Impact of Wetland Development and Degradation on the Livelihoods of Wetland-dependent Communities: a Case Study from the Lower Gangetic Floodplains

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Abstract
‘Wise use’ of wetland ecosystem services has implications for achieving sustainable development goals. Globally, almost 87% of wetlands have been lost since 1700’s with losses projected to be much higher by 2050 in developing economies due to urbanisation. Little is known about how this loss might impact people’s wetland dependency at local scales in the peri-urban landscapes. To understand people’s perception about ecosystem services from the peri-urban Dankuni wetland in Eastern India and associated ecosystem changes, we conducted thirty-seven semi-structured interviews in a single village. Wetland-dependent people identified 18 ecosystem services of Dankuni wetland. The ecosystem services included 12 provisioning services and two each of regulatory, cultural and supporting services. Farming and use of wetland products including molluscs, fuelwood, fodder, fibre and fish was found to subsidize living costs and provide diverse livelihood options to local residents. However, encroachment of wetlands by factories and blockage of its riverine connection were reported as the main factors degrading the wetland. As a result, life and livelihood of people, especially of landless widows and older residents were severely impacted. Respondents believed that it was possible to rejuvenate the wetland by restoring its riverine connections but stressed on vested interests in supporting its degradation. Their perceptions strongly impress upon the need for greater government accountability in wetland protection and integration of local knowledge along with locally suited political action in wetland restoration programmes. In this context, we strongly advocate for the implementation of laws that allow for wetland protection under a socio-ecological framework.

Keywords Ecosystem services · Livelihoods · Lower Gangetic Floodplain · Oral testimonies · Sustainable resource use · Wetland loss and degradation

Abstracta
El “uso racional” de los servicios ecosistémicos de los humedales tiene implicaciones para el logro de los objetivos de desarrollo sostenible. A nivel mundial, casi el 87% de los humedales se han perdido desde 1700 y se prevé que las pérdidas sean mucho mayores para 2050 en las economías en desarrollo debido a la urbanización. Poco se sabe acerca de cómo esta pérdida podría afectar la dependencia de los humedales de las personas a escala local en los paisajes periurbanos. Para
comprehend the perception of the people about the ecosystem services of the peri-urban wetland Dankuni in the east of India and the changes associated with it. The people living in the wetlands identified 18 ecosystem services of the wetland Dankuni. The ecosystem services included 12 services of provisioning and two of each of the remaining services, systematic, and conservation with approaches has been emphasized, particularly in developing countries, in which wetlands are being rapidly degraded (Mahmood et al. 2013; Darwall and Freyhof 2016; Mao et al. 2018; Finlayson et al. 2019; Kumar et al. 2020).

Wetlands are model socio-ecological systems, i.e., systems with social and ecological subsystems, characterised by sustained human–environment interactions (Berkes 2017; Langan et al. 2018). The high dependence of local communities on wetland ecosystems has been documented throughout the world and especially in developing economies (Wondie 2018; Owethu and Buschke 2019; Camacho-Valdez et al. 2020; Aryal et al. 2021). Moreover, local ecological knowledge could be indispensable in addressing knowledge gaps on status of wetlands in countries where detailed wetland inventories are missing. This might create spaces for the choice of developing integrative and inclusive conservation strategies by taking informed decisions on wetland resource allocation when faced with competing uses such as diversions for development purposes (Baird and Flaherty 2005; De Groot et al. 2012; Camacho-Valdez et al. 2013; Adusumilli 2015; Chaikumbung et al. 2016). There is growing advocacy in current literature to overcome human-nature dualism to create management regimes in which the voices of local resource users are prominently represented, especially where inefficient administration, non-transparency, weak systems of regulation and corruption exist (Baird and Flaherty 2005; Sithirith 2015; Holl 2020) Kumar et al. 2020).

In this respect, recent estimates suggesting an 87% decline in global wetland area since pre-industrial times (Walpole and Davidson 2018), is both ecologically and socially alarming. Infrastructure construction-led wetland conversion and industrial waste disposal in the wetlands were identified as important proximate causes of global wetland degradation (Van Asselen et al. 2013; Gardner and
Finlayson 2018), particularly in developing countries. Over 80% of untreated wastewater is released into wetlands globally (WWAP 2012; UN-Water 2015) with lower-middle-class countries treating 28% and low-income countries treating 8% of their wetlands (Sato et al. 2013). Although wetland loss in developing countries was historically lower than developed countries, the future rates of loss is projected to be much higher in the former, particularly in Asia, with a predicted increase of urban population by 1.4 billion by 2050 (United Nations 2008; Hettiarachchi et al. 2015), thereby leading to increased risk of environmental disasters and livelihood loss (Ghosh and Sen 1987; Azarath et al. 1988; Smardon 2009). Water pollution is also increasingly worsening the conditions of all Asian rivers and wetlands (Davidson 2014; WWAP 2017).

The Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat has foregrounded wetland governance in the global environmental policy domain, but the Asian scenario highlights the convention’s inadequacy in dealing with threats that originate from urban development policies shaped largely by broader political-economic forces of developmentalism (Hetti- arachchi et al. 2015). In India, wetlands are protected as per a national wetland law—Wetlands (Conservation and Management) Rules 2017 (Ministry of Environment, Forest and Climate Change 2017) under the overarching Environment ment Protection Act, 1986, yet various types of wetlands, for example, marshlands are categorized as ‘wastelands’ under national development policies (National Remote Sensing Centre 2010). Even though a law supersedes a policy, rapid urbanization at the cost of wetlands continues, and has become the leading cause of the loss of ecosystem services in the Gangetic Plains1 (Das and Das 2019). For example, the East Kolkata Wetland (EKW), a Ramsar site, located within the Lower Gangetic Floodplains, has contracted significantly due to encroachment of built up area in the metropolitan city of Kolkata resulting in reduced productivity and wild fish stocks (Kundu and Chakraborty 2017).

The social costs of urban development for communities dependent on wetland ecosystem services in this floodplain remain less studied, other than in EKW. Damodar-Hugli interfluves2 in the Lower Gangetic Floodplains has a wetland complex called Dankuni (Sinha et al. 2013) with dominant marshland vegetation in which one of the authors (TA) conducted population surveys of Fishing Cat (Prionailurus viverrinus), a wetland-dependent wild cat species (Adhya et al. 2011). The Fishing Cat is a high-rated ‘Evolutionarily Distinct and Globally Endangered’ (EDGE) species, i.e., a priority species for research and conservation, as well as a ‘Vulnerable’ species according to the IUCN Red List assessment (Mukherjee et al. 2016; Tensen 2018). It also deserves the highest protection measures in India as per the Indian Wildlife Protection Act, 1972. The study emphasized the deleterious impact of industries and roads on the Fishing Cat habitat. Later, in 2012, a Public Interest Litigation (PIL)3 was filed at the regional high court by non-government organisations as much of the wetland encroachment was happening without adequate land and environmental clearances (Adhya 2015). Further, marshlands are recognized as ‘wetlands’ under Wetlands (Conservation and Management) Rules 2017 (Ministry of Environment, Forest and Climate Change 2017), which prohibits alteration of its ecological character for development purposes. Local residents like farmers, fishermen and inhabitants of villages surrounding the wetland complex, who were both directly and indirectly dependent on the wetlands for its provisioning and regulating services (e.g.—flood prevention), had also registered protests against the degradation with one prominent activist being murdered (Adhya 2015). However, irrespective of litigations, protests and existence of environmental laws, the degradation of the Dankuni wetland complex continues. This is partly facilitated by the non-transparent practice of declaring tracts of wetlands as agricultural land and thereafter converting them for industrial or real-estate construction purposes as has been acknowledged in the draft West Bengal Wetlands and Waterbodies Conservation Policy, 2012. Moreover, an inventory of the state’s wetlands is yet to be prepared, as is mandated as per the Wetlands (Conservation and Management) Rules, 2017. This indicates the prevalence of serious apathy towards non-charismatic, non-protected, peri-urban wetlands, and the absence of the will to enforce regulations. Such wetlands are rather considered as easy land banks that can be converted for development purposes.

Thus, we wanted to understand the importance of this wetland to the people and environment, which is being threatened due to development, through a study on direct and indirect dependencies of local residents on its ecosystem services. Some of the interviewees were also directly involved in protests and campaigns against the wetland degradation occurring throughout the marshes encompassing a number of villages with similar demography. We considered this study critical to understanding implications for the sustainable use of this wetland, the maintenance of its ecological character and persistence of threatened species like the Fishing Cat. With this background, the specific objectives of the study were to investigate—a) local resident’s dependency on the Dankuni wetland complex, b) their perceptions of

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1 Gangetic Plains constitute part of the Ganges Brahmaputra Basin.
2 Interfluves are elevated terrains between two rivers flowing in the same direction in the same drainage system.
3 PIL type litigations can be filed by any citizen in the court of law if the issue in hand affects public interest.
changes in the condition of the wetland, c) their perceptions of changes in their livelihoods and living due to wetland changes, d) their perceptions of political-economic forces as drivers of change, and, e) how according to them the threats to the ecosystem could be addressed.

**Methodology**

**Study Site**

We chose to conduct the study in a single village, Jhakari (22.75 N, 88.29E to 22.75 N, 88.30E), located on the fringes of the Dankuni wetland complex (see Fig. 1).

The Dankuni wetland complex is approximately 30 km² in area and is perhaps one of the last contiguous marshy stretches in the Damodar-Hugli interfluves of the Lower Ganges Floodplains. It is traversed by one of the busiest railway tracks of the region and is bounded with a national highway in the east.

The wetland complex is dominated by both tall and short emergent vegetation⁴ which are visual cues of marshlands. It experiences seasonal inundation and flooding during monsoon (June–September) especially due to its connection with the river Ganges and starts drying up post-monsoon (October onwards). By summer (March–May), surface water is retained only in some depressions. The wetland is a popular birding site as it provides refuge to both resident and migratory birds throughout the year (Hazra et al. 2012). Apart from this, freshwater fishes, snakes, turtles, amphibians and various kinds of insects especially damselflies have been reported by nature enthusiasts, the exact numbers of which remain to be ascertained. Mammals like Small Indian mongoose, Palm Civet, Small Indian Civet, Golden Jackal, Jungle Cat and Fishing Cat are also present. During the dry season (December to May), cultivation takes place in some

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⁴ 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.
portions (Hazra et al. 2012). Some areas of the wetland were converted for small-scale aquaculture farms in the last two decades. Local residents also collect grasses, wild flowers and stalks, plant parts, molluscs and wild fish from the wetlands.

Jhakari is a typical peri-urban village located in the fringe of the Dankuni wetland complex which is neither completely rural nor fully urban. It is well-connected by road and rail infrastructure and is located 35 km from the metropolitan city of Kolkata. The human population of the village consists of approximately 1000 families and the structure of the village society is heterogeneous with people belonging to both Scheduled and General Castes. Most people are Hindus and a small section of Muslims are also present who are economically poor and landless.

Methods

Fieldwork was carried out in 2019–2020 and thirty seven semi-structured interviews, consisting of 7 female and 30 male interviewees were conducted through snowball sampling. The interviews were conducted in the local Bengali language. A villager was first approached and asked whether he/she was native to the village and could devote some time for the interview after which the motivation of the study was explained. It was also stated that their names would remain anonymous. Upon gaining consent, semi-structured interviews were conducted with the questions structured around the objectives described above (See Supplementary Material). No guideline or reference questionnaire was used to design the study questionnaire as it was formed based on the knowledge gained during one of the author’s (TA) informal interactions with the local community when she conducted her survey on the Fishing Cat here. With the respondent’s consent, the oral testimonies were recorded using a voice-recorder. Information was collected on their dependency on wetlands starting with leading questions such as do they farm, fish, collect anything from the wetland that helps them in their daily lives and provides them livelihood. Secondly, they were asked whether they perceived any change to the wetlands since their childhood as well as recently. During the course of the conversation, we tried to understand how the change might have affected their livelihood and living. Thirdly, we examined their perceptions of threats to the wetland. Lastly, we asked ‘if anything can be done to address the threats’, ‘if so, what’ and ‘if any interventions were taken by local residents or the government’.

Results

Wetland Dependency of the Study Village

We identified 18 ecosystem services from the oral testimonies (see Table 1) out of which 4 ecosystem services provided important sources of livelihood.

Twelve products including plants and animals, edible and non-edible, were identified by the respondents which they obtain from the wetland. Interviewees commonly cultivated edible crops such as paddy, onion, ladies finger, spinach, coriander, beans, cow pea, Indian pea. Among these, paddy was the most important resource for local consumption as well as livelihood. The harvested rice is generally kept for consumption and the excess rice is sold at 1000–1300 Indian Rupees (INR⁶)/bag with each bag containing 60 kg rice. 50 year old GB said “The paddy we harvest is good in quality, much more healthy and tasty than the rice provided by government ration shops which is often mixed with dirt and small stones,” indicating that he felt a certain pride in

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⁵ Caste is a category of social hierarchical difference, especially within Hindu religious identity, based on ritual purity. Castes which have been exploited throughout history, have been constitutionally provided social protection and affirmative action under the category of Scheduled Caste.

⁶ 1 INR = 0.013 USD.
harvesting his own rice. Another farmer, 43 year-old NT, further added that the rice from fair price shops costs around 32–33 INR/kg but his children refuses to eat it because of its poor quality. On the other hand, premium quality rice was reportedly too costly to afford. Other crops are also sold: onion @ 30 INR /kg, coriander @ 70 INR /kg, spinach @ 70 INR /kg, beans @ 40 INR /kg, okra @ 53 INR /kg and Indian pea @ 60 INR/kg. KK, a 30 year old farmer, seemed happy with the significant profit returns from his piece of land after harvesting these crop types, “I spent 20,000 INR for harvesting onion and okra but earned 80,000 INR. After harvesting the paddy, I planted jute in the same land. I spent 20,000 INR in labour again but earned 50,000 INR. For paddy, if I spend 10,000 INR in labour, I get back 26,000 INR.”

Bamboo (Bambusa balcooa) and mud were frequently used wetland products for constructing houses. Bamboo was also used for making fish catching traps, broomsticks and baskets. These products provided additional sources of livelihood and were particularly useful when cultivation failed. 29 year old DD’s crops failed in 2019 but he survived by selling fish catching traps for 250 INR and baskets for 50 INR.

For widows from Jhakari, who were landless, collecting and selling molluscs from the wetland provided the major source of livelihood, through which they could provide for their children. AK, a 63-old widow, reminisced the physically challenging, yet economically rewarding work of searching for molluscs in waist-deep water in the wetland during the day with a company of other women. They then sold them for 80 INR/kg via middlemen who gave back 30–50 INR/kg. 60 year old SK rather preferred selling them door-to-door or by herself in the market and reportedly earned 200 INR/kg. Even after their children grew up and started earning, these widows did not stop this work. They reported that earnings from selling molluscs helped them remain economically independent as well as provided means to support their family when needed. As AK explained with a tone of clear confidence, “My sons look after me but I choose not to ask for money from them to cater to my needs and cravings.” She also added that molluscs are packed with nutrition and are good for eyesight as was told to her by doctors.”

Almost all respondents fished in the recent past (till 5 years ago). Many of them are still involved in fishing. Fish is caught by various methods. SK caught fishes with her bare hands rather than with fish traps or nets and reported that Singee (Heteropneustes fossilis) and Magur (Clarius batracus) are difficult to get, but if caught, they fetch upto INR 1000/kg. Smaller fish like Koi (Cyprinus rubrofuscus) can be sold for 200–300 INR/kg at the nearby market.

Fuelwood (Kath-shola / Aeschynmene indica, jute-sticks and bamboo), fodder, edible plants and plant fibre are useful wetland resources in the village. BT, a 50 year old widow, was especially dependent on fuelwood collected from the swamp to run her small eatery which catered to farmers in the field and to factory workers. Villagers also depended on swamp grass to feed their cows. Leafy vegetables and stalks of aquatic plants were widely collected for local consumption. Poorer people such as widowed women and older residents sold them too. Kath-shola (Aeschynmene aspera) was also used for making marriage gear for brides and grooms and for decorating religious deities. KK (30) reported the selling price to be 300 INR/bundle while SD (49) said that people earn 400–500 INR/bundle to even 1000 INR/bundle during summer. Water from the swamp was reportedly used

| Types of ecosystem services | Ecosystem services recorded | % of respondents reported |
|----------------------------|----------------------------|--------------------------|
| Provisioning (12)          | Seasonal farming           | 54                       |
|                            | Fish                       | 27                       |
|                            | Edible wild flowers        | 5                        |
|                            | Leafy vegetables           | 16                       |
|                            | Mollusc                    | 35                       |
|                            | Fibre                      | 22                       |
|                            | Water                      | 5                        |
|                            | Mud                        | 35                       |
|                            | Bamboo                     | 43                       |
|                            | Jute-stick                 | 3                        |
|                            | Fuelwood                   | 27                       |
|                            | Fodder                     | 30                       |
| Regulating (2)             | Water purification         | 30                       |
|                            | Flood regulation           | 30                       |
| Cultural (2)               | Capacity to reflect        | 10                       |
|                            | Recreation                 | 41                       |
| Supporting (2)             | Fish nursery               | 70                       |
|                            | Nutrient retention         | 53                       |

Table 1 Types of ecosystem services provided by Dankuni wetlands
for irrigating farm plots. “If there is no swamp, then, water
for agriculture will not be available anymore. The surround-
ings are drying up day by day,” said said 32 year old PM.

Older residents also benefited from the wetlands as they
could undertake less laborious tasks and were still able to
support their families. “I cultivate a little bit of onion and
take the cattle out to graze. I also collect edible plants from
the swamp. At my age, that’s as hard as I can work to support
myself and the family. But I will not be able to do this if the
swamp is lost and will have to depend on others for food.”

Regulating Services

From the oral testimonies, we identified two regulatory ser-
VICES of the wetlands – flood control and water purification.
PM (32) explained “If the wetlands degrade, the waters in
monsoon will flood our houses.” HT (70) said “People who
went to work in the swamp did not need to carry water with
them because the swamp water was available. It was like
filtered water.”

Cultural Services

Residents shared that the wetlands provided them with the
opportunity to reflect on life while younger children enjoyed
recreational activities. 49 year old SD shared how children
in the village created doll houses and dolls made out of mud
taken from the wetland whereas young adults used the wet-
land space as social bonding sites. On the other hand, the
wetlands inspired reflection among interviewees evident
in their words. 32 year old ST for instance stated how the
swamp brings prosperity to them and gives them a chance
to cultivate “food of self-respect”.

Supporting Services

We identified two supporting services which are nutrient
retention and sustenance of fish stocks from the oral testi-
monies. 35 year old PS, for example, stated how the water-
logged lands became fertile after recession of the floods
thus facilitating farming. 30 year old KK on the other hand
explained how the wetland created a conducive environment
for fish to breed in.

Change in the Wetland Quality and its Human Cost

Respondents perceived a steady degradation in the wetland’s
quality in the last 20 years with the trend worsening rapidly
during the last three to four years. From their testimonies,
it is apparent that this change has affected their livelihoods
and living in significant ways.

58 year old ST stated that the swamp was four times
bigger two decades back compared to the present extent.

Majority of the respondents reported a reduction in the quan-
tity of products obtained from the wetland. “Tides used to
come into the swamp through the canal which connected
it with Ganges bringing in a variety of fish like Bele, Koi,
Singhi, Punti and their eggs,” said 50 year old GB while
describing how the wetland functioned in the past. Large
sized prawns also used to be available which fetched signifi-
cant monetary returns. Post-monsoon, the flood waters in the
swamp would slowly recede through the canal into Ganges
exposing nutrient-rich soil fit for harvesting. “Paddy like
amon, neramon and beta, pulses, okra, potato, cauliflower,
onion, leafy vegetables, gourds and water melons could be
cultivated in the past. Bags full of food used to be harvested
during April,” reminisced 50 year old GB. Availability of
molluscs and edible wetland plants as well as Aeschynomene
which provides fibre reportedly decreased substantially over
the years.

According to the respondents, the swamp water seemed to
have degraded in quality as well due to loss of its connection
with Ganges over the last 15–20 years. This had increased
the duration of waterlogging and created an unhygienic con-
dition. “The swamp water is rotting. People get skin diseases
now,” says senior citizen DB while teenager P remembered
how clean the water used to be in the canal during his child-
hood when it was connected to Ganges “The water was so
clear that if one dropped a coin, it would be visible right till
it hit the bottom. I used to dive into the canal from the bridge
to take a bath. The water has now become blackish espe-
cially since the last three to four years.” The respondent’s
testimonies suggest that fish diversity and abundance had
decreased substantially over the years, especially Nandus
nandus, Ophisternon bengalense, Glossogobius giuris and
Mystys vittatus as 65 year old DB shared. “I still remember
how my grandmother used to come back with baskets full
of crabs in the past which she used to sell for 2–3 INR/
kg whereas now we sell them for 100 INR/kg,” reminisced
49 year old SD implying that crabs had become scarce. Fish
spawns were reported to be dying in the wetland as the out-
flow of the swamp water got blocked. Aquatic weeds and
leaches had instead proliferated in recent times and the water
had become unsuitable for irrigation. 52 year old U shared,
“We don’t drink water from the swamp anymore.”

The degradation in the quality of the wetland had
changed the way of life in the village. GB, who is 50 years
old now, shared that he did not have to go outside for work
as a younger person as they could get expensive fish like
Heteropneustes fossilis for free from the swamp as well as
pulses and a variety of vegetables. “Those days are gone
now. If I go for fishing now, I will catch fish worth less
than 250 INR whereas if I work as a hired labourer I will
earn atleast 250–300 INR/day. Fish from the swamp was
so integral to our diet. The fish catch used to be huge. Even
after feeding the whole family, the remaining could be sold
for 300–500 INR/day during monsoon.” Similar sentiments were echoed by other respondents and many reported leaving agriculture and fishing due to lower economic returns and thus, being forced to work as hired labourers. Due to lower productivity, many had sold off their land to overcome financial shocks. “Businessmen buy these lands at lesser prices (8,00,000–10,00,000 INR/bigha) taking advantage of unemployed people who are in need of cash and thus sell them at a huge cost (2,00,000 – 3,00,000 INR/katha),” shared PS (35). Some land-owners also decided to convert parts of their water-logged land to small-scale aquaculture.

During 2019–2020, the region received excessive rainfall due to cyclonic depressions over Bay of Bengal which further aggravated the situation. Due to the blockage of the channel connecting the wetland to the river, excess rain water could not flow out, prolonging the waterlogged situation. The standing water from the land usually starts receding by end of October yet GB’s land remained water-logged till mid-January. “In October the land must remain muddy but it has to lose its moisture after that if the onion yield is to be good. It is too late now.” The calamity even disrupted age-old cultural practices as reported by 38 year old RB, “By this time okra plants become upright and even starts flowering. It takes at least 15–20 days for the seeds to germinate. As soon as they do, we celebrate Makar Sankranti, a festival that marks the onset of the new harvest, a 250 year old tradition. But where is the harvest to celebrate this year?”

**Drivers of Change**

Respondents unanimously identified presence of factories as the main factor causing degradation of the Dankuni wetland. According to most respondents, the emergence of garment and fertilizer factories and warehouses, in the last 15–20 years, coincided with the beginning of degradation and wetland shrinkage as they were constructed by filling up parts of the wetland. The factories HT, a senior citizen, explained, “The swamp has shrunk to a fourth of what it used to be due to the construction of factories. 25 years back, this was all swamp,” he said pointing to the horizon and beyond on both sides. 34 year old KT detailed, “The first factory was constructed in the wetland 15 years back. Gradually, other factories also emerged.” ST added, “They dump sand, soil, ash and debris into the wetland everyday and this blocks the passage of water out of the swamp.” PM further explained, “The discharged solid waste materials have accumulated in the canal connecting the wetland to Ganges, making it significantly shallow and the waters stagnant.” The respondents mentioned that the sluice gate of the main canal was not functioning due to which wastewater released by the factories stayed locked inside the wetland. Large buffalo shelters constructed locked inside the wetland. Large buffalo shelters constructed along the canal also added to the problems. “The cattle waste is discharged into the swamp. One can find syringes and broken pieces of glasses in the swamp nowadays,” said 50 year old TB.

**Perceptions on Threat Mitigation**

Almost all respondents said that the only way to restore the health of the wetlands is by dredging the canal that connects the wetland to the river. They also reported that at various times they had informed local politicians and administrative officials of the dire situation of the wetlands but to almost no avail. “They created a small outlet after we agitated but that is not enough. The sluice gate of the main canal has to be repaired. It is broken and clogged with debris. Some of us went there to clean it up but did not succeed,” said KK, himself a senior citizen. Respondents felt that the weed cleaning drives conducted by the panchayat did not yield desired results. Lamenting on failed mitigation actions, 70 year old HT said “There are so many factors due to which the swamp is dying. Just cleaning water hyacinth is not enough. We are unable to farm but our MLAs and MPs do not bother. Nowadays factories run the government so the government will work to benefit them.” The respondents also thought that the onus of protecting the swamp lay with the local community as well. In this respect 32 year old ST stressed, “If the owners protest in unison, the government will have to respond. But if they sell off their land instead, how will the situation be rectified?” However, the views of 38 year old RB differed in this matter, “People do not raise their voices as this kind of destruction is being done by very powerful people at helm who have a lot of money. They will squash us like insects.” In addition, lands belonging to community members were often sold off without their knowledge. Similar processes were at work in other villages surrounding the wetland, which led to its degradation on the one hand and impacted the livelihoods and living of dependent communities on the other.

**Discussion**

Our study showed that villagers residing beside a peri-urban wetland, Dankuni, in the rapidly urbanising Lower Gangetic Floodplains, perceived that the wetlands enhanced the quality of their lives, subsidized their living and provided livelihoods. However, establishment of factories and pollution

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1 katha = ~67 sq metres, 1 bigha = ~.0013 sq km.

8 MLAs (Member of Legislative Assembly) and MPs (Member of Parliament) are the political representatives at the state and central government, respectively.
discharged from them into the wetland along with political apathy to rectify the same reportedly led to diminishing returns/services and had serious negative social implications including loss of livelihood, increased disaster risk and exposure to financial vulnerabilities.

We recorded eighteen ecosystem services of the Dankuni wetlands with twelve provisioning services such as edible crop farming (for example, paddy and vegetables), non-edible crop farming (jute), collection of wetland products such as fish, molluscs, edible wild plants, fibre, water, mud, bamboo, fuelwood and fodder. The wetland was found to subsidize the living costs of respondents. For instance, they could procure cattle fodder, fuelwood, fibre, edible plants, house-building materials and molluscs, without any investment. Apart from this, the wetland also provided regulatory services (like flood control and water purification), supporting services (like nutrient retention and providing refuge for fish stocks) which sustained the provisioning services, and, cultural services that enhanced the quality of their lives. Landless widows and older residents seemed to be solely dependent on the wetlands for subsistence and livelihood. This dependence of women and older residents on common natural resources (such as wetlands) has in fact been well documented elsewhere (Ahmed et al. 2008; Mundoli et al. 2017; Sinthumule 2021).

However, the oral testimonies clearly suggested that there has been significant erosion in all ecosystem services of the wetland over the last 15–20 years and especially in the last three to four years. This degradation coincided with the emergence of factories during the same time span which according to locals were constructed by filling up the wetlands, thereby blocking the flow of water between the wetland and the river. Moreover, wastewater generated from the factories and debris from buffalo shelters had contributed to blocking the canal connecting the wetland to the Ganges. A similar process was observed by one of the authors (TA) in Chilika, a Ramsar site on the Indian eastern coast, where buffalo shelters were first constructed on embankments leading to the lagoon, presumably to create blocks. Thereafter portions of the lagoon were cut off to create illegal aquaculture farms. Constructing buffalo shelters could therefore be a ploy to obstruct vigilance and facilitate wetland conversion. Shrinking and subsequent degradation of the wetland’s water quality rendered it unfit for drinking and irrigation purposes. Fish abundance and diversity was especially affected due to the same reasons and the progressive clogging of the wetlands has decreased its capacity to regulate floods in the face of erratic and excessive rainfall, which affected farming, as was experienced by respondents during 2019–2020. In the era of accelerated climatic shifts, rainfall patterns are poised to be erratic and could therefore cause more urban floods (O’Donnell and Thorne 2020). This has implications for disaster risk management in the surrounding urban and peri-urban areas of Dankuni wetlands.

Unsustainable use of wetlands has been known to impair wetland functions and permanently damage socio-ecological systems elsewhere in the world (Vilardy et al. 2011; Jaramillo et al. 2018). Similar storylines are evolving out of most South Asian countries in which water sources and river health has been severely compromised due to unplanned development (Pal and Talukdar 2018; Reis et al. 2017; Sarkar et al. 2021) decreasing their ecosystem values. In fact, degradation of the wetland was perceived by villagers at Jhakari as an attack on a self-sustaining ecosystem which is giving or had given them prosperity, autonomy and prestige, with the lands of many being simply snatched away without their consent or knowledge. People felt that they were increasingly being pushed towards relying on external actors such as urban markets and unpredictable climate. From being self-dependent, they were being pushed to work as urban labourers for financial security. Urbanisation has been known to cause the loss of these affective dimensions and silence the voices of the marginalized sections of the society (Unnikrishnan et al. 2016; Mundoli et al. 2017). As a result, like other parts of India (Mahanta and Das, 2012), increasing rural-to-urban dependency may be witnessed because of the vicious cycle of wetland health deterioration and consequently of people’s care for and ownership towards it. Some villagers had sold off their land due to diminishing ecosystem services of the degraded wetlands.

Even though we did not directly explore the relevance of SDGs to wetland dependence for the local community at our study site, the testimonies foreground vernacular forms of people’s understanding of sustainability. Through their description of various ecosystem services, people referred to various conceptualisations of SDGs, such as, SDG 1, no poverty (living cost subsidy), SDG 2, zero hunger (food material provisions), SDG 3, good health and wellbeing and 6, clean water and sanitation (emotional wellbeing and good water quality), SDG 8, decent work and economic growth (decent work of collecting materials with self-respect) and SDG 14, life under water (fish nursery). Thus, maintaining ecological health of wetlands could lead to sustainable cities and communities (SDG 11). Jaramillo et al. (2019) identified the improvement of water quality and adoption of ‘wise-use’ of wetlands as central to achieving a range of SDGs covering environmental health, equity, human well-being and justice. Respondents at Jhakari believed that the water quality could be improved if the canal connecting it to river Ganges was dredged which would allow the polluted water of the swamp to flow out and tidal waters to flow in. Globally, wetland restoration with inputs from local communities has been encouraged because of their better understanding of the ecosystem given their closer association with it (Finlayson et al. 2019).
Although local knowledge can facilitate successful community-based conservation and restoration of ecosystems including wetlands (Amano et al. 2018; Kongkeaw et al. 2019; Walle and Nayak 2020), it is hardly encouraged because of the absence of cross-sectoral policy integration for environmental protection along with the prevalence of rampant corruption, the subsequent suppression of local voices and the negligence of environmental laws enhancing socio-ecological vulnerability as a common practice in developing countries (Hettiarachchi et al. 2015; Sen and Nagendra 2020). People’s testimonies identified probable political actions which can be useful to centre-stage socio-ecological concerns and improve ecological health as has been shown in Apiyalakul et al. (2015) and Roose and Panez (2020). The testimonies also suggested technical interventions for rejuvenating the wetland. However, the decade-long litigation battle at Dankuni wetlands to prevent the illegal filling up of wetlands coupled with the presence of a syndicate between local politicians, administrators and factory owners to rapidly develop the wetland, as is perceived by the interviewees, foregrounds the need to increase government accountability and uphold the core tenets of sustainability to counter (mal)development—‘precautionary’ and ‘polluters pay’. It is pertinent to stress here that existing Indian laws allow for the involvement of local communities in conserving socio-ecological spaces. For instance, the Indian Biological Diversity Act, 2020, has provisions to declare areas as Biodiversity Heritage Sites, the criteria being that traditional practices will sustain threatened species and maintain the ecological functions of an ecosystem. Globally there is consensus that wetlands should be conserved within a socio-ecological framework (Kumar et al., 2020). In this regard, remaining wetlands outside protected areas in India can be conserved by developing management plans in collaboration with local residents, researchers, administrators and politicians as per provisions in the above act.

Conclusion

The Lower Gangetic floodplains, which includes Dankuni wetland, is replete with a variety of wetlands that sustain the livelihoods and culture of many communities both in India and Bangladesh. However, our case study from Jhakari shows that such peri-urban wetlands are being developed rapidly and thus compromising sustainable and resilient futures. Popular opinion often point towards rising population as the sole cause for ecosystem changes. However, taking cue from the people of Jhakari, we need to hold (mal) development models accountable for such negative changes. People’s prescription of increasing governmental accountability point towards vernacular conceptualisations of ‘precautionary’ and ‘polluter-pays’ principle, which are core issues of sustainability principles. The social and ecological costs of such pursuit of development reinstates that sustainability remains as a rhetoric. Wetland ecosystems are crucial for achieving many SDGs but continue to be sacrificed at the altar of development. Even though our study is situated in a single peri-urban village Jhakari, the learning we generated from people’s lives there resonates with different communities whose lives and livelihoods have been threatened due to ecosystem degradation across Asia. So, people’s accounts of ecosystem degradation, subsequent repercussions and necessary actions needed to restore the ecosystem functions need to be taken seriously as evidences in academic research, institutional mechanisms and on-ground actions. Such integration of local knowledge and locally suited action will help in building place-based sustainability models. The need to enforce Indian wetland protection laws cannot be stressed enough. More importantly, we strongly suggest that Indian laws that allow for building socio-ecologically sensitive, collaborative and constructive conservation models by encompassing local residents, scientists, policy makers and administrators, be explored with immediate effect for protection of wetlands in rapidly developing landscapes.

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Data Availability The data collected were in the form of qualitative interviews and these testimonies contain sensitive information about our respondents’ social profile and life. So, these dataset cannot be uploaded to external repositories due to ethical concerns. However, the testimonies are available to the corresponding author and if requested, can be shared upon reasonable request.
Declarations

Competing Interests The authors have no relevant financial or non-financial interests to disclose.

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