 doi:10.20944/preprints202007.0148.v1

Title: Continuing wetland degradation dissociates socio-ecological systems and affects interconnected goals of environmental health, equity and wellbeing: A case study from the Lower Gangetic Floodplains

Authors: 1. Tiasa Adhya 2. Sayan Banerjee

Author details:
1. MRes, Conservation of Natural Resources, The University of Trans-disciplinary Health Sciences and Technology, Bengaluru, India. Email: adhyatiasa@yahoo.com

2. PhD, National Institute of Advanced Studies, Bengaluru, India. Email: sayan.workspace@gmail.com

Corresponding Author:
Sayan Banerjee
National Institute of Advanced Studies, Bengaluru, India.
Email: sayan.workspace@gmail.com

Abstract:

Unplanned urbanisation and industrialisation have severely degraded natural ecosystems, particularly wetlands. The Ganges-Brahmaputra Basin support 630 million inhabitants; yet continue to be altered rapidly, jeopardizing the region's social and ecological integrity. By conducting qualitative interviews and participant observation in a wetland dependent village located in the Lower Gangetic Floodplains we investigated how degrading wetlands in sub-urban landscapes were affecting socio-ecological systems. Not only did the wetlands provide livelihood options, mainly fishing and farming, but also provided prestige and autonomy. Vulnerable sections of the society across class, age and gender were solely dependent on the wetland. In absence of political will to safeguard wetland health, industries emerged by altering wetlands, which hampered local community's livelihood and lifestyle. Further, our study demonstrated that local ecological knowledge could provide qualitative baseline information for fast-tracking identification of important wetlands and creating inventories to initiate wetland conservation and management. Finally, we recommend local governance structures should be strongly tied to international or national wetland policies so that wetland functions along with human health and well-being could be sustained. We strongly advocate that contradictions in policies be resolved to strengthen efforts to conserve wetlands which provide resilience to marginal communities in the face of calamities.

Keywords: degradation, dependence, local ecological knowledge, Lower Gangetic Floodplain, wetlands

 doi:10.20944/preprints202007.0148.v1

1. INTRODUCTION

Human cultures dependent on their immediate natural resources have demonstrated sustainable use of the same by evolving community-based robust decision making systems and resource utilisation protocols (Ostrom 1990; Agrawal and Chhatre 2006; Newton et al. 2015). However, colonial and capitalist expansion and post-globalisation economic orders have mounted extreme pressure on natural resources on one hand and detached people from nature on the other (Guha 1983; Unnikrishnan and Nagendra 2015; Srinivasan and Velho 2018; Unnikrishnan et al. 2020). Studies across developing countries in South and South-East Asia have shown how development policies in terms of rapid industrialisation have rendered communities depending on natural systems vulnerable in terms of life chances and life qualities (Zaman 1996; Bisangkhe 2004; Elmhirst 2012; Parasuraman 2016).

One of the ecosystems that have been facing maximum exploitation post-industrialization is wetlands with recent estimates suggesting an 87% decline in global wetland area since pre-industrial times (Walpole and Davidson 2018). Conversion and loss is continuing in all parts of the world, and particularly rapidly in Asia (Davidson 2014). This has implications for sustaining socio-ecological systems, as unsustainable use and conversion of wetlands can permanently damage such systems (Jaramillo et al. 2018). Indeed, wetlands contribute in diverse ways to sustain livelihoods of local communities by preventing floods and droughts (Bullock and Acreman 2003; Westerberg et al. 2017; Penning-Roswell et al. 2019), regulating water and sediment quality, pollutants and nutrients (Chalov et al. 2017) and ensuring food security (McCartney et al. 2010). They also sequester significant amount of carbon, thus playing a critical role in mitigating the climate crisis (Mitsch et al. 2013; Fennessy et. al. 2018). Therefore wetlands are intricately linked with global targets to achieve ecological sustenance and human well-being such as the Sustainable Development Goals

 doi:10.20944/preprints202007.0148.v1

(SDG) and the Ramsar Convention's Fourth Strategic Plan for the period 2016 to 2024 (Ramsar Convention Secretariat 2016).

The rapid degradation of such an ecosystem which is a critical lifeline for the future of humanity is largely driven by a lack of an ecological understanding of wetlands (Mulamoottil 1996; Mitsch and Gosselink 2011). The complex ecosystem is characterized by hydrological processes and exhibits daily, seasonal or long-term fluctuations and might therefore have an ephemeral presence of water such as in a marsh that experiences monsoonal flood pulses or in a tidal swamp (Keddy 2010; Mitsch and Gosselink 2011). Such vacuum in knowledge have also inevitably changed wetland dependent cultures. Academicians have stated that the domination of the 'hydraulic civilization' (of European origin) that sought to control water-flow through building dams, dykes and pumps as against the 'aquatic civilization' in Asia that was better adapted to nature's pulses such as flooding, is responsible for the wide-scale wetland loss in the world (Mitsch and Gosselink 2011). Such cultures included the Marsh Arabs of Southern Iraq which lived for centuries in marsh islands at the confluence of Tigris and Euphrates (Richardson and Hussain 2006) and human communities in the Shandong district of China that lived amidst wetland canal systems and harvested aquatic plants for food and fibre (Kam 2010).

The international basin of Rivers Ganga and Brahmaputra, endowed with diverse wetland regimes, is a key biodiversity habitat and provide for the basin's 630 million inhabitants with food, water and climate security (Kumar and Ambastha 2018). The basin countries have evolved policy frameworks to secure the health and ecological integrity of these wetlands, yet, alteration of the natural flow regimes by intensification of agriculture and urbanisation continues (Kumar and Ambastha 2018). Damodar-Hugli interfluves[1] in the Lower Gangetic Floodplains of this international basin hold an expanse of marshland (Sinha

[1] Interfluves are elevated terrains between two rivers flowing in the same direction in the same drainage system.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 8 July 2020 doi:10.20944/preprints202007.0148.v1

et al. 2013). One of the authors (TA) conducted extensive surveys in the region to study the status of a wetland dependent felid species, Fishing Cat (*Prionailurus viverrinus*) (Adhya et. al. 2011). During the survey, it was found that the marshlands at Dankuni wetlands located in the Damodar-Hugli interfluves was being converted by industries against which a Public Interest Litigation (PIL)[2] was filed by non-government organisations (Adhya 2015). The destruction was happening despite Wetlands (Conservation and Management) Rules 2017 (Ministry of Environment, Forest and Climate Change 2017), a national policy guiding conservation and management of wetlands, which designated marshlands as 'wetlands'. It was also observed that marginalized communities depended on these marshlands. This prompted the authors to conduct the present research to examine the level of dependency of such communities on these wetlands.

The specific objectives of the study were to investigate - a) dependence of marginal communities on the affected marshlands at present, b) their perception towards changes in marshland character, and c) impact of reported degradation of marshland on local livelihood and lifestyle.

2. METHODOLOGY

2.1 Study site

Rather than implementing a survey in a number of villages, we decided to do an in-depth study of a single village which could be representative of the other villages in terms of wetland dependency, livelihoods and lifestyle. We found Jhakari (22.75N, 88.29E to 22.75N, 88.30E), located in the Dankuni wetlands in Hooghly district, West Bengal, India, to be such a village (see Fig 1). [Add Fig 1 here]

[2] PIL type litigations can be filed by any citizen in the court of law if the issue in hand affects public interest.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 8 July 2020 doi:10.20944/preprints202007.0148.v1

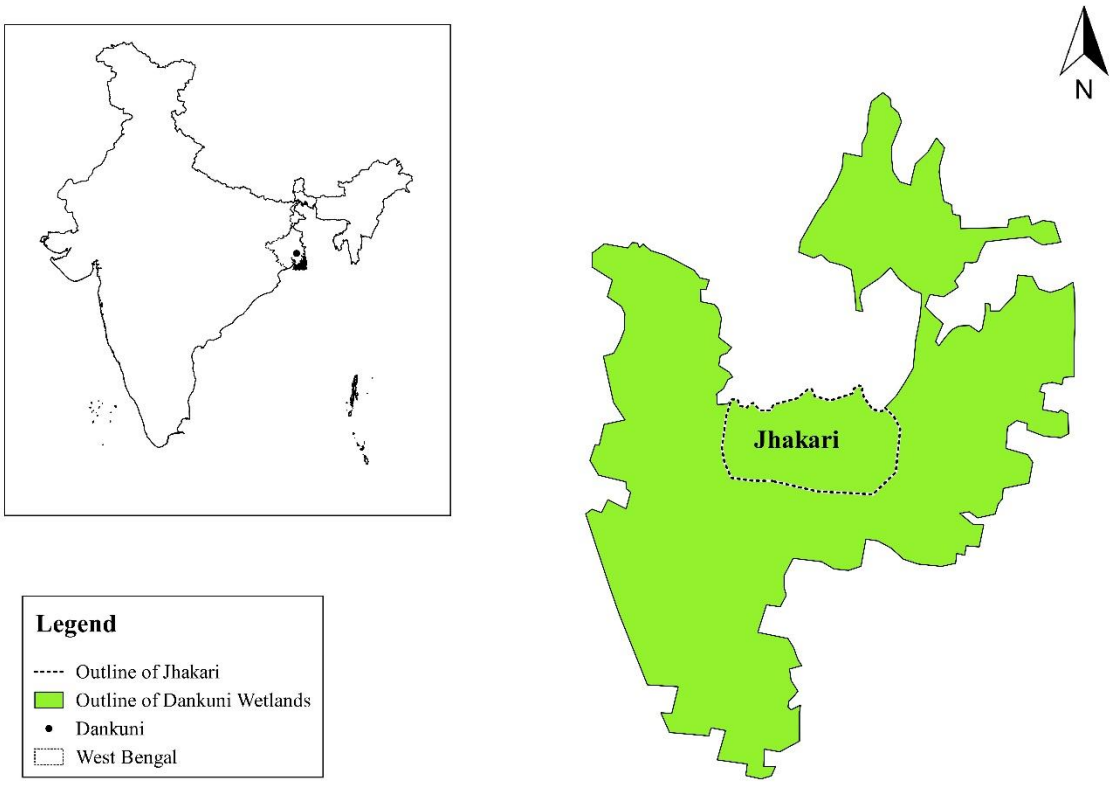

Fig 1 Location of study site in West Bengal, India.

The Dankuni wetland complex is approximately 30 km^2 in area and is perhaps one of the last contiguous marshy stretches in the Damodar-Hugli interfluves of the Lower Gangetic Floodplains. It is traversed by one of the busiest railways tracks of the region and is bounded with a national highway in the east.

The wetland complex is dominated by emergent vegetation[3] such as *Typha* and *Phragmites* and is dotted with small ponds that are used for small scale aquaculture with strips of slightly higher dry lands in between. The wetlands become seasonally inundated during monsoon (June -November). During the dry season (December to May), cultivation takes place in some portions (Hazra et al. 2012). The wetland attracts both resident and

[3] These plants are found in shore areas near waterbodies. Some plants are completely submerged, while some are rooted in the wetland soil, with their stems, leaves and flowers rising above the water.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 8 July 2020 doi:10.20944/preprints202007.0148.v1

migratory water birds throughout the year (Hazra et al. 2012). It is a home to a major wetland flagship species – the fishing cat (Mukherjee et al. 2012)

Jhakari is a typical peri-urban village which is neither completely rural nor urban. Due to the close proximity to the metropolitan city of Kolkata, much of labour and capital circulates between the village and the city. In that sense, the village is in a transition; to be engulfed by the expanding city in the near future. Almost 1000 families inhabit Jhakari. The community structure is mostly heterogeneous and people across class and caste are present. Marginalized groups belonging to economically weaker sections, Scheduled Castes (SC) and Scheduled Tribes (ST) form a significant part of the community. Apart from few houses built with concrete, most of the houses are earthen with roofs made of straws, bamboo leaves, tiles etc. A narrow concrete government made rural road runs through the middle of the village. The village has got one government sponsored play school for children. For higher education, students have to move to nearby towns. There is a primary health centre in the village.

2.2 Methods

To understand wetland dependency of people at Jhakari on the adjacent wetland, we adopted a predominantly qualitative approach where we collected people's testimonies of their dependency on and perceptions of the wetland. Our major modes of data collection were semi-structured interview and participant observation. For the semi-structured interview, we prepared an interview guide with questions related to demography of the respondent, their tangible dependencies on the wetland such as agriculture, fishing, livestock rearing and collection of other important resources; their intangible dependencies such as the importance of the wetland's existence and spatio-temporal changes of the wetland, their perspective on threats, governance and implications of the changes in the wetland-based services.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 8 July 2020 doi:10.20944/preprints202007.0148.v1

The interviews were conducted in 2019-2020. We conducted 26 semi-structured interviews and 2 focus group discussions with respondents belonging to Jhakari. We adopted snowball sampling for conducting interviews. The interview duration was around 30-40 minutes and we conducted the interviews in local Bengali language. Our respondents were aged 25 or above, as we wanted to understand the changes in the wetland that happened in their lifetime. We wanted to have equal representation of men and women respondents in our study but due to social and cultural norms, it was difficult for a male interviewer to interview women. 23% of our respondents were women. Most women denied participation in the interview as either they were extremely busy with their daily household chores or they felt that the male member of the household was more knowledgeable to appear for an interview. In this case, participant observation was used as key tool to understand gender-based dependencies. We conducted participant observation to document livelihood-based or leisure activities that people do with respect to the wetland.

All respondents were informed about the objective of the project and asked for permission to be interviewed and for the same to be recorded. Later, the audio-recorded interviews were transcribed and translated in Microsoft Word software (version 16.0). The transcripts were then coded to find themes related to our objectives. The themes were then compared and contrasted for each transcript to identify the patterns. Observations were noted in the field diary and it was later analysed to triangulate with the interviews.

3. RESULTS

3.1 Wetland Dependency of the People of Jhakari

Due to transition in life and livelihood of people at Jhakari, the dependency of people on the wetland has also changed in last two-three decades. We found both tangible and intangible dependencies on the wetland (see Fig 2). Tangible dependencies were specifically

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 8 July 2020 doi:10.20944/preprints202007.0148.v1

material dependencies i.e. the wetland resources were directly consumed at Jhakari or monetized in markets. The intangible dependencies depicted ways in which ecologically healthy wetlands in Jhakari maintained stable societies through flood and climate regulation.

[Add figure 2 here]

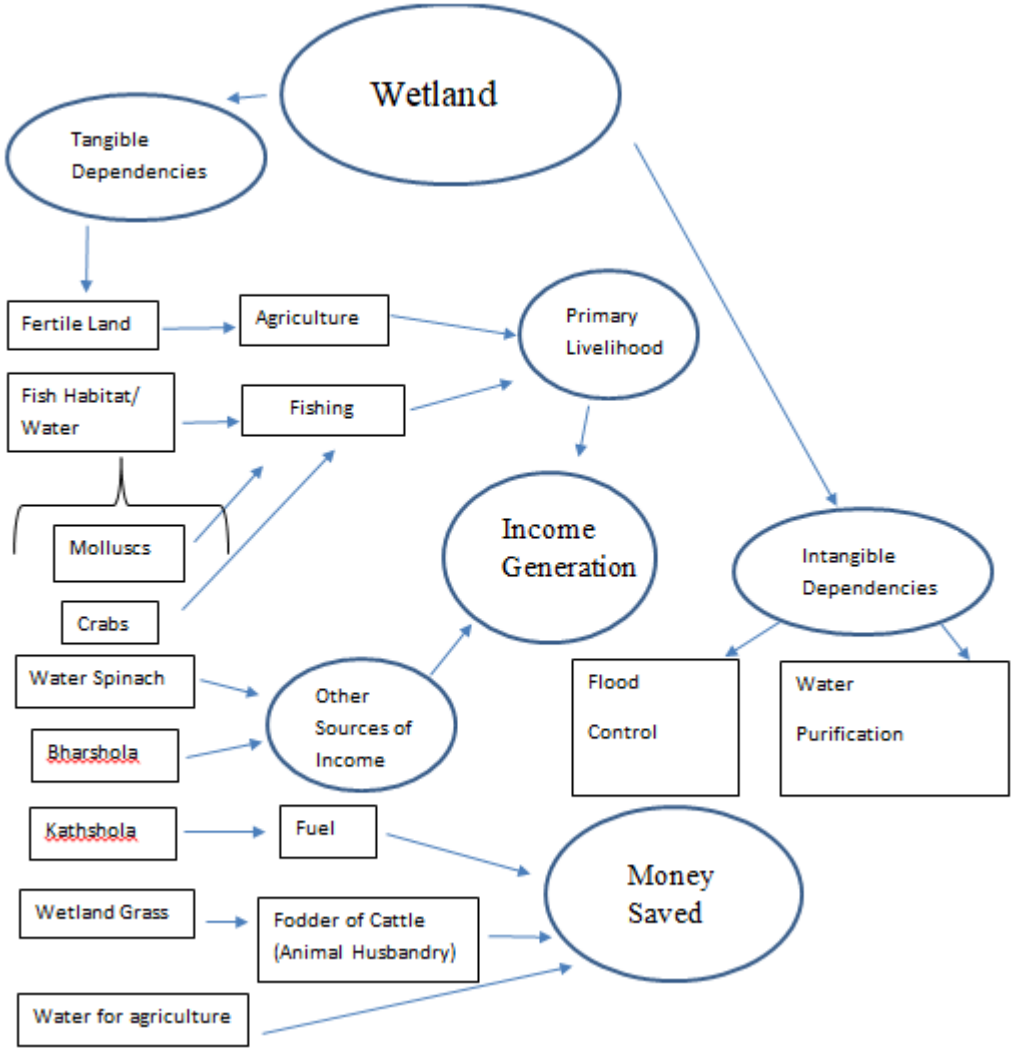

Fig 2 Tangible and intangible dependencies of local community on wetland

3.1.1 Tangible Dependency

72% of the male respondents depended on the wetlands for their primary livelihood which was supplemented by other sources of income such as causal/urban labour. Widows and elder community members reported total dependence on wetlands.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 8 July 2020 doi:10.20944/preprints202007.0148.v1

The major part of the wetland remained inundated in the monsoon months. But, in the dry season (from December to April/May) the water receded, exposing pockets of nutrient-rich dry land which was used for cultivation by the local people. Currently, the main crop cultivated was onion and ladies finger. Apart from this, other minor crops like spinach, coriander, beans, cow pea, Indian pea etc. were also cultivated (see, table 1). Many people also cultivated jute and a high-yield variety of paddy. The paddy cultivated was used for home consumption and for sale in the market. The paddy cultivated here is preferred locally; BP (24), a young farmer and casual labour told that "The rice we cultivate is very fine in texture and much tastier than that given in ration shops". Elucidating this view further, HT (78), an old farmer said that "the agriculture in the wetlands presents a prospect for earning 'food of self-respect'." Some minor crops like water spinach foliage or *kolmi shak* and water lily stems or *shapla* were also obtained from the semi-wet areas of the swamp. Pulses and vegetables like ridge gourd, bitter gourd, drumsticks etc. were also cultivated. The majority of the vegetable was sold at nearby markets, villages or urban centres. [Add table 1 here]

Table 1: Crop cultivated at wetland premises at Jhakari and their selling price

Name of Crop	**Average Selling Price (INR/Kg)**	**Average Selling Price (USD/Kg)**
Coriander (*Coriandrum sativum*)	70	1
Spinach (*Spinacia oleracea*)	70	1
Beans (*Phaseolus vulgaris*)	40	0.50
Indian Pea leaves (*Lathyrus sativus*)	60	0.80
Ladies Finger (*Abelmoschus*	53	0.70

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 8 July 2020 doi:10.20944/preprints202007.0148.v1

esculentus)		
Onion (*Allium cepa*)	30	0.45
water spinach foliage (*Ipomoea reptans*)	10/4-5 bundles	0.10
water lily (*Nymphaea nouchali*)	10/4-5 bundles	0.10

The wetland is nutrient rich and acts as a good habitat of different types of fishes. Fishing has been a major part of the livelihood portfolio of people of Jhakari, providing more economic and nutritional benefits than even agriculture (see table 2). Through our observation and interviews with fishermen, we documented various freshwater fishes such as *Koi*, *Magur*, *Singhi*, *Shol*, *Lata*, *Punti* etc. which were either consumed at the household or sold at nearby markets. Fishermen used various locally made fishing gears with different mesh sizes like *ghuni*, *atol*, *beto*, *kolsi* to capture different kinds of fishes. Molluscs such as snails (*Pila* sp. and *Bellamya* asp.) and oyster were also collected by many villagers for consumption and sell. Fishing was a seasonal activity since the fishes mentioned is available mostly during winter. Expanding on the financial benefits received from the wetland, GB (60), a middle-aged resident of Jhakari opined, "We can eat fish like *singhi*, *magur* etc. caught from the swamp, free of cost" (emphases original). [Add table 2 here]

Table 2: Fish collected from wetland at Jhakari and their selling price

Fish Name	**Average Selling Price (INR/Kg)**	**Average Selling Price (USD/Kg)**
Koi (*Anabas testudineus*)	400	6
Magur (*Clariusbatracus*)	700	10
Singhi (*Heteropneustis fossilis*)	700	10

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 8 July 2020 doi:10.20944/preprints202007.0148.v1

Shol (*Channa striatus*)	250	4
Lata (*Channa morulus*)	100	1.5
Punti (*Puntias ticto*)	100	1.5
Shamuk (*Pila* sp. and *Bellamy* asp.)	80	1.1

Some households raised cows to sell milk. Due to lack of grazing areas, the cows were stall fed with grass (*Brachypodium sylvaticum*, *Poaceae*) collected from the wetland. With the availability of free grass from the wetlands, few were found to afford fodder additives like oil cakes (which costs about Rs. 40/kg) and straws. The wetland essentially subsidized the cost of fodder.

Very few households in Jhakari used LPG cylinders for cooking. Even though most of the households were supposed to get benefits under governmental scheme of subsidized LPG cooking cylinders, logistical and economic hurdles had made the scheme locally redundant. In this scenario, Indian Jointvetch or *kathshola* (*Aeschynmene indica*) which was found to be locally available at the wetland was often used by the villagers as cooking fuel. Apart from *kathshola*, jute-sticks grown in the wetland was often used as cooking fuel in the households.

Harsh Jointvetch or *Bharshola* (*Aeschynmene aspera)* was collected from the wetland which was used for making crafts and religious decorative. RB (38), who was a craft maker at Jhakari told, "*Shola* from the swamp is used to make decoration items like *chandmala*, *mukut* (decorative items) etc. by the *Malakars* (craft-makers). The supply of shola from the swamp falls short of the actual demand. People from Sonarpur, Canning (50-70 km away from Jhakari) come here to buy shola from us." This freely available material from the wetland was sold to external buyers. *Bharshola* was found to be wild but some people have started cultivation to some extent. It grew quite easily and was found to require minimum labour.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 8 July 2020 doi:10.20944/preprints202007.0148.v1

3.1.2 Specific tangible dependency

Different social groups depended differentially on the wetland based on their social and economic status. We found certain patterns of gender and age-based dependencies on the wetland.

Men in Jhakari had higher opportunities than female in terms of income diversification as they could migrate to urban centres to work and also fish or farm in the village. Women mostly described themselves as homemakers. They were involved in wetland based activities which were important for the households but did not necessarily have monetary outcomes. For instance, women were involved in sowing, weeding and land preparation for agriculture during the dry months on the dry pockets of the wetland. Apart from fully responsible for household chores and carework, women also collected fuel and fodder materials from the wetland to support the household activities.

Widowed women were totally dependent on the wetlands. AK (65) depended on the wetland to sustain herself and her young children after her husband passed away. LK (68), another widow said, “We don’t have any farmland. My in-laws didn’t have any property. I was married to a person who worked as hired labourer. When he died, I faced a lot of hardship while rearing my children.” These women were mostly landless and illiterate whose only means of livelihood was to collect molluscs and gather reeds from the wetland. They formed groups of 3-4 and collected molluscs for the entire day. There were some women such as SB (60) who along with collecting molluscs also used to catch fish using their bare hands without using any fishing gear. They evolved their own techniques to catch catfish which is capable of inflicting painful stings. These women also collected water spinach from the wetland (which men usually didn’t). BT (50) ran a small hotel where she used *kathshola* collected from the wetland as cooking fuel.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 8 July 2020 doi:10.20944/preprints202007.0148.v1

Many reported that their sons have now grown up and were hired as daily wage labourers due to which their economic conditions have improved. The women still stuck to their work of collecting resources from the wetland as it assured their independence. For example, AK (65) said, "if I want to go to my parents' home, suppose, I could buy *saree* (women's cloth) as a present or I could feel like eating something special or buy cosmetics. For that, I can depend on myself."

Older people could not migrate to urban centres for work and depended upon the wetland for their only livelihood. They undertook less labour intensive work like collecting vegetables, molluscs, small fishes and *shola* from the wetlands.

3.1.3 Intangible dependencies

The wetland functions to control flood and purify water. RB (38) informed us that "The swamp acts as a reservoir of water accumulating it from the surrounding higher grounds". Other respondents informed that the wetland regulates flood. Thus, Jhakari has never faced severe flood events even though nearby urban areas were inundated. As the wetland was connected to the river Hooghly by a canal, the excess water got drained into the river.

Older respondents informed that the quality of the water in the wetland was once drinkable. It used to be naturally purified and clean. HT (78) compared the water with the present water that people get from filters. Indeed, wetlands have water purification properties. Many reed plants are known to purify water (Al-Samawi 2000).

3.2 Changing nature of the wetland and its impacts

Despite being a life sustaining system to many, the Dankuni wetland is facing threat due to unregulated development. 'Factories' were ranked as the primary threat by 72% men

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 8 July 2020 doi:10.20944/preprints202007.0148.v1

and 43% women followed by 'clogged canals' as reported by 22% men and 29% women. Such changes have affected the lives and livelihood of the people of Jhakari (see Fig 3). [Add figure 3 here]

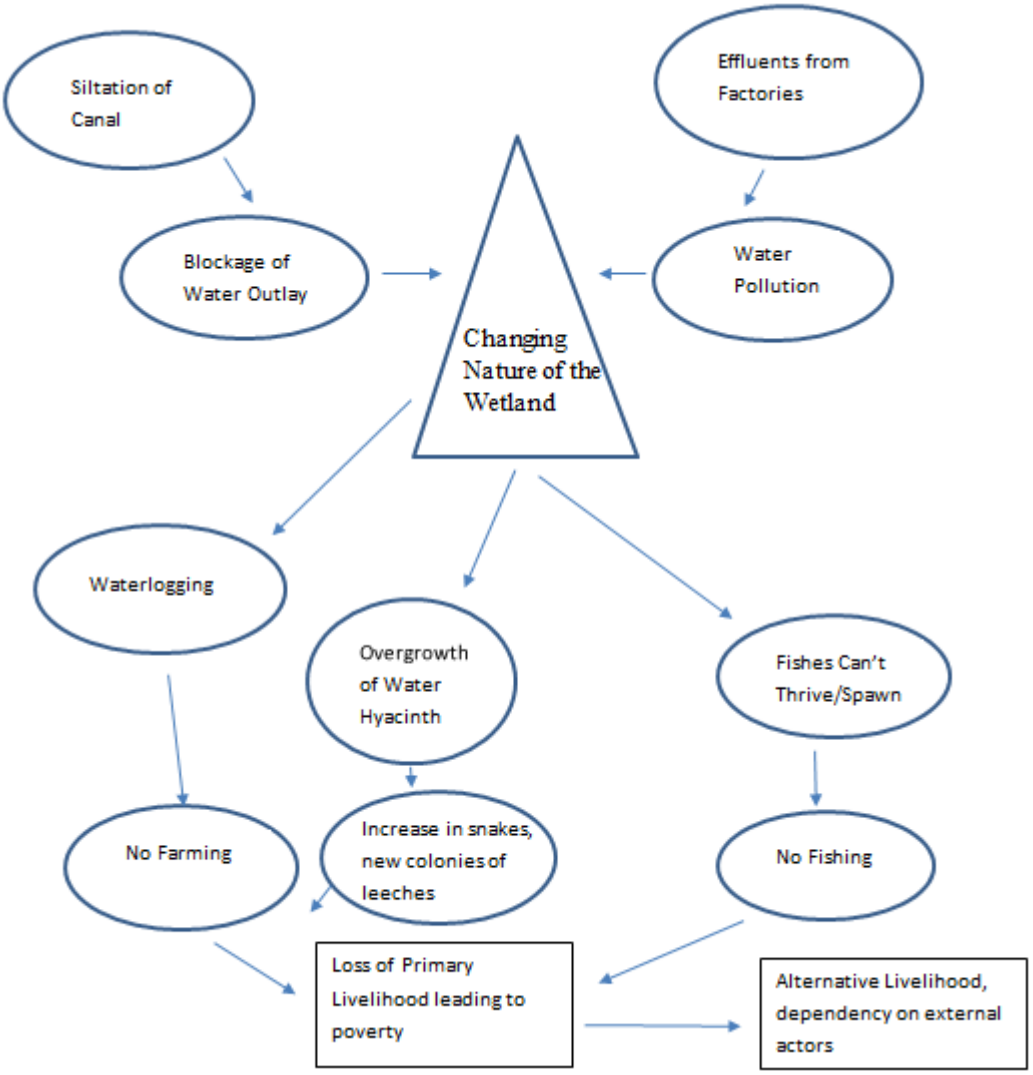

Fig 3 Changing nature of the wetland and its after-effects

3.2.1 Changing nature of the wetland

About 20-30 years ago, the wetland was well connected to the river Hooghly through a canal named *Baidyabati khal*. Due to waste materials being discharged into the canal from

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 8 July 2020 doi:10.20944/preprints202007.0148.v1

newly established buffalo shelters on the banks, the sluice gate present at the junction of the canal and river got clogged, thereby affecting the inflow and outflow of water from the wetland to the river. KB (63) said, "The water from the swamp used to flow out to *Bander beel* (another wetland). This canal extends up to Bally. There it connects to the river Ganges. But the buffalo shelters there have obstructed the canal. There is no dredging." He further added, "The swamp has become *hadh* (full of thick vegetation of grasses) and is inaccessible now. It impedes boat movement deep into the marsh." A majority of the respondents reported waterlogging even in mid-February which is when the wetland is supposed to dry up. In addition, many factories have come up on the wetland by partially filling it up. Respondents unanimously felt that this has led to a contraction in the size of the wetland and due to the mixing of poisonous effluents, water quality had deteriorated. They opined that the water from the wetland had become unsuitable for drinking and was negatively affecting fish populations.

3.2.2 Impacts on the primary livelihood

As the natural water outflow system of the wetland has been disturbed, seasonal farming has also been affected. Many land owners could no longer cultivate their lands and had sold or leased off their lands for aquaculture to outsiders in the last two years. Few who owned land at a slightly higher elevation in the village could use it for crop production and had to wait till the water had receded. The time for water to recede has increased over the years. So, farmers who were previously totally dependent on farming lost their primary mode of income. Due to a decrease in the cultivated paddy which was mostly used for self-consumption, people now have to buy rice from subsidized public shops which cost more but were poor in taste.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 8 July 2020 doi:10.20944/preprints202007.0148.v1

NT (43) said, “It is all waterlogged and even in this dry season, one can ply a boat in the waters. So, no farming is possible. By this time, sowing is generally completed in other years and paddy plants attain a certain height. Due to this waterlogging, fish spawns are destroyed. Some fishes are not seen anymore. Previously, different varieties such as big prawns, *bata* (*Labeo bata*) etc. were available in the swamp. Those are not seen now. Even, *shol, lata, koi* etc. have also decreased in number.”

Not only that, other materials obtained from the wetland such as molluscs, water spinach have also decreased, leaving the dependents in a state of erratic income from wetland resources. The elders of Jhakari were increasingly losing their independence and found to be relied on their sons who work as migrant labourers to support them.

3.2.3 Loss of income

Due to loss of the primary livelihood i.e. fishing and agriculture, the villagers have experienced an overall loss in income. Due to the low level of education at Jhakari, most now find it difficult to get decent jobs. Specifically, the most vulnerable groups such as elderly people and widows who had no other means were greatly affected. The education of children had suffered under such circumstances as financial instability made it difficult for parents to provide for bus fares for children to travel and avail highly subsidized government education at distant villages. NT (43) said “if they (children) get higher education, they might be able to get good jobs outside the village. But that is not possible. The youngsters in the village are educated up to class 7 or 8. Beyond that, it is not possible to provide education to them. The high school is far from the village. Going there requires INR 30 (USD 0.50) everyday as bus fare. As there is no security of income, it is not possible to give the fare every day.”

Factories and buffalo shelters which had degraded the wetlands over the years have not compensated the loss by offering jobs to the people of Jhakari. Most of these factories

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 8 July 2020 doi:10.20944/preprints202007.0148.v1

required skilled labour which was unavailable at Jhakari. Rather, the labour force in these factories was outsourced.

3.2.3 Increase in market based expenditure

Due to decreasing food provisions from the wetland, the people of Jhakari became more dependent upon the market to meet their basic needs. Buying rice and vegetables had increased expenditures significantly. The situation is getting worse due to increase in market values of daily needed commodities and food products over time.

3.2.4 Degradation of wetland quality

Respondents informed that water snakes had increased and many residents had been bitten by these snakes. Leeches had also appeared recently which were absent earlier. Respondents complained that collecting resources from the wetland had become a painful task due to leech attacks. People also claimed of getting skin rashes and lesions due to daily exposure to effluent mixed water of the wetland. PT (35) said, “Some factories emit yellow coloured liquid while some emit blue coloured liquid that does not let even an insect to survive in the swamp. Even a cow cannot go into the swamp. If the cow or goat enters the swamp, it develops skin rashes in the legs. The water in the swamp is that poisonous!”

3.2.5 Evolution of alternative livelihood

As the majority of people of Jhakari were uneducated, chances of getting government jobs or jobs that require skilled labour were very less. As an alternative, people had started working as casual hired labourer in agricultural lands owned by others in nearby villages or as urban labourers. SB (30) said “I have a family with wife and kids. In the factory, they give INR 900 (USD 12) per week only. My little daughter needs food worth INR. 50 (USD 0.70)

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 8 July 2020 doi:10.20944/preprints202007.0148.v1

daily. That sort of work doesn't provide enough money. There are my personal expenses as well. So, I mostly work as hired labourer. I earn INR 350-400 (USD 5-7) daily."

Some found employment in nearby jute mills. A few people had got their names enlisted under the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), one of the largest rural development programs in the world, which guaranteed employment for hundred days in a financial year to households whose adult members agree to do unskilled manual work to produce productive assets in the village. Despite some job security, it still did not guarantee year round income. Some youths had migrated to other metropolises of India for better remuneration.

3.2.6 Loss of interest over wetlands

Due to deterioration of the wetland quality, reduced economic returns and changes in lifestyle and livelihood, a number of people, mostly the younger generation were found to have a reduced interest in the wetlands. Many had stopped going to the wetland and were found to have a denuded sense of belonging to the wetland. The older generation's wisdom related to the interactions between the wetland and the society was seemingly missing from the youth's narratives.

3.3 Institutional responses to this crisis

Given the negative changes and reduced functionality of wetlands, the respondents opined that some interventions were necessary to restore the wetlands. Many respondents thought that the government was the owner of the wetland and hence government authorities and local administrative bodies should take care of the wetland. Some thought that the natural outflow could be restored through dredging the canal that joins the river. PS (30) echoing many others' opinions, said, "The government is responsible for the protection of the swamp.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 8 July 2020 doi:10.20944/preprints202007.0148.v1

If the canal is restored, all problems will be solved. People will start agriculture again. There is no initiative from the government; only verbal promises. The village authorities only look for votes. They promise many things, but nothing has been materialized yet."

The negative effects on the lives of people of Jhakari in general and marginalized sections in particular have not been addressed at state or *Panchayat* (rural administrative body) levels. Many thought that authorities favoured factories more than the lives of people at Jhakari. UT (40) said, "The government doesn't care for us. The government only takes care of the factories! They are not bothered about the poor."

So, an institutional vacuum existed that could not address the negative ecological and social changes that were happening at Jhakari.

4. DISCUSSION

In this study we attempted to examine the remunerative and societal linkages of local residents on wetlands amidst rapidly urbanising landscapes. We also sought to understand their perceptions of how wetlands were changing and how their lives were being consequently affected.

4.1 Interconnecting poverty and wetland dependency

Fishing and agriculture were the major material forms of attachment for the local community with the wetland that provided livelihood, food, autonomy, and prestige. More importantly, we found that vulnerable sections of the society like the older generation and especially widows were solely dependent on wetlands. Poverty has both income and non-income dimensions and is often conceptualised as exclusion from basic needs and deprivation of capability (Sen 1992; Organisation for Economic Co-operation and Development 2012; Alkire et al. 2015). In our case, although the local community members have significantly

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 8 July 2020 doi:10.20944/preprints202007.0148.v1

lower income than those in urban centres, many other dimensions of poverty have been countered through the dependency on wetland. The ecological functions of wetlands that provided food, fuel, drinking water and fodder buffered excess expenditure which is often a reality for urban residents. In the absence of wetlands, such marginalized communities are rendered vulnerable in the face of climate, social and financial crisis.

4.2 Social costs of a changing wetland

Jhakari as a part of the Dankuni wetlands, which is perhaps the largest contiguous wetland system persisting in the Lower Gangetic Floodplains outside protected areas, portrayed degradation of self-sustaining ecological systems. The changes promoted a detachment between culture and nature, pushing the vulnerable to the brink, and alienating the younger generation towards transitioning into an unstable urban casual labour force. We showed that industries that were emerging by filling up wetlands were not enhancing the lives of local residents, most of whom were unskilled and uneducated. We further highlighted the ignorance and lack of will in local administration to prevent such degradation of wetlands. A significantly altered wetland with decreased functionality could also alter the autonomy enjoyed by the local community. The residents had developed specific skills over generations which had helped them carve out life and livelihood options by intimately engaging with the wetland functions. It made them self-dependent and resilient against adversities. Such autonomy would cease to exist if irreversible changes occur in the wetland and in that case, the local community will be forced to shift from self-determined livelihood systems to complete dependency on external actors, where, their bargaining power is set to reduce to a large extent.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 8 July 2020 doi:10.20944/preprints202007.0148.v1

4.3 Policy implications for 'wise use' of wetlands

It has been estimated that the freshwater wetlands worldwide provided ecosystem services from 1997 to 2011 worth US$2.7 trillion per year (Constanza et al. 2014). In fact, values of inland and coastal wetland ecosystem functions far outweigh that of terrestrial ecosystems and therefore, underline the importance of wetlands in maintaining the most fundamental nexus between water, food and energy (Russi et al. 2013). It is globally recognized that wetlands provide the ecological infrastructure to meet a range of policy objectives, neglecting which will lead to significant loss of human well-being. Wetland related ecosystem functions need to be integrated into national policies to achieve the transition to a resource efficient, sustainable economy (The Ramsar Secretariat 2016). We suggest that peri-urban wetlands, such as Dankuni wetlands could be vital for recognizing many of the Sustainable Development Goals set for 2030 by the United Nations as they are tightly coupled with each other, rather than being trade-offs (Jaramillo 2019). As seen from our study, such coupling can recognize Sustainable Development Goals such as reduction of poverty (SDG 1), hunger (SDG 2), inequality (SDG 5), optimizing consumption and production (SDG 12), enhancing good health and well-being (SDG 3), providing access to clean water (SDG 6), improving climate action (SDG 13) and conserving life below water (SDG 14) and life on land (SDG 15).

Despite being signatories of Ramsar Convention, there is a lack of political will to stem wetland loss and the unregulated growth of industries at the cost of wetlands and marginal communities. The new wetland law of India, Wetlands (Conservation and Management Rules) 2017 (Ministry of Environment, Forest and Climate Change 2017) introduced a provision where only wetlands that are notified by the State or Central government would receive protection. In line with the Ramsar Convention, it was mandated that all state governments should notify their wetlands, demarcate their boundaries within 26th

 doi:10.20944/preprints202007.0148.v1

September, 2018, describe their ecological character and prohibit destructive activities. Indian states are majorly still to comply with this policy mandate.

Often lack of an ecological understanding of wetlands becomes an impediment in identifying them, especially those that are not permanent waterbodies and have a seasonal presence of water. In such a scenario, we demonstrated the utility of local ecological knowledge as a portal to access past and present conditions of such wetland systems in instances where scientific information based on long-term data collection is unavailable. Such knowledge systems may be relied upon to build a foundation, for example, to contribute to the description of the ecological character of a wetland and to understand its boundaries and zones of influence. For instance, the description of the local residents points towards occurrence of seasonal inundation which is a characteristic feature of wetlands. Wetlands are defined as 'lands transitional between terrestrial and aquatic systems' that are periodically inundated by water and that they produce 'dominantly undrained hydric soil' with anaerobic conditions and are 'saturated with water or covered by shallow water at some time' (Keddy 2010; Mitsch and Gosselink 2011). In fact, Ramsar mandates that traditional knowledge and practices of local communities that are relevant for the wise use of wetlands should be documented and fully integrated and reflected in the implementation of the Convention (Ramsar Convention Secretariat 2016). India, as a Convention of Biological Diversity (CBD) member has constituted The Biological Diversity Act, 2002 under which people's knowledge can be documented to promote sustainable use of resources. We suggest that this mechanism can be used to document local ecological knowledge for the wise use of wetlands. Such an initiative will also fulfil Ramsar's vision of establishing synergistic efforts with other conventions in the Biodiversity Liaison Group (BLG) to implement wetland conservation at the national scale. Local ecological knowledge remains underutilized as a means to identify

 doi:10.20944/preprints202007.0148.v1

and recognize the potential of wetlands in the Lower Gangetic Floodplains and in the larger Ganges-Brahmaputra Basin.

Because weak institutional structures drive environmental change (Young and Gasser 2002; Adekola and Mitchell 2011), we highlight the need to tie international policies and national laws more intricately with local governance structures to expedite wetland conservation in human dominated landscapes. For instance, wetland restoration can be included to generate jobs under the Indian labour law and social security measure that aims to guarantee the 'right to work' under the National Rural Employment Guarantee Act, 2005. This will also ensure that the local governance structure develops a responsibility to monitor the health and well-being of the wetlands in their surroundings. Over time, a holistic management plan might evolve with participation of local people and support from researchers and conservation practitioners, which will ultimately result in 'wise-use' of wetlands, a central tenet guiding the Ramsar Convention.

Further, contradictions between national policies, for example, the status of marshlands in India as 'wetlands' (Ministry of Environment, Forest and Climate Change, 2017) and as 'wastelands' (National Remote Sensing Centre 2010), create legal loopholes that are being exploited to expedite wetland conversion. This needs to be resolved to aid wetland conservation and to secure the food-water-energy nexus, which is primal for sustaining the future of marginalized local communities. Calamities such as the Covid-19 pandemic which forced reverse migration of urban labourers to rural India is exemplary in highlighting the need to maintain resilient socio-ecological systems.

5. CONCLUSION

In this paper we showed that poor, marginalized people living in the vicinity of common natural resources, such as wetlands, are dependent on it for their life and livelihood.

 doi:10.20944/preprints202007.0148.v1

Ecological functions of wetlands subsidize living costs for these communities by providing material and intangible support. Degradation of wetlands can harm these self-sustaining and relatively autonomous socio-ecological systems. We also showed that people's knowledge and experiences of temporal and spatial changes of wetlands can provide rapid assessment of important wetlands in the country. Engaging with such knowledge frameworks can foreground local community's voices in the response to global environmental changes. Further, we suggest that international and national policies for wetlands be tied more intricately with local governance structures. More importantly, wetlands with ephemeral presence of water such as marshlands need to be liberated from loopholes in the legal framework and recognized as critical natural infrastructures in accordance with global wetland conventions and national wetland legislations.

Acknowledgement:

We are indebted to our respondents at Jhakari for graciously agreeing to participate in the study and enriching our knowledge. We would like to thank Dr. Pushan Chakraborty for his extensive contributions to the study and Divyajyoti Ganguly for his technical contributions to the manuscript. We express our utmost gratitude to Wildlife Conservation Trust for generously supporting this study.

Declarations:

There is no conflict of interest associated with this study. The study was supported with a generous grant from Wildlife Conservation Trust.

Author contributions:

Both authors have equal contributions in developing the study and the manuscript.

REFERENCES

Adekola O, Mitchell G (2011) The Niger Delta wetlands: threats to ecosystem services, their importance to dependent communities and possible management measures. International Journal of Biodiversity Science, Ecosystem Services & Management 7(1): 50-68

Adhya T, Dey P, Das U, Hazra P (2011) Status survey of Fishing Cat (Prionailurus viverrinus) in Howrah and Hooghly, West Bengal. Intermediate report submitted to the small grants programme, WWF, India. WWF India

Adhya T (2015) Martyr and a court ruling: Wetlands in Howrah still ravaged by real estate. Down To Earth. https://www.downtoearth.org.in/blog/martyr-and-a-court-ruling-41796. Accessed 28 June 2020

Agrawal A, Chhatre A (2006) Explaining success on the commons: Community forest governance in the Indian Himalaya. World development 34(1): 149-166

Alkire S, Foster J, Seth S, Santos ME, Roche JM, Ballon P (2015) Multidimensional poverty measurement and analysis. Oxford University Press, Oxford

Al-Samawi AA (2000) The use of reed plants for wastewater treatment: the Iraq experience. Schriftenreihe des Vereins fur Wasser-, Boden-und Lufthygiene 105: 311-317

Bisangkhe S (2004) Water projects related involuntary displacement in Nepal. Water Nepal 11(1): 85-103

Bullock A, Acreman M (2003) The role of wetlands in the hydrological cycle. Hydrology and earth system sciences discussions, European Geosciences Union 7(3): 358-389

Chalov S, Thorslund J, Kasimov N, Aybullatov D, Ilyicheva E, Karthe D et al (2017) The Selenga river delta: a geochemical barrier protecting Lake Baikal waters. Regional environmental change 17(7): 2039-2053

Constanza R, De Groot R, Sutton P, Van der Ploeg S, Anderson SJ, Kubiszewski I et al (2014). Changes in the global value of ecosystem services. Global environmental change 26: 152-158

Convention of Biological Diversity. 2014. Progress towards the Aichi biodiversity targets: an assessment of biodiversity trends, policy scenarios and key actions. Convention of Biological Diversity. https://www.cbd.int/gbo4advance. Accessed 5 June 2020

Davidson NC (2014) How much wetland has the world lost? long-term and recent trends in global wetland area. Marine and Freshwater Research 65(10): 934-941

Elmhirst R (2012) Displacement, resettlement, and multi-local livelihoods: positioning migrant legitimacy in Lampung, Indonesia. Critical Asian Studies 44(1): 131-152

Fennessy MS, Wardrop DH, Moon JB, Wilson S, Craft C (2018) Soil carbon sequestration in freshwater wetlands varies across a gradient of ecological condition and by ecoregion. Ecological Engineering 114: 129-136

Guha R (1983) Forestry in British and post-British India: a historical analysis. Economic and Political Weekly 18(44): 1882-1896

Hazra P, Sinha A, Mondal P, Khan TN (2012) Calendar-effects and temperature-impacts in migratory waterbirds at three tropical Indian wetlands. Acta oecologica 43: 60-71

Jaramillo F, Licero L, Åhlen I, Manzoni S, Rodríguez-Rodríguez JA, Guittard A, Hylin A, Bolaños J, Jawitz J, Wdowinski S et al (2018) Effects of hydroclimatic change and rehabilitation activities on salinity and mangroves in the Ciénaga Grande de Santa Marta, Colombia. Wetlands 38: 755–767

Jaramillo F, Desormeaux A, Hedlund J, Jawitz JW, Clerici N, Piemontese L et al (2019) Priorities and interactions of sustainable development goals (SDGs) with focus on wetlands. Water doi:10.3390/w11030619

Kadlec RH, Wallace S (2008) Treatment wetlands. CRC press

Kam SP (2010) Valuing the role of living aquatic resources to rural livelihoods in multiple-use, seasonally-inundated wetlands in the Yellow River Basin of China, for improved governance. CGIAR

Keddy PA (2010) Wetland ecology: principles and conservation. Cambridge University Press

Kumar R, Ambastha K (2018) Wetlands of the Ganga-Brahmaputra Basin. In: Finlayson CM, Milton GR, Prentice RC, Davidson NC (eds) The Wetland Book: II: Distribution, Description, and Conservation. Springer, Netherlands

McCartney M, Rebelo LM, Senaratna Sellamuttu S, De Silva S (2010) Wetlands, agriculture and poverty reduction (Vol. 137). IWMI

Mitsch WJ, Gosselink JG (2011) Wetlands. John Wiley & Sons, Inc

Mitsch WJ, Bernal B, Nahlik AM, Mander Ü, Zhang L, Anderson CJ et al (2013) Wetlands, carbon, and climate change. Landscape Ecology 28(4): 583-597

Ministry of Environment, Forest and Climate Change. 2017. Wetlands (Conservation and Management) Rules, 2017. MoEFCC. http://envfor.nic.in/content/gsr-1203e-wetlands-conservation-and-management-rules-2017. Accessed 5 July 2020

Mukherjee S, Adhya T, Thatte P, Ramakrishnan U (2012) Survey of the Fishing Cat Prionailurus viverrinus Bennett, 1833 (Carnivora: Felidae) and some aspects impacting its conservation in India. Journal of Threatened Taxa, 4(14): 3355-3361

Mulamoottil G (ed) (1996) Wetlands: environmental gradients, boundaries, and buffers. CRC Press

National Remote Sensing Centre (2010) Wastelands Atlas of India 2010. Department of Land Resources, Ministry of Rural Development, Delhi

Newton P, Oldekop J, Agrawal A, Cronkleton P, Etue E, Russell AJ et al (2015) What are the biophysical, institutional, and socioeconomic contextual factors associated with improvements in livelihood and environmental outcomes in forests managed by communities?: a systematic review protocol (Vol. 172). CIFOR

Organisation of Economic Co-operation and Development (2012) Perspectives on global development 2012: social cohesion in a shifting world. OECD, Paris

Ostrom E (1990) Governing the commons: The evolution of institutions for collective action. Cambridge university press

Parasuraman S (2016) The development dilemma: displacement in India. Springer

Penning-Roswell EC, Parker DJ, Harding DM (2019) The economics of flood alleviation and land drainage. In *Floods and Drainage* (pp. 86-119). Routledge

Ramsar Convention Secretariat 2016 The fourth Ramsar strategic plan 2016–2024. Ramsar. https://www.ramsar.org/sites/default/files/documents/library/4th_strategic_plan_2016_2024_e.pdf. Accessed on 5 July 2020

Richardson CJ, Hussain NA (2006) Restoring the garden of eden: an ecological assessment of the marshes of Iraq. BioScience 56(6): 477-489

Russi D, ten Brink P, Farmer A, Badura T, Coates D, Förster J, Kumar R, Davidson N (2013) The Economics of Ecosystems and Biodiversity for Water and Wetlands. IEEP, London and Brussels; Ramsar Secretariat, Gland

Sharma S (2014) Development for whom and at whose cost: displacement due to dams in India. Indian Journal of Public Administration 60(1): 19-34

Sinha S, Basu LK, Halder A, Chakraborty T (2013) A case study on the changing pattern of wetlands in West Bengal and its possible impacts on groundwater resources. Workshop on Sustainable development and management of ground water in West Bengal and future of irrigation vis-a-vis arsenic contamination in ground water. Central Ground Water Authority & Central Ground Water Board Eastern Region, Kolkata. 19 February 2013

Sen AK (1992) Inequality reexamined. Oxford University Press.

Srinivasan U, Velho N (ed) (2018) Conservation from the Margins. Orient Black Swan Private Limited

Unnikrishnan H, Nagendra H (2015) Privatizing the commons: impact on ecosystem services in Bangalore's lakes. Urban Ecosystems 18(2): 613-632

 doi:10.20944/preprints202007.0148.v1

Unnikrishnan H, Nagendra H, Castán Broto V (2020) Water governance and the colonial urban project: the Dharmambudhi lake in Bengaluru, India. Urban Geography 1-26

Walpole M, Davidson N (2018) Stop draining the swamp: it's time to tackle wetland loss. Oryx 52(4): 595-596

Westerberg IK, Di Baldassarre G, Beven KJ, Coxon G, Krueger T (2017) Perceptual models of uncertainty for socio-hydrological systems: a flood risk change example. Hydrological Sciences Journal 62(11): 1705-1713

Wilmsen B, Webber M, Yuefang D (2011) Development for whom? rural to urban resettlement at the Three Gorges Dam, China. Asian Studies Review 35(1): 21-42

Young OR, Gasser L (2002) The institutional dimensions of environmental change: fit, interplay, and scale. MIT press

Zaman MQU (1996) Development and displacement in Bangladesh: toward a resettlement policy. Asian Survey 36(7): 691-703