



Note

Contribution of floodplain wetland (beel) fisheries to livelihood and nutritional security of fishers in Eastern India

ARUN PANDIT, A. EKKA, D. K. BISWAS, L. CHAKRABORTY, D. K. MEENA
AND VIKASH KUMAR

ICAR-Central Inland Fisheries Research Institute, Barrackpore, Kolkata - 700 120, West Bengal, India
email: arunpandit74@gmail.com

ABSTRACT

The floodplain wetlands or the oxbow lakes support millions of rural poor for earning their livelihood and nutritional security. The present study was conducted among the fisher households in two floodplain wetlands (locally known as beel) of West Bengal (Kholshi and Akaiapur) and one in Assam (Deepor). One hundred fisher households from West Bengal and 80 fisher households from Assam were selected using simple random sampling method. The study indicated that the socio-economic conditions of the fisher households based on the level of education, operational holdings and off farm income were well below the desired level. Fishing was the major occupation of around 70% of the fishers of West Bengal and 90% of fishers of Assam. The fishery contributed more than 60% of the household income to 42% fishers of West Bengal and 90% of fishers of Assam. In Deepor Beel it was found that no fisher household received less than 40% of their livelihood from the beel. Further, the study showed that beel fishes were the only source of animal protein to more than 71% of the households of Deepor Beel. Similarly, more than 68% of households in West Bengal beels obtained animal proteins through fishes caught in the beel itself. For sustainable use of wetland resources and to ensure livelihood and food security, there is a need to design appropriate management strategies. Arrangement of supplementary livelihood options was prescribed for the fishers to reduce the fishing pressure on the wetlands.

Keywords: Animal protein, Assam, Fishers, Floodplain wetlands, Livelihood, West Bengal

Wetlands are natural resources having immense ecological and economic importance. They play various ecological functions including groundwater recharging, flood control, shoreline stabilisation, sediment and nutrients retention, biodiversity conservation and biomass export. Wetlands can be termed as “biological supermarkets” as the ecosystem is rich in fish biodiversity (EPA, 2016). Wetlands are home to 40% (approximately 8500 species) of fish species in the world (Parish and Looi, 1999). Forty-seven per cent of India’s flora and fauna find habitats in wetlands (Choudhury, 2007). Besides, they also generate products like fishery, forest, wildlife, forage, agricultural resources, as well as supply water (Acharya and Adak, 2009).

Among the wetlands, the floodplain wetlands or the oxbow lakes are locally known as beels in eastern India, particularly, West Bengal and Assam. Being diverse, dynamic and adaptive in nature, they are the support to millions of rural poor for earning their livelihood and nutritional security. Research conducted in various parts of the globe show that the wetlands contribute significantly to the rural livelihoods by providing income and nutritious food (Dixon and Wood, 2003; Jogo and Hassan, 2010; Al-Amin *et al.*, 2021; Dar *et al.*, 2022). Dixon and Wood

(2003) reported that a range of socio-economically important products and services of wetlands has been used for generations in Sub-Saharan Africa. Similarly, in Uganda, Nelson *et al.* (2013) reported that wetland resources contribute enormously to the household food security to over 80% of the respondents in some places. In India, wetlands have a key role in water supply, human livelihoods and the irrigation of farmlands in addition to providing several beneficial ecological services (Everard *et al.*, 2021; Sarkar *et al.*, 2021; Dar *et al.*, 2022). Besides, through weather modifications and nutrient retention they also indirectly contribute to food security. Wood (1996) concluded that wetlands significantly contribute to food security and income generation in many parts of eastern and central Africa. However, due to siltation, loss of river connectivity, conversion to arable land, dumping of refuse, nutrient enrichment through sewage effluents and agricultural fertilisers, the floodplain wetlands are degraded day by day which leads to destruction of aquatic resources (fisheries resources in particular) and threatening of livelihood of the fishers. With this backdrop, this study tries to assess the extent of contribution of floodplain wetlands in livelihood and protein food consumption to fishers in eastern part of India.

Flood plain wetlands in India are mainly concentrated in eastern and north-eastern region. West Bengal and Assam are the major states in flood plain wetland presence. Therefore, for the present study two wetlands from West Bengal (Kholshi and Akaipur) and one from Assam (Deepor) were selected. One hundred fisher households from West Bengal and 80 fisher households from Assam were selected using simple random sampling method. Information on socio-personal characteristics of the respondents, livelihood sources and consumption of animal protein were collected and analysed.

Study area

The study was conducted in Deepor (Assam) and Kholshi and Akaipur beels (West Bengal). The Deepor and Kholshi are seasonally open beels and Akaipur is a closed beel. Open beel maintains the connectivity with the parent river and in closed beels the connectivity is lost. The Kholshi is in Nadia and Akaipur is in North 24 Parganas District of West Bengal. The Deepor Beel is a permanent freshwater lake, located in the south-western part of Guwahati City in Kamrup District of Assam. The waterbody provides sources of livelihood to a number of local families. Nine villages in the vicinity of the beel are dependent on this beel. In Kholshi Beel, there are 317 registered members of the cooperative society whereas the corresponding figure for Akaipur is 80. In addition to the household members of cooperative societies, other fishers from nearby areas also catch fishes, however, they are allowed to catch mainly the weed fishes. In the Deepor Beel, the core area covers 414 ha, whereas the area of the Kholshi is around 55 ha and that of Akaipur is 28 ha. All the beels are perennial in nature.

Socio-economic status of the fishers

Analysis of data indicated poor socio-economic conditions of the fisher households (Table 1). The years of schooling as an indicator of education level of the

head of the household, was only around 3 in Kholshi, 4.5 in Akaipur and 4.7 in Deepor and majority of them are illiterate (41, 34 and 49%, respectively). The average family size was 4.47, 4.38 and 4.75, for Kholshi, Akaipur and Deepor, respectively. No fisher household head had education beyond higher secondary level. Around 24 and 30% of them had primary level education for overall West Bengal and Assam beels, respectively. In Deepor Beel, less number of fishers are educated beyond primary level than the WB beels. Very few of them are office bearer or member of any social organisations.

Table 1 shows that the sex ratio was male dominated, indicated by the fact that there are only 867 and 881 females per 1000 males in the beels of West Bengal and Assam, respectively. It has been seen that on an average 1.5 family members per household were engaged in fishing. The table further shows that possession of livestock and poultry was meager in Deepor. In the beels of West Bengal, the fishers possess comparatively more livestock and poultry which are significant sources of animal protein for them.

Table 2 shows that fishers in all the beels had very low economic base. In West Bengal, their agricultural land holding was meager, 0.097 ha in Kholshi and 0.136 ha in Akaipur. In Akaipur, majority of the society members got 0.067 ha of land from the society in the vicinity of the beel on which they grow different crops including paddy, jute and oilseeds. In Kholshi, almost 39% of the fisher households did not have any agricultural land. Many of them cultivated on leased-in land. In Deepor Beel, their land holding was slightly better, being 0.636 ha per household.

Both the beels were unable to satisfy the livelihood needs. Hence, the members of the households were involved in many income generating activities. On an average, Kholshi fishers were involved in 2.86 activities

Table 1. Demographic profile of the respondents

Variable	Kholshi	Akaipur	Overall	Deepor
Age of the respondent (years)	48.61	50.06	49.32	44.69
Family size	4.47	4.38	4.43	4.75
Females per 1000 males (overall)	888	845	867	881
Years of schooling of the head of family	3.24	4.51	3.86	4.69
Level of education of the family head				
Illiterate	40.82	34.04	37.50	48.7
Primary	24.49	23.40	23.96	30.3
Secondary	34.69	34.04	34.38	17.1
Higher Secondary and above	-	8.51	4.17	3.9
Livestock possession (Nos. per family)				
Cattle	2.2	1.2	1.7	0.25
Goat	2.4	1.5	2.0	0.37
Pig	0	0	0	0.41
Poultry	5.8	3.5	4.8	2.71

Table 2. Economic status of fisher households

Parameter	Kholsi	Akaipur	Overall	Deepor
Own land holding (ha)	0.097	0.136	0.116	0.6
Landless (%)	38.78	25.53	32.29	28.3
Share croppers (%)	32.65	38.30	35.42	38.5
Economic activities of the households (% of households)				
Fishing	100.00	100.00	100.00	100.00
Crop farming	36.73	75.51	57.29	62.6
Daily wage labour	65.31	53.19	59.38	53.4
Service	12.24	19.15	15.63	08.5
Business	10.20	10.64	10.42	12.8
Self employed	10.20	10.64	10.42	7.6
Animal husbandry	51.02	61.70	56.25	26.7
Others	-	4.26	2.08	-
Avg. no. of economic activities	2.86	3.38	3.11	2.2

and their counterpart in Akaipur involved in 3.38 activities. Therefore, in Akaipur, the fishers had more diversified sources of income. Daily wage labour was the second most important economic activity of the fisher households. More than 65% of households in Kholsi and more than 53% households in Akaipur were engaged in labour work. About 62% of the Akaipur fisher households kept animals to supplement their family income and it is significantly ($p < 0.05$) higher than that of the Kholsi Beel (51%). In Deepor Beel, the average number of economic activities was lower, 2.2 per household (HH). More number (62.6%) of households in this beel were engaged in crop farming as they possess more agricultural land than the fishers of West Bengal. However, significantly ($p < 0.01$) less number of households possessed livestock and poultry as compared to WB beels.

The major occupation of majority of the respondents was fishing and it was also the only source of income to a sizeable number of households. Table 3 shows that fishing was the main occupation for around 70% of the fishers of West Bengal beels, while close to 90% of the fishers of Deepor Beel adopted it as their major occupation. It

Table 3. Major occupation of the fishers' households

Occupation of HH head	Percentage households			
	Kholsi	Akaipur	Overall	Deepor
Fishing	71.43	70.21	70.83	89.83
Fish vending	2.04	2.13	2.08	1.69
Crop farming	4.08	6.38	5.21	0
Business	2.04	0.00	1.04	3.39
Service	0.00	8.51	4.17	1.69
Self employed	2.04	2.13	2.08	0
Wage labour	18.37	8.51	13.54	0
Others	0.00	2.13	1.04	3.4
Monthly income from fishing (₹)	4186	5736	4945	13652

was found that fishing contributed more than 60% of the household income of West Bengal fishers, while in Deepor, the fishers derived 85% of the total income from fisheries. Crop farming was the major economic activity to significantly ($p < 0.01$) higher number of fishers of Akaipur Beel. While it was not a major occupation for any of the fisher households of Deepor. Daily wage labour was the major activity to 18.37% fisher households of Kholsi Beel which was significantly ($p < 0.01$) more than that of Akaipur Beel. In lean seasons, the youth generally engaged themselves in the daily wage works or rickshaw pulling to earn their livelihood. In Deepor, daily labour was not a major occupation for any of the household. Other major occupation included fish vending/marketing, service, self-employment and business. On an average, fisher households earned ₹4186 per month in Kholsi, ₹5736 per month in Akaipur Beel and ₹13,652 in Deepor Beel from fishing. Therefore, this study shows that fisheries was the single source of income for sizeable number of fishers. Similar study was reported in Bangladesh, where wetlands provide subsistence, semi-commercial and benefit requirement to the adjacent communities (Al-Amin *et al.*, 2021).

In Deepor Beel, the fishers observed fishing holidays for 90 days of the year *w.e.f.* 15 April to 15 July. They fish in the core areas (deeper part) during Jan to March. During rest of the period, they fish in the fringe areas. The average fish catch per household was estimated to be 3.03 kg day⁻¹.

The Deepor Beel provides a means of livelihood to a number of local families. Nine villages in the vicinity of the beel and around 850 households are involved in fishing. Moreover, during February-March fishers from neighboring villages also catch fish. It was found that, fishing in the beel was the only livelihood source that contributed to 44% of the fisher households. Contrary to

this, in West Bengal along with fisheries they have other sources of income, although minor. Crop farming was practiced by very few fishers. Moreover, livestock rearing was also not very popular among the fisher households. In Deepor, though the number of livestock including poultry are less but they were distributed among more number of families.

Table 4 shows the extent of contribution of fisheries to the livelihood of the fisher families. In the Deepor Beel, fishing contributed 80 to 100% livelihood to 31% households and no household was found below 40% group. In West Bengal, around 35% of the households derived 40-60% livelihood from these waterbodies. Around 40% of the households drew less than 40% of the livelihood from the beel. Hence, fisheries constituted an important contributor to the livelihood of fishers in both the states.

Consumption of animal protein rich food like meat, milk and fish indirectly indicates the socio-economic status of the fishers since these are high value food. The respondents were asked to recall the amount of these food items brought for home consumption during the last seven days. The study shows that except, fish and milk, the West Bengal fisher households consumed more high value products. In particular, fish consumption is significantly ($p < 0.01$) higher in the Deepor Beel than the West Bengal beels. Since fish was easily available, every household consumed fishes which came from their own catch (Table 5). On an average, one household consumed 1.3,

Table 4. Contribution of the beel fisheries to livelihood of the fishers (% of households)

Contribution to livelihood (%)	Kholsi	Akaipur	Overall	Deepor
100	10.20	2.13	6.25	44.83
80-100	22.45	17.02	19.79	31.03
60-80	18.37	21.28	19.79	13.79
40-60	40.82	27.66	34.88	12.07
<40	8.16	31.91	19.79	0.00

Table 5. Weekly consumption of high value food items per household

Food item	Kholsi	Akaipur	Overall	Deepor
Mutton/Chevon (kg)	0.052	0.074	0.063	0.0339
Chicken (kg)	0.326	0.396	0.360	0.246
Fish (kg)	1.349	2.091	1.713	3.017
Eggs (No.)	2.63	3.74	3.18	1.78
Milk and Milk products (kg)	0.974	1.335	1.151	1.831
Fruits (₹)	31.469	41.798	36.526	21.52
Processed and packed food (₹)	31.429	36.596	33.958	17.75

2.09 and 3.02 kg of fishes in seven days in Kholsi, Akaipur and Deepor beels, respectively. The corresponding figures for chicken were 326, 396 and 246 g, respectively. The consumptions were higher in Akaipur than the Kholsi Beel.

Further, Table 6 shows that in Deepor Beel, fish was the only source of animal protein to more than 71% of the households. While for 29% fishers of WB, it was the only animal protein source. Chicken, milk and eggs are eaten by comparatively more number of WB fishers. Fishes were also present in other combinations of animal protein food intake. Moreover, all the fishes came from the beel itself. Hence, the beel fishes were extremely important for providing nutritional security to the fishers in both the states.

Wetlands are among the most productive ecosystems in the world characterised by dynamic interactions between terrestrial and aquatic habitats at different scales. These systems support valuable floodplain fisheries that are a major livelihood for riparian communities (Mosepele *et al.*, 2022). The results indicated that wetlands contribute significantly to the livelihood and nutritional security of the fisher households. Moreover, it was also found that these wetlands provide a major source of animal protein to the fisher population. Similar studies were reported in Bangladesh and African countries where floodplain fisheries contributed to food security and livelihood support (Duku *et al.*, 2022; Kupika *et al.*, 2022; Mosepele *et al.*, 2022; Utete *et al.*, 2022). In another study, local fish species were identified for social, economic, cultural and religious purposes which attach high intrinsic socio-economic value to the fisheries resources and wetland ecosystem services provided by the Mushumbi Pools, Zimbabwe (Utete *et al.*, 2022). Bennett *et al.* (2018) also reported that capture fisheries provide the world's growing population with crucial source of food and many essential nutrients, including vitamins, minerals and omega-3 fatty acids, which are necessary to end malnutrition. Yet the contributions of fisheries are undermined by threats such as overfishing, climate change, pollution and competing uses for freshwater.

Table 6. Animal protein food intake by the households (%)

Food item	Kholsi	Akaipur	Overall	Deepor
Only fish	30.61	27.66	29.17	71.19
Fish + Chicken	20.41	10.64	15.63	5.08
Fish + Milk	18.37	17.02	17.71	6.78
Fish + Egg	8.16	19.15	13.54	6.78
Fish + Milk + Egg	10.2	8.51	9.38	1.69
Fish + Pork	-	-	-	8.47

The conservation status of wetlands in India is vulnerable which threatens the livelihood of fishing dependent communities (Kumar *et al.*, 2011; Everard *et al.*, 2021). Fisher households with limited resources and limited capital will continue to rely on the wetlands for family income and food security. Therefore, there is a need to design appropriate management strategies to protect and conserve the fishery resources, ensure sustainable use for livelihood and nutritional security. The future research should focus on understanding the present societal priorities and challenges arising from food production, energy, water and environmental change for these ecosystems to play a part in sustainable solutions to human well-being.

Acknowledgements

The authors are thankful to the Presidents and Secretaries of the Fishermen Cooperative Societies of the 3 floodplain wetlands and all the fishers for their active help and support during data collection. They extend heartfelt thanks to the Director, ICAR-CIFRI, Barrackpore for administrative and financial approval for carrying out the research work.

References

- Acharya, S. and Adak, T. 2009. Wetland management for sustainable development. *J. Soil Water Cons.*, 8(4): 25-30.
- Al-Amin, A. K. M., Alam, K., Shrestha, U. B., Prodhan, M. H., Hossain, M. A., Sattar, N and Akhter, T. 2021. Ecosystems, livelihood assets and willingness to pay for wetland conservation in Bangladesh. *Environ. Dev. Sustain.*, 23(12): 17503-17534.
- Bennett, A., Pawan, P., Kristin, K., Doug, R. John, V. and Xavier, B. 2018. *Contribution of fisheries to food and nutrition security: Current knowledge, policy, and research. NI Report 18-02*. Duke University, Durham, North Carolina, USA. <http://nicholasinstitute.duke.edu/publication>.
- Choudhury, B. C. 2007. *Planning a national aquatic area network for conservation and management of rare, threatened and endangered wetland biodiversity. Key note presentation on biodiversity and conservation of wetlands* TAAL, 2007, 12th World Lake Conference, 28 October - 02 November 2007), Jaipur, India. <http://www.moef.nic.in/sites/default/files/nlcp/Keynote/KN-5%20B.C.%20Chaudhary.pdf>.
- Dar, S. A., Hamid, A., Rashid, I. and Bhat, S. U. 2022. Identification of anthropogenic contribution to wetland degradation: Insights from the environmetric techniques. *Stochastic Environ. Res. Risk Assess.*, 36(5): 1397-1411.
- Dixon, A. B. and Wood, A. P. 2003. Wetland cultivation and hydrological management in eastern Africa: Matching community and hydrological needs through sustainable wetland use. *Nat. Res. Forum*, 27: 117-129. <https://doi.org/10.1111/1477-8947.00047>.
- Duku, E., Mattah, P. A. D. and Angnuureng, D. B. 2022. Assessment of wetland ecosystem services and human wellbeing nexus in sub-Saharan Africa: Empirical evidence from a socio-ecological landscape of Ghana. *Environ. Sustain. Indicators*, 100186.
- Ellison, A. M. 2004. *Wetlands of Central America: Wetlands ecology and management*, 12: 3-55. <https://doi.org/10.1023/B:WETL.0000016809.95746.b1>.
- EPA 2016. *Why are wetlands important?* US Environmental Protection Agency. <https://www.epa.gov/wetlands/why-are-wetlands-important>.
- Everard, M., Kataria, G., Kumar, S. and Gupta, N. 2021. Assessing livelihood-ecosystem interdependencies and natural resource governance in a tribally controlled region of India's north-eastern middle Himalayas. *Environ. Dev. Sustain.*, 23(5): 7772-7790.
- Jogo, W and Hassan, R. 2010. Balancing the use of wetlands for economic well-being and ecological security: The case of the Limpopo Wetland in southern Africa. *Ecol. Econ.*, 69(7): 1569-1579.
- Kumar, R., Horwitz, P., Milton, G. R., Sellamuttu, S. S., Buckton, S. T., Davidson, N. C. and Baker, C. 2011. Assessing wetland ecosystem services and poverty interlinkages: A general framework and case study. *Hydrological Sci. J.*, 56(8): 1602-1621.
- Kupika, O. L., Mahlatini, P. and Nyachowe, T. 2022. How local communities access, utilise and evaluate inland fisheries, and their influence on fishery conservation status in northern Zimbabwe. *Water SA*, 48(3): 227-239.
- Mosepele, K., Kolding, J., Bokhutlo, T., Mosepele, B. Q. and Molefe, M. 2022. The Okavango Delta: Fisheries in a fluctuating floodplain system. *Front. Environ. Sci.*, 10: 854835.
- Nabahungu, N. L. and Visser, S. M. 2011. Contribution of wetland agriculture to farmers' livelihood in Rwanda. *Ecol. Econ.*, 71: 4-12. DOI:10.1016/j.ecolecon.2011.07.028.
- Nelson T., Kakuru, W. Tweheyo, M. and David, M. T. 2013. Contribution of wetland resources to household food security in Uganda. *Agric. Food Secur.*, 2: 5. <http://www.agricultureandfoodsecurity.com/content/2/1/5>.
- Parish, F and Looi, C. C. 1999. *Wetlands, biodiversity and climate change. Opinions and needs for enhanced linkage between the Ramsar conventions on wetland*, Convention on Biological Diversity, UN Framework Convention on Climate Change and Global Environment Network.
- Rabelo, L. M., McCartney, M. P. and Finlayson, C. M. 2010. Wetlands of Sub-Saharan Africa: Distribution and contribution of agriculture to livelihood. *Wetlands Ecol. Manage.*, 18(5): 557-572. <https://doi.org/10.1007/s11273-009-9142-x>.

Sarkar, S., Sarkar, U. K., Ali, S., Kumari, S. and Puthiyotti, M. 2021. Status, ecological services and management of aquatic weeds of floodplain wetlands in India: An overview. *Lakes and Reservoirs: Research. and Management*, 26(1): 76-91.

Wood, A. P. 1996. Wetland drainage and management in south-west Ethiopia: Some environmental experiences of an NGO. In: Reenburg, A. and Nielsen, M. H. S. (Eds.), *The Sahel Workshop 1996*, Institute of Geography. University of Copenhagen, Copenhagen, Denmark.