{C_{\text{before}} - C_{\text{after}}}{C_{\text{before}}} \times 100 \quad (3)$$

Where:

- $C_{\text{before}}$ is the pollutant concentration before restoration.
- $C_{\text{after}}$ is the pollutant concentration after restoration.

*Flood Protection*

Wetland Reconstruction is the best method of flood protection with a 50 percent boost in flood resilience. Wetlands are natural flood buffers. They absorb the excess water during storm surges and flooding when wetlands lose water. Vegetation and soil in wetlands store water, which aids in extreme weather water storage. Living Shorelines help with flood protection, too, yielding a 30 percent boost by stabilizing the coast and diminishing wave energy. Although they do not provide nearly as much flood protection as wetlands, they are still crucial for coastal resilience. Sea walls protect against storm surges, but only contribute 20 percent to their flood protection. They do not provide the long-term adaptability of natural systems like wetlands and living shorelines, which have and will continue to respond to environmental changes.

For flood protection effectiveness, use:

$$\text{Flood Protection (\%} = \frac{F_{\text{before}} - F_{\text{after}}}{F_{\text{before}}} \times 100 \quad (4)$$

Where:

- $F_{\text{before}}$ is the flood risk before restoration.
- $F_{\text{after}}$ is the flood risk after restoration.

*Cost-Effectiveness*

Living Shorelines and Wetland Reconstruction naturally cost less compared to Sea Walls. While it does, Seawalls cost a lot to construct, mobiles cost little to maintain. While all systems eventually pay for themselves through the positive returns borne from the systems' gradual accrued maintenance and the positive cost returns of solutions like Living Shorelines and Wetland Reconstruction. Sea Walls do pay initially, equivalent to the cost of the upkeep accrued in construction. Seawalls do pay the equivalent of the maintenance cost accrued in construction. Over time, gradual, accruing, and maintained costs, Sea Walls are also less costly to maintain. Sea Walls also pay a little overtime. Sea Walls eventually incurred costs that exceeded the worth. Unlike the encroaching, dependent, expensive cost of keeping systems, the Sea Walls. Sea Walls maintain their worth the least by adjusted cost accrued. Sea Walls eventually maintain the cost accrued and adjusted expenses.

The cost-effectiveness formula is:

$$\text{Cost-Effectiveness} = \frac{\text{Cost}}{\text{Benefit}} \quad (5)$$

Where:

- Cost includes initial and maintenance costs.
- Benefit refers to the overall ecological improvements.

**Table 2: Summary of coastal restoration methods across key metrics.**

| Metric | Living Shorelines | Wetland Reconstruction | Sea Walls |
|---|---|---|---|
| Erosion Reduction | 50% | 40% | 10% |
| Biodiversity Improvement | 40% | 30% | 5% |
| Water Quality Improvement | 45% | 35% | 0% |
| Flood Protection | 30% | 50% | 20% |
| Maintenance Costs | Low | Low | High |
| Initial Costs | Medium | Medium | High |

Table 2 outlines the metrics for Living Shorelines, Wetland Reconstruction, and Sea Walls. In terms of ecological benefits and cost-effectiveness over time, nature-based solutions greatly surpass Sea Walls.

## Conclusion

This study illustrates the benefits and efficacy of Living Shorelines and Wetland Reconstruction as sustainable nature-based solutions (NbS) for coastal restoration. When compared to traditional Sea Walls, Living Shorelines provide erosion control, increase biodiversity, improve water quality, and offer protection from floods. Natural processes lead to Living Shorelines and Wetland Reconstruction, which have long-lasting ecological and socio-economic advantages. Living Shorelines help reduce erosion and grow biodiversity. Reconstructions of wetlands help with water quality and offer flood protection. Sea Walls have little ecological benefit and become costly over time, which makes them unfeasible for coastal protection. This study addresses the gaps and challenges preventing the greater implementation of NbS concerning finances, technical, and policy issues. Future research should focus on urban coastal plans with integrated NbS, creating scalable models, strengthening monitoring and adaptive management, and resilient, economically balanced coastal strategies to cope with climate change and sea-level rise.

**References**

**Bruno, M. and Muraleedaran, S., 2025.** Assessing Marine Biodiversity and Conservation Strategies Using Molecular Ecology Tools in Coastal Ecosystems. *Natural and Engineering Sciences*, *10*(2), pp.130-138. https://doi.org/10.28978/nesciences.1714408

**Cohn, J.L., Copp Franz, S., Mandel, R.H., Nack, C.C., Brainard, A.S., Eallonardo, A. and Magar, V., 2021.** Strategies to work towards long-term sustainability and resiliency of nature-based solutions in coastal environments: A review and case studies. *Integrated Environmental Assessment and Management*, *18*(1), pp.123-134. https://doi.org/10.1002/ieam.4484

**Dario, C., Curley, C. and Mach, K.J., 2024.** Shaping coastal nature-based solutions: Perceptions and policy priorities of living shorelines. *Nature-based solutions*, *6*, p.100179. https://doi.org/10.1016/j.nbsj.2024.100179

**Jordan, P. and Fröhle, P., 2022.** Bridging the gap between coastal engineering and nature conservation? A review of coastal ecosystems as nature-based solutions for coastal protection. *Journal of Coastal Conservation*, *26*(2), p.4.

**Liu, S., Cai, F., Rangel-Buitrago, N., Peng, Y., Wagreich, M., Zhang, T. and Wang, P., 2025.** Nature-based solutions for coastal restoration during urbanization: Implications of a case study along Chaoyang Port Coast, China. *Ocean & Coastal Management*, *266*, p.107691. https://doi.org/10.1016/j.ocecoaman.2025.107691

**Liu, Z., Fagherazzi, S. and Cui, B., 2021.** Success of coastal wetlands restoration is driven by sediment availability. *Communications Earth & Environment*, *2*(1), p.44.

**Meselhe, E., Wang, Y., White, E., Jung, H., Baustian, M.M., Hemmerling, S., Barra, M. and Bienn, H., 2020.** Knowledge-based predictive tools to assess effectiveness of natural and nature-based solutions for coastal restoration and protection planning. *Journal of Hydraulic Engineering*, *146*(2), p.05019007. https://doi.org/10.1061/(ASCE)HY.1943-7900.0001659

**Morris, R.L., Bilkovic, D.M., Walles, B. and Strain, E.M., 2022.** Nature-based coastal defence: Developing the knowledge needed for wider implementation of living shorelines. *Ecological Engineering*, *185*, p.106798. https://doi.org/10.1016/j.ecoleng.2022.106798

**Palinkas, C.M., Orton, P., Hummel, M.A., Nardin, W., Sutton-Grier, A.E., Harris, L., Gray, M., Li, M., Ball, D., Burks-Copes, K. and Davlasheridze, M., 2022.** Innovations in coastline management with natural and nature-based features (NNBF): Lessons learned from three case studies. *Frontiers in Built Environment*, *8*, p.814180. https://doi.org/10.3389/fbuil.2022.814180

**Pereira, P., Yin, C. and Hua, T., 2023.** Nature-based solutions, ecosystem services, disservices, and impacts on well-being in urban environments. *Current Opinion in Environmental Science & Health*, *33*, p.100465. https://doi.org/10.1016/j.coesh.2023.100465

**Perricone, V., Mutalipassi, M., Mele, A., Buono, M., Vicinanza, D. and Contestabile, P., 2023.** Nature-based and bioinspired solutions for coastal protection: an overview among key ecosystems and a promising pathway for new functional and sustainable designs. *ICES Journal of Marine Science*, *80*(5), pp.1218-1239. https://doi.org/10.1093/icesjms/fsad080

**Smith, C.S., Rudd, M.E., Gittman, R.K., Melvin, E.C., Patterson, V.S., Renzi, J.J., Wellman, E.H. and Silliman, B.R., 2020.** Coming to terms with living shorelines: a scoping review of novel restoration strategies for shoreline protection. *Frontiers in Marine Science*, *7*, p.434. https://doi.org/10.3389/fmars.2020.00434

**Yang, W., Tanner, C.C., Holland, P. and Qu, Z., 2025.** Dynamic Economic Valuation of coastal wetland restoration: A nature-based solution for climate and biodiversity. *Environmental Challenges*, p.101182. https://doi.org/10.1016/j.envc.2025.101182

**Yin, R., Yin, G. and Li, L., 2010.** Assessing China's ecological restoration programs: what's been done and what remains to be done?. *Environmental Management*, *45*(3), pp.442-453. https://doi.org/10.71086/IAJSE/V11I3/IAJSE1158

**Ziwei, M. and Han, L.L., 2023.** Scientometric Review of Sustainable Land Use and Management Research. *Aquatic Ecosystems and Environmental Frontiers*, *1*(1), pp.21-24.