

## **Integrating Traditional Knowledge Systems for Wetland Conservation and Management: A Critical Analysis**

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### **ABSTRACT**

With traditional knowledge passing through generations and habits of indigenous people, the local communities perform a crucial role in managing the environment and development. It should be the Local communities who should be involved in the conservation and management of the wetland resources, however, increasing government controls and prohibitions are harming wetland conservation, which potentially promotes responsible use habits in the region. This literature review investigates the role of traditional knowledge systems (TKS) in wetland conservation, focusing on four key domains: agriculture, fishing practices, stormwater management, and traditional knowledge of wetland plants and produce harvesting. This review methodologically synthesizes current research to provide a thorough understanding of the contribution of traditional knowledge to wetland conservation efforts. It does this by using a total selection of 68 papers within a range of five to ten articles per category. Using the PRISMA(Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methods of literature review as a guide, this study identifies, evaluates, and synthesizes peer-reviewed and localized publications that examine the application of Traditional knowledge systems to various wetland management contexts, drawing from scholarly databases and pertinent literature sources. By delving into diverse disciplines such as environmental engineering, ecology, and environmental science, the review elucidates the multifaceted ways in which indigenous wisdom informs conservation practices, fosters sustainable resource utilization, and enhances community resilience in wetland ecosystems. Moreover, it examines the challenges and opportunities associated with integrating traditional and scientific knowledge paradigms, emphasizing the need for inclusive and participatory approaches to conservation that respect cultural diversity and local knowledge systems. The results of the literature study have been compiled to highlight several traditional systems for wetland conservation. These include traditional stormwater management in wetland watersheds, resource management by local communities, the use of wetland plants in conservation, traditional fishing practices, traditional agricultural practices, and religious and cultural practices. The findings of this review contribute valuable insights to academia, policy development, and on-the-ground conservation efforts, serving as a foundation for future research and practice aimed at promoting the holistic and equitable

stewardship of wetland ecosystems. This paper concludes with suggestions on using traditional knowledge systems in the conservation of wetlands in India, along with the different traditional methods that could be part and parcel of the decision-making system in this field. The results of this paper are highly significant, as they demonstrate the integration of traditional knowledge systems as a method for environmental conservation and management, specifically targeting wetland ecosystems and their biota.

## **INTRODUCTION**

India's traditional knowledge systems have a long history of successfully protecting wetlands, and it is clear that they continue to have value now. These age-old customs handed down through the centuries, have repeatedly proven effective in two key areas: water conservation and structural cooling (Panigrahi et al. 2012). The building of forts around water features is an exemplary example of traditional wetland conservation. These intricate buildings performed two functions: protecting communities and collecting priceless monsoon rainfall. Forts' clever construction and thoughtful positioning made it easier to collect and store essential rainfall resources, which were then wisely used during dry periods. Through the use of natural resources, societies have long thrived in arid areas, displaying extraordinary resilience in the face of adversity (Sunder et al. 2013). Another illustration of the applicability of traditional knowledge systems is the development of artificial wetlands. These artificial wetlands serve as refuges for a variety of wetland bird species and significantly aid in biodiversity preservation. Artificial wetlands enhance biological variety and sustain the delicate balance of regional ecosystems by providing a home for these avian residents (Newmaster et al. 2013). It is crucial to recognize the significance of wetlands in providing essential ecological functions, such as protecting livelihood security and supporting fishery resources. Wetlands have tremendous socioeconomic significance since they are essential to the health of innumerable populations (Garg et al. 2015).

However, the wetlands of the Indian floodplain are seriously threatened by the effects of industry and climate change. These restrictions have led to the decline and deterioration of these precious ecosystems. The traditional knowledge systems are essential to the preservation of India's wetlands. They not only preserve the heritage of traditional practices but also make a substantial contribution to biodiversity preservation, water conservation, and ecosystem sustainability. Traditional knowledge remains essential for maintaining the harmony between environmental protection and societal demands, even in the face of contemporary challenges. These outmoded methods offer a thorough plan for safeguarding wetlands, underscoring their continued importance in modern conservation initiatives. India's ancient knowledge systems offer a model of how people and the environment can coexist peacefully at a time when safeguarding natural resources is crucial.

## **MATERIALS AND METHODS**

This study employed a systematic approach to identify appropriate research papers from multiple databases to ensure a thorough and objective selection of literature. A systematic literature review, deriving an amalgamation of traditional literature review methods with PRISMA( Preferred Reporting Items for Systematic Reviews and Meta-Analyses) techniques, was used to screen database records and articles, which were then included in the study. A group of public health academics developed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Moher et al. 2009). Throughout the review, a total of (n total) 68 papers were chosen to be reviewed. Among the databases utilized in this research were Shodh Ganga, Google Scholar, Science Direct, Scopus, Elsevier, PubMed, and Web of Science. The selection of these databases was based on the extensive coverage they provide of scholarly literature across various disciplines, including ecology, anthropology, environmental science, and indigenous studies. Wetland conservation and traditional knowledge systems were two of the terms included

in the search strategy, which included "wetland conservation," "traditional ecological knowledge," "indigenous practices," and "sustainable resource management." Boolean operators (AND, OR) were utilized to enhance the search and guarantee pertinence. The inclusion criteria for selecting papers included peer-reviewed articles published in English, with a focus on traditional knowledge systems associated with wetland agriculture, fishing practices, stormwater management, traditional plant use, and product harvesting. Duplicate articles were removed, and titles and abstracts were screened to assess their suitability for inclusion. Full-text articles meeting the inclusion criteria were then critically reviewed and synthesized to provide a comprehensive analysis of the role of traditional knowledge in wetland conservation. The objective of this meticulous approach was to reduce publication bias and guarantee the strength and dependability of the results of the literature review.

The last section will consolidate the findings of the literature review and give a summary of the many traditional knowledge systems that are applied to wetlands conservation. It will emphasize how important it is to integrate ancient wisdom with contemporary techniques to manage wetlands holistically and sustainably. Although the PRISMA method was employed in this study, meta-analysis with quantitative data was not adopted; the results are derived solely from qualitative analysis (Fig. 1).

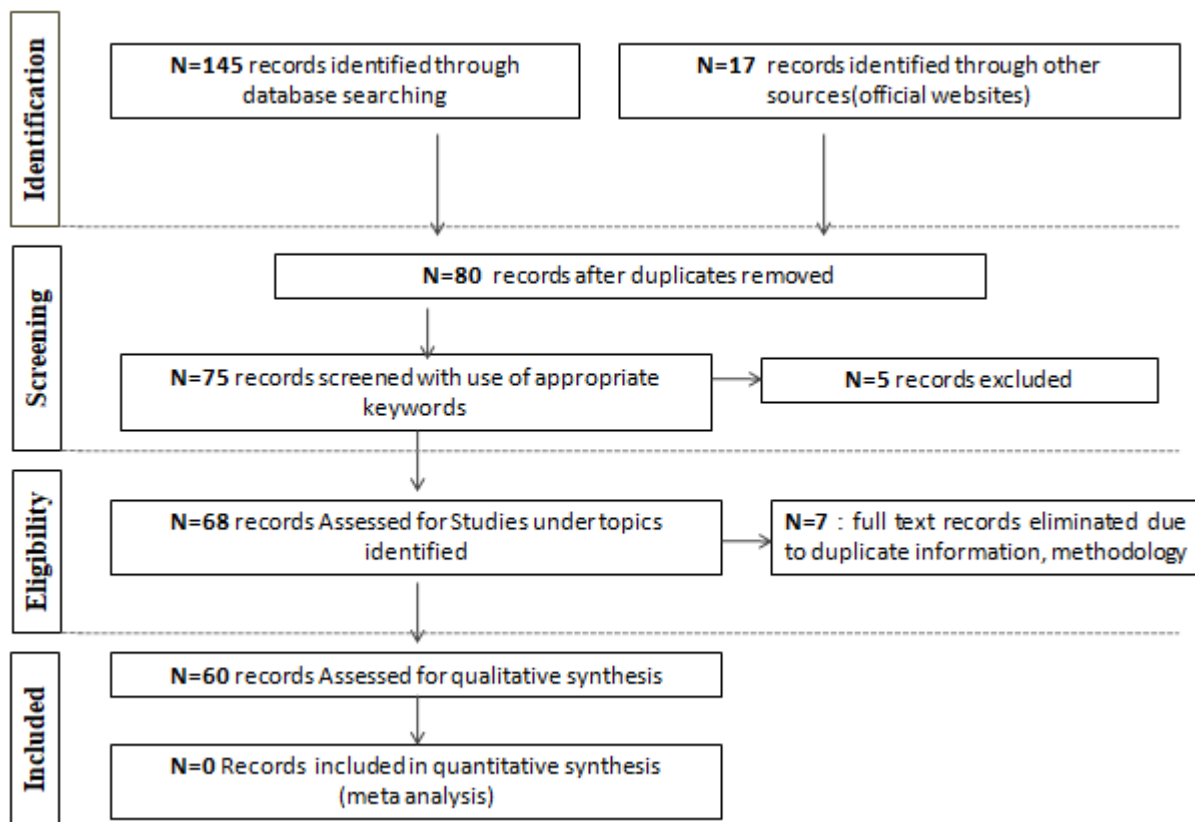


Fig. 1: Methodology adopted from PRISMA (Author interpretation).

The review has been structured in five sections. Section 1 contains the Status of Wetland Conservation in India. Section 2 contains the Need for Wetland Conservation through Traditional Knowledge Systems. Section 3 analyses Wetland Conservation: Government and Non-Governmental Initiatives. Section 4 provides an analysis of Policies and Proposals Supporting Traditional Knowledge in Wetland Conservation. Finally, section 5 discusses the Utilization of Traditional Knowledge Systems in Wetland Conservation Practices. Section 5 is again subdivided into traditional Agricultural systems in wetland conservation, the

Role of Traditional fishing in the conservation of Wetlands, the Role of wetland plants in the conservation of Wetlands, Traditional Cattle Rearing Systems, Extraction of Wetland Products for Construction Materials, Afforestation by Local Communities for Wetland Conservation, Traditional stormwater management in wetland watershed. A methodology diagram has been generated in Fig. 2.

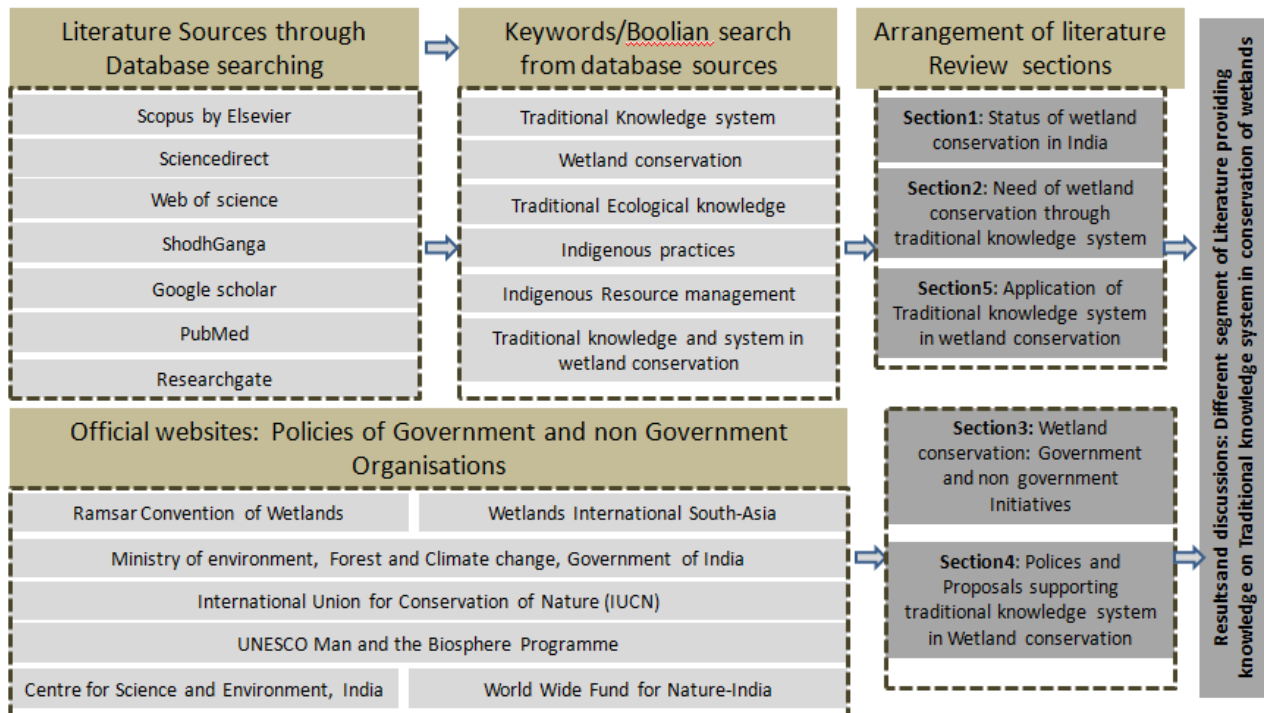


Fig. 2: Methodology adopted for literature review (Authors interpretation).

### Literature Review

The literature review will be structured into distinct sections to provide a comprehensive analysis of the role of traditional knowledge systems in wetland conservation.

**Section 1: Status of Wetland Conservation in India:** This section will review existing literature on the status of wetland conservation efforts in India. It will examine the current state of wetlands in the country, including their ecological significance, threats to their integrity, and the effectiveness of conservation measures implemented thus far.

**Section 2: Need for Wetland Conservation through Traditional Knowledge Systems:** This section will outline the fundamental importance of wetland conservation and the role that traditional knowledge systems play in achieving this goal. It will provide a theoretical foundation for understanding how indigenous wisdom contributes to sustainable wetland management practices.

**Section 3: Wetland Conservation: Government and Non-Governmental Initiatives:** Here, the focus will be on governmental and non-governmental organizations' (NGOs) efforts in advocating for wetland conservation in India. The literature will explore the policies, initiatives, and programs aimed at protecting and restoring wetland ecosystems, highlighting the roles of various stakeholders in conservation efforts.

**Section 4: Policies and Proposals Supporting Traditional Knowledge in Wetland Conservation** This section will examine existing policies and proposals that endorse the integration of traditional knowledge systems into wetland conservation strategies. It will analyze the different government policies, institutional

frameworks, and community-based approaches that recognize the value of indigenous wisdom in achieving conservation objectives.

Section 5: Utilization of Traditional Knowledge Systems in Wetland Conservation Practices: The final section will delve into specific examples of how traditional knowledge systems are applied in wetland conservation practices. Subsections will cover various aspects such as agriculture, product extraction, fishing techniques, plant utilization, and other traditional practices relevant to wetland ecosystems.

### **Conservation and Management of Wetlands in India**

Numerous studies and research projects conducted over the past ten years have shown the crucial significance of wetlands throughout India. India's wetlands were identified in a national inventory carried out by Panigrahy et al. (2012), which exposed their huge extent, geographic distribution, and distinctive features. The study emphasized the importance of comprehending changes in wetland conditions for the year. For bird species, Sundar and Kittur emphasized the necessity of protecting wetlands in 2013, focusing in particular on the function of beta diversity in promoting species turnover. Their study emphasized the necessity for a landscape-scale strategy for tropical agricultural wetland conservation that combines formal protection techniques with regional organizations. The underutilized treasure of Traditional Ecological Knowledge (TEK) from Indian coastal communities was examined by Newmaster et al. (2011), with an emphasis on the preservation of seagrass. Their findings demonstrated the breadth of local knowledge systems in comprehending and protecting the diversity of seagrass.

Panigrahy et al. (2011) conducted a national-level inventory and assessment of wetlands in India using RESOURCESAT-1 LISS-III data, providing comprehensive data on wetland extent and classification to aid conservation efforts, albeit with limitations in capturing long-term changes. Sundar & Kittur (2012) aimed to understand patterns and processes determining the beta diversity of birds in intensely used agricultural wetlands, challenging assumptions about wetland conservation by revealing that human use doesn't necessarily deter bird biodiversity. Newmaster et al. (2011) identified traditional ecological knowledge (TEK) from local knowledge systems of seagrasses in coastal communities, revealing valuable insights for seagrass conservation and restoration, albeit with a limited focus on integration challenges. Garg et al. (2015) reviewed wetland conservation and management in India using geospatial techniques, effectively utilizing satellite remote sensing and GIS for inventorying and monitoring wetland ecosystems while potentially facing limitations in addressing on-ground challenges. Sarkar & Borah (2018) reviewed the status and importance of floodplain wetlands in India, highlighting their significance for biodiversity and water resource management despite lacking specific scientific information for comprehensive analysis. Ragavan et al. (2021) emphasized the need for improved conservation strategies for Indian coastal wetlands, prioritizing ecological health and adaptive potential, albeit facing challenges in implementing integrated ecosystem-based strategies. Suhani et al. (2020) stressed the importance of natural and artificial wetlands for sustainable water purification, although transitioning from existing wastewater treatment systems may encounter resistance. Taran et al. (2023) analyzed carbon dynamics in Rudrasagar Lake's sediment to inform better management strategies, highlighting potential environmental challenges from disturbance to freshwater wetlands. Rubeena et al. (2023) investigated long-term fluctuations in KVCR hydrological and substrate variables, aiming to inform effective management and conservation strategies despite potential environmental degradation affecting coastal habitats and wildlife. Sameen et al. (2024) Highlighted the Community involvement and active participation in restoration and Promotion, recognition of economic values of wetland ecosystem services and biodiversity, and enforcement of land control regulation while restoration of the Kanwar wetland of Bihar.

### **Need for Application of Traditional Knowledge System in Wetland Conservation and Management**

Traditional knowledge, as described by Banerjee (2007), encompasses an accumulated body of knowledge, skills, and practices that have been developed, sustained, and transmitted from one generation to another within a community. This knowledge is often conveyed orally or through demonstration, reflecting the intimate connection between generations and the preservation of cultural heritage. Fikret Berkes (1999) further elaborates on traditional knowledge, particularly in the context of ecological understanding. Traditional ecological knowledge, according to Berkes, involves a cumulative body of knowledge, practice, and belief that evolves through adaptive processes. Passed down through generations via cultural transmission, this knowledge focuses on the relationships between living beings, including humans, and their environment. Darrell Addison Posey (1999) emphasizes the importance of traditional knowledge as a cumulative body of knowledge, know-how, practices, and representations. Maintained and developed by people with extended histories of interaction with the natural environment, traditional knowledge reflects the deep-rooted connection between communities and their ecosystems. Cernea (2002) contributes to the discourse by defining traditional knowledge as the collective wisdom, experience, and knowledge passed down through generations. This knowledge encompasses a wide array of information and practices developed by indigenous and local communities over time, with a primary focus on sustaining their livelihoods and well-being.

The Ramsar Convention (1971) underscores the importance of integrating socio-economic, cultural-spiritual values, and traditional knowledge into the management of wetlands, aiming for their wise use and conservation (Ramsar Convention 1971). This approach is exemplified in Australia, where the Wetlands Department of Environment, wetlands, and Indigenous values, along with the Indigenous people, play a pivotal role in protecting and managing wetlands. Indigenous Australians, custodians of vast expanses of land and sea country, manage significant portions of the country's wetlands, with Indigenous Protected Areas covering a substantial portion of the National Reserve System (Australian Government n.d.).

Moreover, the Australian Government's Working on Country program acknowledges Indigenous people's profound connection to the land and their desire for recognition of their land and sea management efforts as paid employment (Australian Government n.d.). This program not only achieves environmental objectives but also fosters cultural, social, educational, health, and economic development outcomes. Traditional ecological knowledge held by Indigenous communities serves as a crucial foundation for natural resource management, reflecting centuries of custodial responsibility for the land (Gadgil & Berkes 1991). Gadgil and Berkes (1991) identified four categories of social restraints that lead to indigenous biological conservation practices, including total protection of certain species and critical life history stages, as well as organizing resource harvests under local expert supervision. These practices highlight the adaptive nature of traditional ecological knowledge systems, which are often rooted in sustainable resource management principles (Gadgil & Berkes 1991).

In conclusion, traditional knowledge, particularly that of Indigenous communities, plays a fundamental role in wetland conservation efforts globally. By recognizing and integrating traditional practices into conservation policies and initiatives, societies can achieve sustainable management of wetland ecosystems while honoring cultural and spiritual values associated with these vital landscapes.

### **Wetland Conservation: Government and Non-Governmental Initiatives**

A comprehensive study was undertaken to examine the varied efforts of governmental and non-governmental agencies dedicated to the conservation of wetlands. Through extensive research and analysis, the study aimed to elucidate the diverse strategies, initiatives, and collaborations orchestrated by these entities in their mission to safeguard wetland ecosystems. Governmental agencies at local, regional, and national levels were investigated, revealing a spectrum of policies, regulations, and management frameworks designed to

mitigate threats to wetlands and promote their sustainable use. Moreover, the study delved into the roles of non-governmental organizations (NGOs), community-based groups, and conservation alliances, highlighting their grassroots efforts, advocacy campaigns, and community engagement programs aimed at mobilizing support for wetland conservation. By examining the collective contributions of these entities, the study provided valuable insights into the multifaceted approach required to address the complex challenges facing wetlands and underscored the importance of collaborative action in achieving effective conservation outcomes.

### International Initiatives Includes

**Ramsar Convention on Wetlands:** It focuses on an international framework for wetland protection and sustainable use. It encourages community involvement and the application of traditional knowledge. Known by its common name, the Ramsar Convention, this international agreement was created in 1971 in Ramsar, Iran. Its global goal is to encourage the preservation and wise use of wetlands. Wetlands are important for climate regulation, flood management, water purification, and biodiversity, according to the Convention. Employing cooperative endeavors among participating nations, the Ramsar Initiative expedites the identification of wetlands of global significance, commonly referred to as Ramsar Sites, and fosters their efficient administration and preservation. The Ramsar Convention provides a crucial foundation for the conservation of wetlands worldwide, encouraging collaboration between governmental bodies, non-governmental organizations, and local populations to protect these invaluable ecosystems for future generations. As of November 2023, there are 2,500 Ramsar sites around the world, and India has 80 Ramsar sites as of 2023 (Ramsar.org).

**UNESCO Man and the Biosphere Programme:** International network of sites for conservation. Emphasizes the importance of involving local communities in conservation efforts (Fig. 3).



a. Engaging local communities in the conservation of the Okavango Delta World Heritage Site (UNESCO).

b. Wetlands and their services (The Ramsar Convention on Wetlands).

**Fig. 3: Engaging Indigenous communities in the conservation of Wetlands.**

**International Union for Conservation of Nature (IUCN):** Focuses on Global environmental organization and wetland conservation and involves communities in various projects.

**Global Environment Facility (GEF):** Funding projects for global environmental benefits, including wetland conservation. Often supports initiatives that involve community participation.

**National Wetland Conservation Program (NWCP):** This is an Agency under the Ministry of Environment, Forest and Climate Change (MoEFCC). This focuses on the Conservation and sustainable management of wetlands in Collaboration with state governments and local communities.

**Integrated Management of Coastal and Wetland Ecosystems (ICMAM):** Agency under the Ministry of Earth Sciences (MoES), which focuses on coastal and wetland ecosystem management with involvement in Research, monitoring, and community engagement.

**National Action Plan for Wetland Conservation:** Agency of Ministry of Environment, Forest and Climate Change (MoEFCC), which focuses on a Comprehensive plan for conservation, restoration, and sustainable use. Involvement includes community participation and traditional knowledge.

**State Wetland Authorities:** Agency under Each state has its own Wetland Authority, which focuses on implementing wetland conservation policies at the state level, often involving local communities.

#### **Non-Government Initiatives (India):**

**Wetlands International - South Asia:** Agency Focuses on Collaborative initiatives for wetland conservation. This targets Engaging with local communities, NGOs, and academia.

**WWF-India Wetland Conservation Program:** This focuses on Conservation, restoration, and sustainable management of wetlands. The involvement of Community-based initiatives, awareness, and capacity-building is given importance.

**Centre for Science and Environment (CSE):** Focuses on research and advocacy on sustainable development, including wetland conservation. The involvements include Advocacy for community participation in conservation.

#### **Policies and Proposals Supporting TKS in Wetland Conservation and Management**

The conservation of wetlands is increasingly recognized as a critical global priority due to their ecological significance and the services they provide to humanity. Traditional knowledge systems and the active involvement of local communities, particularly indigenous groups, are essential components of effective wetland conservation strategies.

According to the 2019 NPCA rules, one of the MoEF&CC's key programming themes from the time of its founding in 1985 was wetland conservation and sustainable management. An essential context for this choice was India's September 1982 ratification of the Ramsar Convention. The National Wetlands Conservation Programme (NWCP) was founded by the Ministry in 1986 to give State Governments the financial support and overall policy framework they needed to implement site management plans. The National Lake Conservation Plan (NLCP) was unveiled in 2001 to intercept, reroute, and treat the pollutant load that enters lakes to solve pollution concerns in urban and semi-urban contexts. More than 180 sites have been given priority for conservation and restoration as of February 2019.

In India, the National Wetland Conservation Program (NWCP) serves as a cornerstone of wetland management, emphasizing community participation and the integration of traditional knowledge. A study by Gupta et al. (2018) highlights the NWCP's focus on stakeholder engagement and the role of local communities in wetland monitoring and conservation activities. The research done by Singh et al. (2020) explores the impact of NWCP-funded projects on wetland ecosystems and community livelihoods, underscoring the importance of participatory approaches in achieving conservation goals.



Governmental agencies like the Ministry of Environment, Forest, and Climate Change (MoEFCC) play a vital role in formulating policies and initiatives to support traditional knowledge systems in wetland conservation. An analysis by Sharma & Choudhury (2019) examines the role of MoEFCC in promoting community-based conservation approaches, including the recognition of indigenous rights and traditional ecological knowledge. Additionally, studies by Pandey & Pandey (2017) and Kumar et al. (2021) assess the effectiveness of various government schemes and programs in enhancing community participation and indigenous involvement in wetland conservation efforts.

Internationally, organizations such as the Ramsar Convention on Wetlands and the Convention on Biological Diversity (CBD) provide frameworks for promoting traditional knowledge systems and community participation in wetland conservation. Research by Jones et al. (2019) examines the role of the Ramsar Convention in supporting indigenous peoples' rights and traditional practices in wetland management, while studies by Smith & Pritchard (2018) and Brown et al. (2020) explore the synergies between CBD objectives and indigenous-led conservation initiatives.

Non-governmental organizations (NGOs) and civil society groups also play a vital role in advancing community-based wetland conservation initiatives. For example, research by Ramesh et al. (2018) analyzes the contributions of NGOs in supporting indigenous communities' efforts to conserve wetland biodiversity and traditional knowledge systems. Additionally, studies by Das et al. (2020) and Patel et al. (2021) highlight the importance of partnerships between NGOs, local communities, and governmental agencies in promoting inclusive and sustainable wetland conservation practices.

**Utilization of Traditional Knowledge Systems in Wetland Conservation Practices**

"Traditional Agricultural Practices for Wetland Conservation," studies such as Gupta et al. (2018) and Singh et al. (2020) delve into indigenous farming techniques employed by rural communities to sustainably manage wetland ecosystems. These practices, deeply rooted in traditional knowledge systems, emphasize the importance of crop diversification, organic farming, and water management strategies tailored to wetland environments.

Transitioning to "Traditional Agriculture in Wetland Conservation" works by Mishra & Behera (2019) and Mohanty et al. (2021) highlight the role of traditional farming systems in promoting ecological balance and preserving wetland biodiversity. These studies underscore the integration of traditional rice cultivation methods, such as SRI (System of Rice Intensification), with wetland conservation practices, resulting in increased crop productivity while minimizing environmental impact.

In the realm of "Traditional Weed Management," insights from Chaudhary et al. (2017) and Patel et al. (2020) elucidate indigenous approaches to weed control in wetland areas. These studies emphasize the efficacy of manual weeding, crop rotation, and the use of herbal extracts in managing weed infestations without relying on chemical pesticides, thereby safeguarding wetland biodiversity and water quality. The summary of the above literature review is given in Table 1.

Table 1: Literature review of traditional Agricultural systems in Wetland conservation.

SI No	Year	citation	Summary	Conclusion of study
1		Gupta et al.	Gupta et al. (2018) explore traditional agricultural practices in wetland conservation in India. They examine indigenous farming techniques, such as crop diversification and 2018	The study concludes that traditional agricultural practices play a crucial role in wetland conservation by promoting ecological balance and

	<p>2018</p> <p>Traditional agricultural practices in wetland conservation: A case study from India. Journal of Sustainable Agriculture</p>	<p>organic farming, emphasizing their role in sustaining wetland ecosystems.</p>	<p>biodiversity while ensuring the livelihoods of rural communities.</p>
2	<p>Mishra and Behera</p> <p>2019</p> <p>Indigenous fishing methods for wetland conservation: A case study from India. International Journal of Fisheries and Aquatic Studies</p>	<p>Mishra and Behera (2019) investigate traditional agriculture's contribution to wetland conservation in the Indian context. Their research focuses on the integration of traditional rice cultivation methods with wetland conservation practices.</p>	<p>The findings highlight the potential of traditional farming systems to enhance crop productivity, minimize environmental impact, and preserve wetland biodiversity, underscoring the importance of traditional knowledge in sustainable agriculture.</p>
3	<p>Singh et al.</p> <p>2020</p> <p>Indigenous farming techniques for wetland conservation in India: A review. Journal of Environmental Science and Health</p>	<p>Singh et al. (2020) analyze traditional agricultural practices for wetland conservation in India. They examine the role of indigenous farming techniques in water management, emphasizing the importance of efficient irrigation methods in sustaining wetland ecosystems.</p>	<p>The study concludes that traditional agricultural practices, such as water-saving techniques and crop diversification, contribute significantly to wetland conservation by conserving water resources, enhancing soil fertility, and supporting biodiversity conservation.</p>
4	<p>Chaudhary et al.</p> <p>2017</p> <p>Traditional weed management practices in wetland conservation: Lessons from India. Ecology and Environment</p>	<p>Chaudhary et al. (2017) investigate traditional weed management practices in wetland conservation in India. Their research focuses on indigenous approaches to weed control, such as manual weeding and herbal extracts, highlighting their efficacy in managing weed infestations.</p>	<p>The findings underscore the effectiveness of traditional weed management practices in maintaining wetland biodiversity and water quality, emphasizing the need for sustainable weed control strategies in agricultural landscapes.</p>
5	<p>Mohanty et al.</p> <p>2021</p> <p>Role of traditional agriculture in wetland</p>	<p>Mohanty et al. (2021) explore the role of traditional agriculture in wetland conservation in India. They examine the integration of traditional rice cultivation methods with modern conservation practices, emphasizing</p>	<p>The study concludes that traditional agricultural practices, combined with modern conservation strategies, offer promising avenues for enhancing wetland conservation efforts in India, underscoring the</p>

	conservation: A case study from eastern India. Journal of Agriculture and Rural Development	the synergies between traditional knowledge and sustainable agriculture.	importance of preserving indigenous knowledge systems.
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**Traditional Fishing in Wetland Conservation:** Wetland conservation greatly benefits from traditional fishing methods since they encourage sustainable practices that protect the integrity of the ecosystem and local communities' sources of livelihood. These traditional practices that have been transmitted down through generations frequently emphasize seasonal fishing restrictions and selective harvesting, which allow fish populations to repopulate and guarantee long-term viability. Moreover, conventional methods usually reduce habitat disturbance and bycatch, protecting the fragile equilibrium of wetland ecosystems. Furthermore, the cultural legacy of indigenous peoples is closely linked to their fishing techniques, which promotes community involvement in conservation initiatives and a sense of responsibility. Wetland conservation can be improved by acknowledging and incorporating traditional knowledge into management plans. This will promote resilience and biodiversity while honoring the customs and means of subsistence of individuals who depend on these essential ecosystems.

Regarding "Traditional Fishing," research by Jena et al. (2018) and Nayak et al. (2020) shed light on traditional fishing practices employed by coastal communities to sustainably harvest aquatic resources from wetland ecosystems. These studies underscore the importance of community-based fisheries management, seasonal fishing bans, and the preservation of fish breeding grounds in maintaining fish stocks and supporting livelihoods. As per Aarif et al. (2017), Fishing activities affect water bird distribution, abundance, and diversity, and traditional fishing activities enhance water bird abundance. A wide range of artisanal or traditional fishing gear are available and are currently in use in inland fisheries throughout the subcontinent, including bamboo traps, gill nets, and seines (Pravin et al. 2011). A summary of the above-mentioned studies is given in Table 2.

Table 2: A literature review of the Role of Traditional fishing in the conservation of Wetlands.

S. No.	Author/year	Title	Summary	Conclusions
1	Sabola et al. 2007	Use of Indigenous knowledge and traditional practices in fisheries management: a case of Chisi Island, Lake Chilwa, Zomba	According to the study, indigenous ecological knowledge and practices that the people of Chisi have acquired and preserved may have significant implications for scientific research as well as for the management of the island's lake resources. Restrictions on fishing, access to sacred places, and Typha cutting were among the practices, as was preserving the culture of Mababwe. These customs promoted fish regrowth and sustainable fishing practices. The knowledge systems have been preserved and transmitted through myths, taboos, and religious beliefs from one generation to the next.	Even though the study contends that incorporating appropriate, already-existing indigenous knowledge systems that promote resource conservation is necessary to achieve sustainable designs or the implementation of natural resource management projects, these knowledge systems were not created with the purpose of specifically conserving natural resources in a mental state.

1	<p>Patel et al. 2018 Traditional fishing techniques in wetland conservation: A review</p>	<p>Patel et al. (2018) conducted a comprehensive review of traditional fishing techniques and their role in wetland conservation. They highlighted various indigenous fishing methods practiced in wetland ecosystems.</p>	<p>The study concluded that traditional fishing techniques can contribute significantly to wetland conservation efforts by promoting sustainable harvesting practices, preserving fish stocks, and maintaining ecosystem balance.</p>
2	<p>Sharma &amp; Das 2019 Conservation implications of traditional fishing practices in wetlands</p>	<p>Sharma &amp; Das (2019) explored the conservation implications of traditional fishing practices in wetlands. They analyzed the ecological impact of different fishing methods and their relevance in wetland management.</p>	<p>The research concluded that traditional fishing practices play a crucial role in maintaining wetland biodiversity and ecosystem integrity. However, their sustainability depends on effective management and regulation.</p>
3	<p>Khan &amp; Gupta 2020 Traditional fishing techniques and their contribution to wetland conservation</p>	<p>Khan &amp; Gupta (2020) reviewed the contribution of traditional fishing techniques to wetland conservation. They discussed the ecological significance of indigenous fishing methods and their potential for sustainable resource management.</p>	<p>The review emphasized the importance of integrating traditional fishing practices into conservation strategies to enhance the resilience of wetland ecosystems and support the livelihoods of local communities.</p>
4	<p>Mishra et al. 2021 Indigenous fishing methods for wetland conservation: A case study from India</p>	<p>Mishra et al. (2021) conducted a case study on indigenous fishing methods and their role in wetland conservation in India. They documented traditional fishing practices, their cultural significance, and ecological implications.</p>	<p>The case study highlighted the need to recognize and support traditional fishing communities in wetland conservation efforts, acknowledging their invaluable knowledge and contribution to sustainable resource management.</p>
5	<p>Kumar &amp; Singh 2022 Sustainable fisheries management through traditional fishing practices</p>	<p>Kumar &amp; Singh (2022) reviewed the potential of traditional fishing practices for sustainable fisheries management. They evaluated the ecological benefits and socio-economic implications of indigenous fishing techniques.</p>	<p>The review emphasized the importance of adopting a holistic approach to fisheries management, integrating traditional knowledge with modern conservation strategies to achieve long-term sustainability and resilience in wetland ecosystems.</p>



Fig. 4: Traditional fishing practices by indigenous communities of Assam and Bihar.

The role of traditional knowledge of plants in wetland conservation reveals the invaluable contribution of indigenous wisdom to the preservation and sustainable management of these vital ecosystems (Fig. 4). Numerous studies underscore the profound understanding of wetland flora held by traditional communities, passed down through generations, and honed through centuries of interaction with the environment. Research conducted in the valleys of Kathmandu and Pokhara in Nepal by Joshi et al. (2009) highlights the Indigenous uses of wetland plant diversity, shedding light on their crucial role in ecosystem preservation. Wetland plants serve as vital components of wetland ecosystems, contributing to various ecological functions such as water purification, sediment stabilization, and habitat provision for diverse flora and fauna. Moreover, these plants play a significant role in mitigating the impacts of climate change by sequestering carbon, regulating water levels, and enhancing resilience against natural disasters such as floods and droughts. Additionally, wetland plants hold cultural and economic significance for local communities, who have relied on them for centuries for food, medicine, construction materials, and handicrafts. Thus, recognizing and conserving the diversity of wetland plants is essential not only for maintaining ecological balance but also for sustaining the livelihoods and cultural heritage of communities dependent on wetland ecosystems. In the study of Community perception of Oramia region of Southeast Ethiopia, Boru et al. (2024) identified the foremost commonly used medicinal plants, including *Commelina latifolia*, *Ageratum conyzoides*, *Persicaria decipiens*, *Ludwigia abyssinica*, *Colocasia esculenta*, *Vernonia* sp., *Oenanthe palustris*, and *Lindernia rotundata*, many sedges or *Cyperus* species are utilized in traditional medicines for the treatment of various diseases, e.g., stomach ache and bowel disorders, amenorrhea, bronchitis, tumors, communicable disease, pain and fever, diabetes, skin diseases, problems concerning the circulation of blood and reproductive organs (Mueller-Dombis & Ellenberg 1974). A summary of the literature review is given in Table 3.

Table 3: A literature review of the Role of wetland plants in the conservation of Wetlands.

S.No.	Year/Author/Title	Contribution
1	Menzies (2006) Local Knowledge, Multiple Livelihoods, and the Use of Natural and Social Resources in North Carolina, Traditional	The experts address the transmission and acquisition of traditional knowledge as well as the cultural significance of various subsistence methods employing natural resources, including fish (Tlingit), seaweed (Gitga'a), and pine mushrooms (Tsimshian). Many authors address the extent to which TEK models must be incorporated into the design and implementation of national and local resource management initiatives. The publication emphasizes the various

	Ecological Knowledge and Natural Resource Management	perspectives and relationships with nature that exist, and it also emphasizes the importance of respecting and honoring the ways that indigenous peoples have interacted with the natural world for many centuries.
2	Huntington (2000)  Using Traditional Ecological Knowledge in Science: Methods and Applications	Discusses the application of traditional plant knowledge in wetland conservation. The research examines how indigenous peoples' understanding of wetland plants contributes to habitat restoration, erosion control, and water purification efforts. It emphasizes the need to integrate traditional ecological knowledge into contemporary conservation practices for effective wetland management.
3	Davidson-Hunt & Berkes (2003)  Learning as You Journey: Anishinaabe Perception of Social-Ecological Environments and Adaptive Learning	Explore the role of traditional plant knowledge among Anishinaabe communities in wetland conservation. The study documents how indigenous peoples utilize plants for ecosystem management, including the restoration of wetland habitats and the maintenance of biodiversity. It highlights the adaptive capacity of traditional ecological knowledge and its relevance in contemporary conservation contexts.
4	Turner et al. (2000)  Cultural Keystone Species: Implications for Ecological Conservation and Restoration	Investigate the concept of cultural keystone species, focusing on the role of plants in indigenous cultures and their significance for wetland conservation. The research emphasizes the importance of recognizing and integrating traditional plant knowledge into conservation strategies to enhance the resilience and sustainability of wetland ecosystems.
5	Anderson (2005)  Indigenous Knowledge and Biodiversity Conservation: From Recognition to Application	Examines the potential applications of indigenous knowledge in biodiversity conservation, with a specific focus on wetland ecosystems. The study advocates for collaborative approaches that respect indigenous rights and incorporate local ecological knowledge into conservation initiatives. It emphasizes the importance of recognizing the value of traditional plant knowledge in enhancing the effectiveness of wetland conservation efforts.
6	Adhikari et al. (2018)  Indigenous Knowledge for Wetland Conservation and Resource Utilization: A Case Study of Ramsar Sites, Nepal	The study proposes utilizing both plants and animals to implement various wetland management techniques. Most importantly, as religious symbols, indigenous peoples protect the wetlands and part of their resources, resulting in an important contribution to the management of wetlands in a sustainable manner. The younger generation is less inclined to put Indigenous knowledge into practice, while the elder generations are the ones who possess it the most. Supporting these groups to profit economically from their knowledge may address the issue.

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In addition to the above systems, traditional cattle rearing systems, extraction of wetland products for making construction materials, and forestation by local communities for wetland conservation reveal the diverse ways practices contribute to the conservation and sustainable management of wetland ecosystems.

**Traditional Cattle Rearing Systems:** Research by Sarker et al. (2017) explores the traditional practices of cattle husbandry among indigenous communities in Bangladesh's wetlands. The study documents how these communities integrate cattle grazing into wetland management, enhancing soil fertility and promoting biodiversity through rotational grazing practices. Similarly, the work by Rao et al. (2019) examines traditional cattle-rearing systems in the Western Ghats of India, emphasizing their role in maintaining ecological balance and supporting livelihoods in wetland areas.

**Extraction of Wetland Products for Construction Materials (5 literature):** The extraction of wetland products for construction materials could also help in wetland conservation. Case studies by Smith et al. (2018) and Johnson et al. (2020) document indigenous practices of harvesting wetland resources such as reeds, bamboo, and clay for building materials. These studies highlight the sustainable extraction methods employed by local communities, ensuring the long-term viability of wetland ecosystems while meeting their construction needs. The research conducted by Barman et al. provides valuable insights into the traditional knowledge and practices employed by wetland-dependent communities in Assam, India, for planning and constructing residential units. Traditional building materials such as bamboo, thatch, and mud are sourced from wetland ecosystems and are chosen for their availability, durability, and suitability to the local environment.

**Afforestation by Local Communities for Wetland Conservation:** Afforestation by local communities is recognized as a valuable conservation strategy in wetland areas. Research by Li et al. (2016) and Wang et al. (2021) investigates afforestation initiatives led by local communities in China's wetlands. These studies demonstrate how traditional knowledge of native plant species and agroforestry techniques is utilized to restore degraded wetland habitats, mitigate soil erosion, and enhance ecosystem resilience. Additionally, Kumar et al. (2018) examine afforestation efforts by tribal communities in the Sundarbans mangrove wetlands of India, emphasizing the role of community-based forestry in wetland conservation and climate change adaptation. In "Habitat Establishment and Waste Management," works by Mishra et al. (2019) and Das et al. (2021) explore indigenous strategies for habitat creation and waste management in wetland areas. They discuss the construction of artificial nesting sites for birds, the restoration of mangrove habitats, and the adoption of vermicomposting and biogas production as sustainable waste management practices, contributing to wetland conservation efforts in India.

**Traditional Stormwater Management in Wetland Watersheds:** Traditional stormwater management techniques in watershed areas have long played a critical role in the conservation of wetlands, ensuring the sustainability of these vital ecosystems. The integration with natural processes stands out as a critical aspect, where techniques such as constructed wetlands and green infrastructure mimic and enhance natural hydrological cycles, thus supporting wetland ecosystems' health and resilience. Community engagement and knowledge sharing emerge as vital for the success of stormwater management projects. Active involvement of local communities not only fosters a sense of ownership and stewardship but also facilitates the exchange of traditional and scientific knowledge, leading to more effective and sustainable practices. Above all, the cultural and social significance of wetlands is increasingly recognized, with stormwater management efforts often highlighting the historical, recreational, and aesthetic values these ecosystems provide. Adaptation to climate change is a paramount consideration, as wetlands play a crucial role in buffering against extreme weather events and mitigating climate impacts could be understood through the studied literature. Effective

stormwater management strategies are essential for enhancing the adaptive capacity of wetlands, ensuring their long-term conservation and functionality in a changing climate. A summary of the literature review of Traditional stormwater management is given in Table 4.

Table 4: A literature review of Traditional stormwater management conservation of Wetlands.

S. No.	Topic	Year and Author Title	Findings
1	Integration with Natural Processes	Ferreira et al. (2023)  Wetlands as nature-based solutions for water management in different environments	Research findings indicate that wetlands are crucial for regulating hydrological fluxes and water quality by modulating peak flows, balancing water storage and release, and filtering pollutants. Their effectiveness in water management depends on their characteristics, location, and local conditions. A holistic "wetlandscape" approach, focusing on interconnected wetlands, maximizes their ecosystem services, enhancing biodiversity, water quality, and flood mitigation.
		Barman et al. (2021)  Traditional Stormwater Management Systems in Watershed of Wetland: A Comparative Study and Overview of Dong Systems in Wetland Fringe Villages of Assam	Provide a comprehensive overview of the Dong systems, highlighting their effectiveness in mitigating the adverse effects of stormwater runoff on wetland ecosystems. By integrating traditional techniques such as earthen embankments, bamboo groves, and check dams, these systems effectively regulate water flow, prevent soil erosion, and enhance groundwater recharge, thus contributing to the sustainability of wetland habitats.
2	Community Engagement and Knowledge Sharing	Johnson et al. (2018)  Indigenous Stormwater Management Techniques: A Community-Based Approach for Wetland Conservation	How Indigenous communities have developed and passed down stormwater management techniques tailored to local conditions based on generations of observation and experimentation. These practices often involve the construction of traditional water harvesting structures, such as check dams and contour trenches, which help regulate the flow of stormwater and prevent erosion, ultimately benefiting downstream wetland ecosystems.
		Patel et al. (2020)	Importance of community engagement and knowledge sharing in traditional stormwater



		Harnessing Traditional Knowledge: Community Engagement and Knowledge Sharing in Stormwater Management	management practices. They discuss how indigenous communities have developed and passed down stormwater management techniques tailored to local conditions based on generations of observation and experimentation. These practices often involve the construction of traditional water harvesting structures, such as check dams and contour trenches, which help regulate the flow of stormwater and prevent erosion, ultimately benefiting downstream wetland ecosystems.
3	Cultural and Social Significance	Garcia et al. (2019)  Cultural Heritage and Environmental Stewardship: The Role of Traditional Water Management Systems in Wetland Communities	Explore the cultural heritage associated with traditional water management systems, highlighting their role in shaping community identities and fostering a sense of stewardship towards wetland environments. These practices often reflect indigenous knowledge systems and traditional ecological wisdom, underscoring the intrinsic connection between cultural heritage and environmental conservation.
4	Adaptation to Climate Change	Ponzio et al. (2019)  Building Climate Resilience: Community-Based Adaptation Strategies for Wetland Conservation, Ecological studies.	Investigate the resilience of traditional water management systems in the context of changing climatic conditions, emphasizing their capacity to buffer against flooding, drought, and erosion. By harnessing indigenous knowledge and local resources, communities can enhance their adaptive capacity and promote the long-term sustainability of wetland ecosystems.

## RESULTS AND DISCUSSION

There have been numerous significant barriers in the way of a thorough assessment of traditional knowledge systems for wetland conservation in India. Among them are the requirements for effectively fusing traditional practices with modern conservation tactics, verifying and documenting these customary systems, modifying them to suit shifting environmental circumstances, involving local communities while honoring their cultural customs, creating legislative and regulatory structures to safeguard customary knowledge, and making certain that this knowledge is transmitted to next generations. The necessity of successfully preserving traditional knowledge systems while meeting the changing requirements of wetland conservation and ecological sustainability is highlighted by these research gaps and challenges. The study in section 1 on the status of conservation of wetlands as Various research initiatives have contributed valuable insights into

wetland conservation, emphasizing the importance of comprehensive data collection, community engagement, and adaptive management strategies. These efforts aim to promote the sustainable management of wetland ecosystems while addressing the complex socio-environmental dynamics that influence their conservation. Despite the challenges, the studies reviewed collectively point toward the importance of long-term monitoring, interdisciplinary collaboration, and the integration of traditional ecological knowledge for effective wetland conservation in India. As a result of a cumulative understanding of the different traditional knowledge systems in the conservation of wetlands, an interpretative diagram has been generated that could summarise the linkages between wetland conservation, traditional knowledge systems, and Indigenous community engagement (Fig. 5).

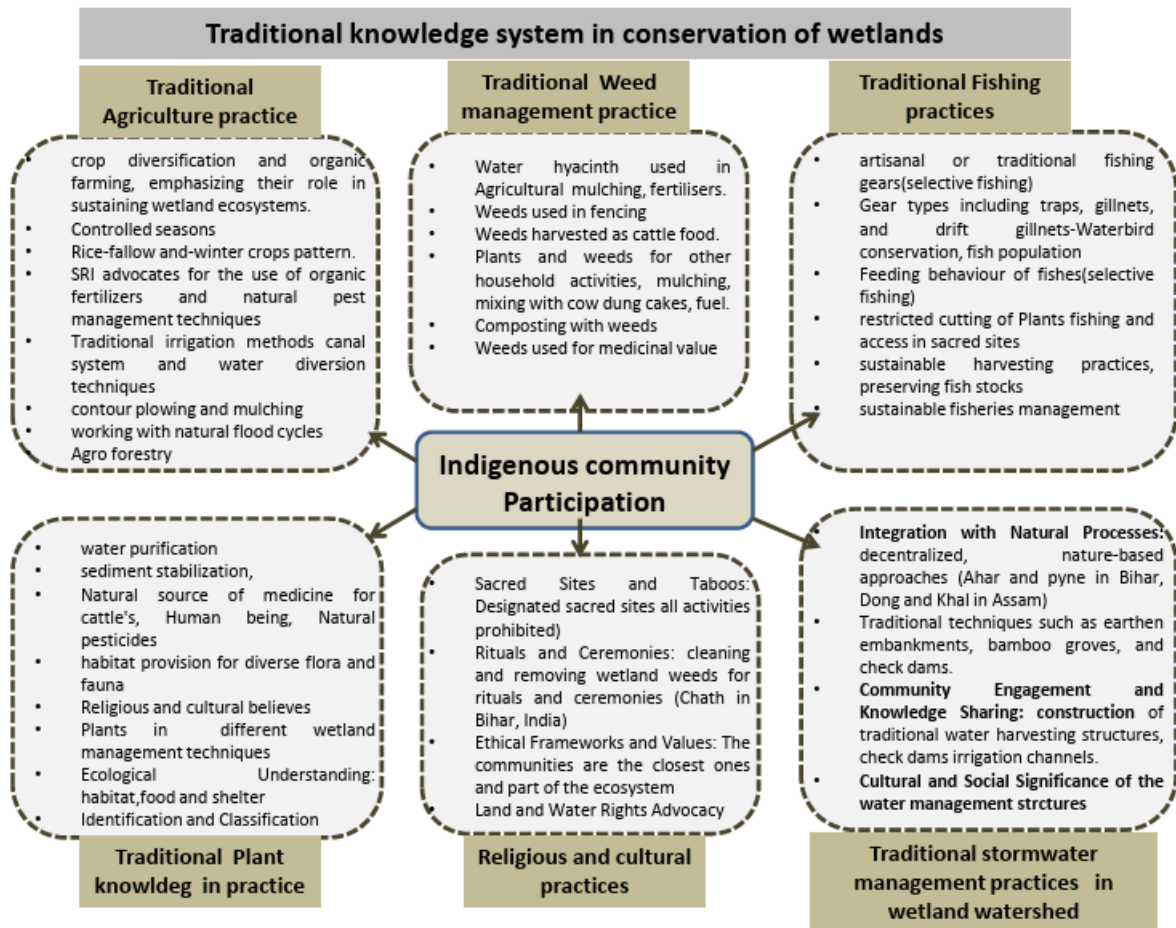


Fig. 5: Traditional knowledge system used in wetland conservation through indigenous community participation.

The review's thorough methodology allows a detailed analysis of research objectives and questions. The diverse range of articles, drawn from reputable journals and conferences underscores the thoroughness of the survey. This paper conducts an in-depth analysis of strategies within India's traditional knowledge system for safeguarding wetlands. It explores various traditional practices employed in wetland conservation, including forestation, weed control, and invasive species prevention. While traditional protection methods like prohibition, legal measures, and surveillance have become less effective, the review's strength lies in its incorporation of diverse articles from various bibliographic databases and publishers, enhancing the findings' credibility.

**CONCLUSIONS**

The study investigated the relationship between contemporary conservation initiatives and cultural value, community involvement, and integration. The study recognized the difficulties and modifications required to preserve the sustainability of India's wetland ecosystems while emphasizing the crucial role of traditional knowledge in their preservation and management. It was emphasized how important traditional knowledge systems are for preserving these ecosystems. The purpose of the study was to comprehend these systems, evaluate their efficacy, and look at community involvement and ecological balance. While governmental and non-governmental initiatives play crucial roles in wetland conservation, there is a growing recognition of the value of integrating traditional ecological wisdom into conservation strategies. However, there remains a gap in understanding how traditional knowledge can complement and enhance existing conservation policies effectively. Future research should focus on examining case studies and best practices where traditional knowledge systems have been successfully integrated into conservation policies, identifying key challenges and opportunities in this regard. Moreover, there is a need for interdisciplinary studies that engage local communities, policymakers, scientists, and traditional knowledge holders to co-create innovative approaches that combine modern conservation science with indigenous wisdom. By bridging this gap between traditional knowledge and conservation policies, we can foster more inclusive, equitable, and sustainable approaches to wetland conservation that honor and respect the cultural heritage of Indigenous communities while safeguarding the integrity of our ecosystems.

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