Socio-Economic Value of Wetlands: A Case Study of Bihar

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Abstract

This paper delves into the socio-economic significance of wetlands and the associated conservation challenges. Notably, North Bihar heavily relies on wetlands, contributing 64%, while South Bihar contributes 36% to the total wetland area. The diverse importance of these wetlands is evident through their ecosystem services, encompassing domestic use, income generation, ecotourism, and biodiversity support. Vital economic activities, including fisheries and agriculture, thrive, playing a pivotal role in supporting local livelihoods. Despite their cultural and religious significance, Bihar's wetlands confront threats like altered water flow, pollution, and encroachment. Urgent and tailored conservation strategies are essential to ensure the enduring sustainability of these ecosystems. The study offers valuable insights into wetland distribution, services, challenges, and conservation efforts in Bihar.

Keywords: Conservation, North Bihar, South Bihar, Socioeconomic Value and Wetlands.

Introduction

Bihar, one of India's most populous and agriculturally significant states, stands at the crossroads of a complex interplay between ecological challenges and socio-economic intricacies. Amidst this dynamic landscape, the state's wetlands emerge as vital ecosystems, cradling a myriad of species, sustaining local livelihoods, and significantly contributing to Bihar's socio-economic fabric. Central to understanding the distribution and extent of these wetlands is the National Wetlands Atlas of Bihar (2010), a seminal resource that forms the cornerstone of this study. The National Wetlands Atlas of Bihar reveals a staggering tapestry of 21,998 wetlands sprawled across the state, covering an extensive 403,209 hectares.

Within this expanse, a delicate balance exists between natural and man-made wetlands, with natural wetlands claiming a substantial 92% of the total. Particularly noteworthy is the dominance of the "River/Stream" category, enveloping a significant 74.01% of the wetland landscape. Lakes/Ponds (Natural) and "Wetlands (<2.25ha)" emerge as pivotal contributors, portraying a diverse canvas of wetland types that form the ecological backbone of the region. Bihar's geographical expanse unfurls into two distinct regions – South Bihar and North Bihar, constituting 43% and 57.04% of the state, respectively. This regional diversity extends to wetlands, with South Bihar contributing 36% and North Bihar commanding a dominant 64% share of the total wetland area. At the district level, this variation becomes more apparent, with certain districts emerging as champions of wetland conservation while others allocate minimal land to these vital ecosystems. The intricate distribution of wetlands across regions and districts sets the stage for a nuanced exploration of the socio-economic and ecological dynamics at play.

In the pursuit of unraveling the significance of wetlands in Bihar, this study delves into the ecosystem services provided by these natural marvels. Drawing insights from the health status report of 28 wetlands, the study uncovers the multifaceted nature of these services. From supporting domestic needs to fostering income-generating activities such as fisheries and irrigation, Bihar's wetlands paint a comprehensive picture of the intricate relationship between these ecosystems and the socio-economic fabric of the state. These wetlands, beyond being biodiverse habitats, emerge as engines of local economies, ensuring the sustenance of communities and the well-being of the region.

Against the backdrop of these insights, this study embarks on a journey to unravel the nuanced dynamics of wetlands in Bihar. It seeks to explore their ecological resilience, understand their socio-economic significance, and emphasize the imperative for tailored conservation strategies in the face of emerging threats. The delicate balance between human needs and environmental preservation becomes apparent, underscoring the urgency of informed and targeted conservation efforts to ensure the sustainability of Bihar's wetland ecosystems. As the state grapples with the complexities of development, this study aims to contribute valuable insights that can inform policies and practices for the preservation and sustainable management of Bihar's invaluable wetlands.

Review of Literature

Wetlands play a critical role in sustaining life on Earth, serving as highly productive environments and biodiversity hubs essential for the survival of numerous plant and animal species (Ramsar Conservation Bureau, 2001). Despite providing invaluable provisioning, regulatory, cultural, and supporting services,

wetland ecosystems are often overlooked (Farley et al., 2009; Lamsal et al., 2015). The net primary productivity of wetlands varies based on nutrient availability, with wetland ecosystem services ranking highest per hectare among all ecosystems, constituting 47% of global ecosystem values (Costanza et al., 1997; Mitsch & Gosselink, 2015; Ghermandi et al., 2008). Unfortunately, since the 1900s, 64%–71% of wetlands have been lost or degraded due to human-induced land use changes and pollution (Davidson, 2014; Bassi et al., 2014). In India, wetlands contribute significantly to water services, carbon sequestration, pollution reduction, flood control, and biodiversity conservation (Blankespoor et al., 2012; Kumar et al., 2008; Liu & Diamond, 2012). However, these vital ecosystems face threats from urbanization, land use changes, pollution, and climate change. Likewise, Bihar, renowned for its wetlands, plays a crucial role in the state's economy and society. Despite their significance, there is a dearth of studies based on data collected by state governments on specific wetlands. This article addresses this gap by presenting a comprehensive analysis of selected wetlands in Bihar.

Objective

This paper aims to investigate the socio-economic value of wetlands in Bihar, focusing on distribution, ecosystem services, and conservation challenges. Through a comprehensive analysis of the National Wetlands Atlas of Bihar (2010) and health status reports of 28 wetlands, the study seeks to unveil the nuanced dynamics of wetland ecosystems. The objective is to provide valuable insights into the distribution of wetlands, the services they offer, the challenges they face, and the conservation efforts in Bihar. The ultimate goal is to contribute knowledge that informs policies and practices for the preservation and sustainable management of Bihar's wetlands.

Methodology

This paper employs a comprehensive and nuanced approach to unravel the intricate dynamics of wetlands in Bihar, utilizing a multi-faceted methodology. The data source is the National Wetlands Atlas of Bihar (2010), serving as the foundational document for comprehending the distribution and extent of wetlands in the region. This atlas, a pivotal repository of information, facilitates a meticulous categorization of wetland types and their geographical spread. To capture regional and district-wise variations, the research integrates geographical data, utilizing Bihar's extensive 94,163 square kilometers as the spatial canvas. This spatial approach involves a nuanced analysis of South and North Bihar, emphasizing their distinct contributions to the total wetland area. At the district level, the study scrutinizes variations to identify wetland conservation commitments and land allocations, offering a granular understanding of the regional

conservation landscape. For insights into the health and services of wetlands, the study taps into the health status reports of 28 wetlands obtained from the Government's Website. These reports furnish a detailed understanding of the ecosystem services, ranging from domestic use and income-generating activities to ecotourism and biodiversity support. The analysis synthesizes data from diverse wetland types, enriching the research with a holistic perspective that captures the multifaceted contributions of wetlands to the socio-economic and ecological fabric of Bihar.

Findings and Discussions

Distribution and Extent of Wetlands in Bihar

The National Wetlands Atlas of Bihar (2010) provides a comprehensive overview, revealing that Bihar is home to 21,998 wetlands spanning 403,209 hectares. Notably, 92% of these wetlands are natural, while 3.5% are man-made. Wetlands smaller than 2.5 hectares constitute 4.36% of the total wetland area. Analysing the distribution of wetland types, it's intriguing to observe the dominance of the "River/Stream" category, covering a substantial 74.01% of the total wetland area. Lakes/Ponds (Natural) and "Wetlands (<2.25ha)" also contribute significantly. The atlas reports the post-monsoon water-covered area of inland wetlands at 2,24,655 hectares and 1,48,382 hectares during the pre-monsoon period. Understanding these variations is crucial for managing and conserving wetlands, ensuring their ecological health and the diverse services they provide to the environment and society.

Regional and District-wise Variations in Extent and Type of Wetlands

Bihar, spanning an extensive 94,163 square kilometers, unfolds as a diverse landscape divided into two major regions: South Bihar, constituting 43% of the state, and North Bihar, occupying 57.04%. The state's wetlands, covering a significant 403,209 hectares, play a crucial role in sustaining diverse species and ecosystems. Notably, South Bihar contributes 36% of the total wetland area, underscoring its pivotal role in conserving aquatic habitats and biodiversity. In contrast, North Bihar dominates with a 64% share, highlighting its significance in preserving the state's wetland ecosystems and maintaining ecological balance. When assessing wetland proportions relative to the geographical area, distinct district-level variations emerge. Some districts, such as Begusarai and Katihar, exhibit a strong commitment to wetland conservation, emphasizing the importance of preserving these vital ecosystems. Conversely, districts like Kaimur and Sheikhpura allocate minimal land to wetlands, signifying a potential area of concern. This regional and district-wise variation underscores the need for tailored conservation strategies to address the unique challenges and priorities within each locality. In navigating the intricate landscape of Bihar, characterized by its expansive geography and diverse wetland distribution, the importance of a nuanced

and targeted approach to conservation becomes evident. Understanding the regional dynamics and district-level commitments is essential for developing effective strategies that ensure the sustainability of Bihar's wetland ecosystems and the preservation of their invaluable contributions to biodiversity and ecological equilibrium.

Socio-Economic Value of Wetlands of Bihar

This comprehensive study delves into the multifaceted socio-economic valuation of Bihar's wetlands, utilizing a nuanced and multidimensional approach. Extracting data from health status reports of 28 wetlands, coupled with an extensive literature review, the research seeks to unveil the intricate ecosystem services provided by these vital ecological systems. The evaluation reveals the pivotal role played by Bihar's wetlands in addressing domestic needs, acting as a crucial water source for various purposes, including drinking, bathing, and as watering holes for domestic animals. Beyond their ecological value, economic studies, with a focus on the Kabartal Wetland, highlight the substantial contribution of wetlands to local livelihoods (Ambastha et al., 2007). Notably, Kabartal supports agriculture and livestock maintenance for a significant percentage of the population, showcasing its direct economic impact on the region.

Historically, wetlands in Bihar, spanning tanks, ponds, lakes, and reservoirs, have been integral to various income-generating activities, forming a crucial economic asset for the region. The Kabar Lake, also known as Kabartal Wetland, serves as a prime example, yielding two tonnes of fish daily and playing a vital role in irrigation (Shah & Laha, 2022). Wetlands contribute significantly to cost savings in agriculture, particularly in terms of reduced fertilizer expenses. Traditional tank systems across Bihar, as well as neighboring states like Orissa, Uttar Pradesh, and West Bengal, play a substantial role, contributing nearly 25% to the net tank-irrigated area (Pant & Verma, 2010). Moreover, these wetlands play a crucial role in fisheries, providing substantial value in terms of household income, nutrition, and health, especially benefiting economically disadvantaged populations.

The wetlands of Bihar also hold immense potential for ecotourism, driven by diverse ecosystems, rich biodiversity, and unique cultural heritage. Sites like Kanwar Lake Bird Sanctuary, Bhimbandh Wildlife Sanctuary, and Kusheshwar Asthan Bird Sanctuary attract birdwatchers and ornithologists, establishing them as birding tourism hotspots. Opportunities for wildlife observation, boating, fishing, picnicking, meditation, and nature walks contribute to the overall ecotourism experience. Infrastructure development, supportive policies, and marketing campaigns are identified as key factors that could further boost wetland ecotourism, thereby contributing not only to conservation efforts but also generating increased visitation and revenue for the region.

Biodiversity conservation emerges as a crucial aspect of the wetlands' significance, supporting a diverse range of plant and animal species and acting as congregation sites for migratory birds. The presence of endangered species, such as the Greater Adjutant storks in Jagatpur Lake, underscores the critical role these wetlands play in protecting vulnerable wildlife. Studies conducted on Jagatpur wetland and Kanwar Tal provide insights into the diverse flora and fauna inhabiting these regions, emphasizing the importance of wetlands in biodiversity conservation (Kumar & Pandey, 2021).

Flood control stands out as another vital ecosystem service provided by Bihar's wetlands. The state, susceptible to floods, particularly in the Gangetic plain during the monsoon season, benefits from the natural floodwater drainage points created by wetlands. The mitigating impact of wetlands on flood situations is highlighted, especially considering Bihar's experience of severe floods in 2010, which prompted substantial allocations for flood management initiatives in subsequent years.

Cultural and religious significance are deeply interwoven with the local way of life in Bihar's wetlands, with notable examples like Kanwar Lake in Begusarai district, considered sacred due to its association with Hindu mythology (Ambastha et al., 2007). The connection between wetlands and religious practices is further emphasized during festivals like Chhath Puja, involving rituals conducted in and around water bodies. Local myths and legends contribute to the cultural significance of wetlands, inspiring conservation efforts as communities and religious leaders actively engage in their protection and preservation. The sacred nature of these wetlands, reflected in traditions like the 'Kojagara' festival and wedding customs, highlights the unique blend of tradition and environmental awareness associated with Bihar's wetlands.

Threats to Wetlands in Bihar

Table 1 highlights the present threats to wetlands in Bihar, focusing on specific concerns for each listed wetland. Changes in water inflow and outflow pose significant risks to various wetlands, including Jagatpur, Braila Chaur, Gamhoria Chaur, Bhatkesri Chaur, Mangolapur Chaur, Dhurde Tal/Chaur, Samika Chaur, Maken Wetland, Lochan Chaur, Bawlee Lake, Boaria Chaur, Tal Berai, Sohag Man, Sarotar Chaur, Bhutaha Chaur, and Balwa Man. Pollution is identified as a threat to Jagatpur, Mangolapur Chaur, Dhurde Tal/Chaur, Samika Chaur, Lochan Chaur, Bawlee Lake, Boaria Chaur, Tal Berai, Sonbarsa Man, Sohag Man, Sarotar Chaur, Matwalee Man, Dariyapur Lake, Chorma Siraha Jalkar, Bhutaha Chaur, and Balwa Man, which can adversely affect the water quality and ecosystem health.

Table 1: Present Threats to wetland in Bihar

Problems	Names of Wetland
Changes in water inflow and outflow	Jagatpur, ,Braila Chaur, Gamhoria Chaur, Bhatkesri Chaur, Mangolapur Chaur, Dhurde Tal / Chaur, Samika Chaur , Maken Wetland, Lochan Chaur, Bawlee Lake, Boaria Chaur, Tal Berai, Sohag Man, Sarotar Chaur, Bhutaha Chaur, Balwa Man
Pollution	Jagatpur, Mangolapur Chaur, Dhurde Tal / Chaur, Samika Chaur , Lochan Chaur, Bawlee Lake, Boaria Chaur, Tal Berai, Sonbarsa Man, Sohag Man, Sarotar Chaur, Matwalee Man, Dariyapur Lake, Chorma Siraha Jalkar, Bhutaha Chaur, Balwa Man
Unsustainable harvest of biological resources	Jagatpur, Dhurde Tal / Chaur, Maken Wetland, Lochan Chaur, Boaria Chaur, Tal Berai, Sarotar Chaur
Mining	Jagatpur, Gamhoria Chaur, Lochan Chaur, Boaria Chaur, Tal Berai, Sohag Man
Siltation	Jagatpur, Bhatkesri Chaur, Mangolapur Chaur, Samika Chaur , Maken Wetland, Lochan Chaur, Bawlee Lake, Boaria Chaur, Tal Berai, Sonbarsa Man, Sarotar Chaur, Matwalee Man, Dariyapur Lake, Chorma Siraha Jalkar, Bhutaha Chaur, Balwa Man
Encroachment	Lochan Chaur, Tal Berai, Sonbarsa Man, Sarotar Chaur, Matwalee Man, Chorma Siraha Jalkar, Bhutaha Chaur, Balwa Man
Spread of invasive species	Jagatpur, Bhatkesri Chaur, Dhurde Tal / Chaur, Maken Wetland, Bawlee Lake, Tal Berai, Sonbarsa Man, Sohag Man, Sarotar Chaur, Matwalee Man, Dariyapur Lake, Chorma Siraha Jalkar, Bhutaha Chaur, Balwa Man

Source: Authors' Compilation using Health Cards of Wetland Downloaded from Government's Website.

Unsustainable harvest of biological resources is a concern for Jagatpur, Dhurde Tal/Chaur, Maken Wetland, Lochan Chaur, Boaria Chaur, Tal Berai, and Sarotar Chaur, threatening the balance of these wetland ecosystems. Mining activities in Jagatpur, Gamhoria Chaur, Lochan Chaur, Boaria Chaur, Tal Berai, and Sohag Man may disrupt habitats, while siltation poses risks to Jagatpur, Bhatkesri Chaur, Mangolapur Chaur, Samika Chaur, Maken Wetland, Lochan Chaur, Bawlee Lake, Boaria Chaur, Tal Berai, Sonbarsa Man, Sarotar Chaur, Matwalee Man, Dariyapur Lake, Chorma Siraha Jalkar, Bhutaha Chaur, and Balwa Man, impacting water quality and depth. Encroachment threatens Lochan Chaur, Tal

Berai, Sonbarsa Man, Sarotar Chaur, Matwalee Man, Chorma Siraha Jalkar, Bhutaha Chaur, and Balwa Man, leading to habitat loss and altered ecological conditions. The spread of invasive species is identified as a concern for Jagatpur, Bhatkesri Chaur, Dhurde Tal/Chaur, Maken Wetland, Bawlee Lake, Tal Berai, Sonbarsa Man, Sohag Man, Sarotar Chaur, Matwalee Man, Dariyapur Lake, Chorma Siraha Jalkar, Bhutaha Chaur, and Balwa Man, potentially impacting native biodiversity and ecological dynamics. Addressing these threats is crucial for the conservation and sustainable management of wetlands in Bihar.

Conclusion

In summary, Bihar's wetlands, as outlined in the National Wetlands Atlas of Bihar (2010), are pivotal ecosystems intertwining ecological richness and socio-economic significance. Spanning 21,998 wetlands across 403,209 hectares, these natural wonders delineate a delicate balance between natural and man-made landscapes. South Bihar contributes 36%, with North Bihar commanding 64%, underscoring regional variations crucial for conservation efforts. District-level discrepancies highlight champions of wetland preservation and areas necessitating targeted interventions. Ecosystem services offered by these wetlands extend beyond biodiversity, emerging as economic engines supporting domestic needs, income generation, and ecotourism. Kabartal Wetland exemplifies this impact on local livelihoods, providing fodder and sustaining fisheries. However, impending threats, including altered water flow, pollution, and resource exploitation, demand immediate attention to ensure the long-term sustainability of these vital ecosystems. To address these challenges, a multifaceted approach is essential.

Policy recommendations include integrated conservation strategies, leveraging community engagement, and promoting ecotourism to enhance awareness and generate revenue for conservation initiatives. Sustainable resource management practices, including controlled fishing and agriculture, are imperative to prevent over-exploitation. Stringent pollution control measures, coupled with regular monitoring, will help maintain water quality and ecosystem health. Flood management strategies should capitalize on the natural drainage functions of wetlands, alleviating the impact of recurrent floods in the region. Legal protections, such as designating certain wetlands as protected areas, can safeguard these ecosystems from encroachment and unsustainable activities. Additionally, continuous research efforts are vital to understand evolving ecological dynamics and inform adaptive management strategies.

In essence, the proposed policies aim to strike a delicate balance between meeting human needs and preserving environmental integrity. By fostering a harmonious coexistence between communities and wetland ecosystems, these recommendations seek to ensure the sustained management and conservation of Bihar's invaluable wetlands for the benefit of current and future generations. Through proactive and

targeted measures, the state can navigate the intricate challenges posed by development, fostering a model of conservation that respects both the socio-economic intricacies of the region and the ecological vitality of its wetlands.

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