Ecological Change and Migration of Fisherfolk: A Study of Ramsar Wetland, Loktak Lake, in Manipur, India

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Introduction

The Lokatak Lake, a Ramsar wetland of international importance, is one of the largest freshwater lakes in South Asian countries. It covers an area of 287 sq km, spreading over districts of Bishnupur and Imphal West of the northeast (NE) Indian state of Manipur. It is unique for the floating bio-reserve Keibul Lamjao National Park (KLNP), the last home of endangered Sangai Deer, and the floating biomass islands, locally called *phumdis*. The wetland contains a rich biodiversity with 233 macrophytes, 425 animal species, including 249 vertebrates and 176 invertebrates (Trisal and Manihar 2004), and a home for 116 bird species, of which 21 are migratory waterfowl (Singh 1991). Moreover, the lake has immense socio-economic and cultural values. It supports 50,400 fishers and 44 per cent of fishing households (Devi 2017). Around 55 settlements, including around 0.30 million or 12 per cent of the Manipur population, reside in and around Loktak Lake (Bharati et al. 2017). Almost 100,000 people living in 55 rural and urban settlements heavily rely on fishing and farming cum fish farms (Kosygin and Dhamendra 2009). About 11 per cent of the state's fish demand is met by the Loktak Lake (Trisal and Manihar 2004). The lake supplies aquatic plants for vegetable items, fuel, fodder, thatching, handicraft materials, and medicinal plants. The lake is a unique tourism site that fosters the economic support of locals and provides visitors with a fantastic opportunity to appreciate the beauty of the lake floating with *phumdis* of various geometrical shapes (Xalxo 2022). Thus, the wetland is considered the 'lifeline of Manipur.'

The ecology of the Loktak Lake is a grave concern. In 1993, it was included in the Montreux Record. The Ramsar committee cited that the ecological problems in Loktak have arisen due to "deforestation in the catchment area, infestation of water hyacinths, and pollution" (Ramsar n.d.). The construction of the Ithai Barrage in 1983 with a target of 105 MW hydropower and irrigation purposes has "caused the local extinction of several native fish species" (Ramsar n.d.), and ecological deterioration severely affects the livelihoods of the fisherfolk. The barrage submerged the vast fertile agricultural land and triggered frequent floods in the Imphal valley (Singh 2018). Manipur has suffered ₹3 billion (₹300 crore) losses in agriculture in the catchment areas (Singh 2018). Farmers have been displaced and marginalised. Many have shifted from farming to fishing.

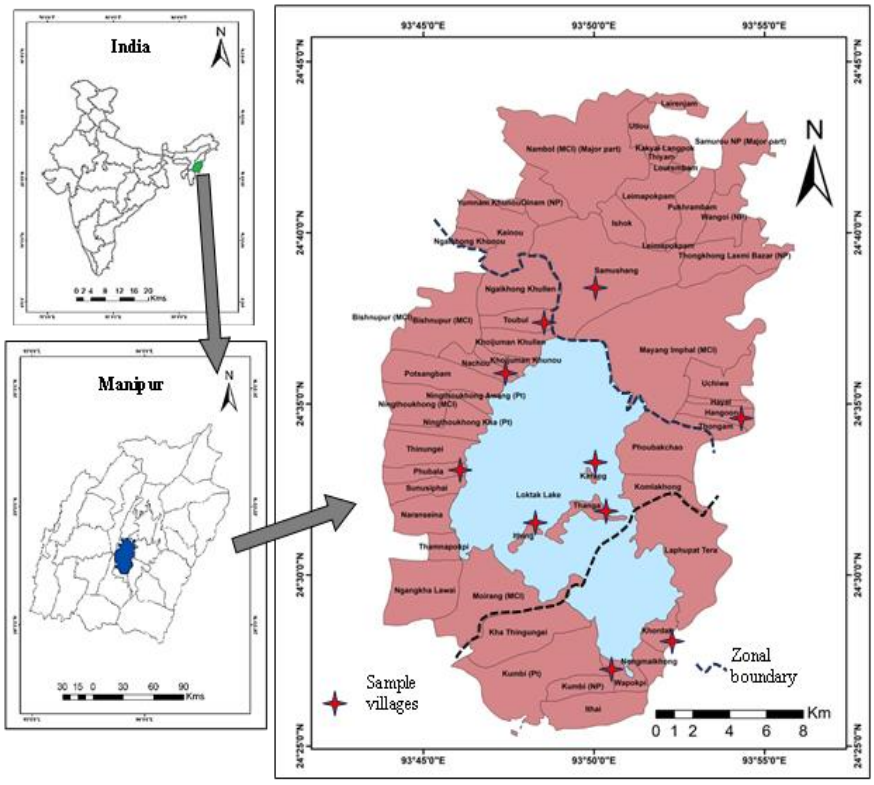
On the one hand, blocking the natural drainage cycle at the Ithai dam and, on the other hand, the rivers- Potsangbam, Awangkhujairok, Thongjaorok, Merakhong, Nambol, and Nambul- drain directly into the lake, leads to siltation, eutrophication, depleting water quality, and proliferation of *phumdi* and water hyacinths (Roy and Majumder 2019). It adversely affects fish breeding, and some indigenous species have disappeared from the lake (Ghosh 2018). The aquatic plants used for livelihood purposes have been severely damaged. Moreover, implementing the rules and regulations from time to time under the Manipur Loktak Lake (Protection) Act of 2006 is skewed toward environmental sustainability rather than fishers' economic and cultural interests (Anand 2019). When fishing and aquatic harvest encounter challenges, and farming is a grave concern due to submergence, fishers have little choice except to migrate to urban centres to search for work/employment either permanently or temporarily. Against this backdrop, the present study tries to assess the impact of ecological changes on fishing activities in Loktak wetland and to investigate migration as a livelihood strategy to cope with the adverse situation.

Relevance of the study

Nowadays, climate change and environmental-induced migration are widely discussed worldwide. The ecological changes that affect livelihood and lead to migration are very sparse in the domain of migration study, and it is hardly traced in the Indian context as well as in the Loktak wetland. The phenomena of migration and displacement due to livelihood issues from Loktak are incidentally reported in newspapers (Mohanty 2020; The Shillong Times 2011), online magazines (McDougall 2021; Anand 2019) and organisations' web reports (IUCN 2018). A regional online magazine roughly estimated that thousands of fisherfolk migrated to Imphal city in the last couple of decades to pull rickshaws or do odd jobs whatever they get (Anand 2019). The empirical research on migration induced by the livelihood crisis in and around Loktak Lake has hardly been explored.

Objectives

The objective of the present study is to assess the ecological risks in fishing activities in the Loktak wetland and the livelihood strategies of the fisherfolk in response to the crisis. In this context, the subjective risks of the fishers in their means of living are estimated first, and their livelihood strategies in response to the perceived risk are discussed in detail. Migration, which is one of the prominent livelihood strategies in fishers' households, has been brought under the gamut of study for detailed discussion. Finally, factors influencing the likelihood of labour migration from a household are investigated through a case-controlled study, where migrated households are considered as exposure group and non-migrated households are the controlled group.



Map 1. Location Map: Settlements along with Sample villages in and around Loktak Wetland
Source: Authors

Data source and methods

Sample design

The present study is based on a field investigation of 400 samples, which are equally divided, 200 samples each, into two strata- exposure and control groups. The target or exposure group consists of households exposed to migration of any household members due to work/employment during the last

730 days since the survey date, while the controlled group consists of households without any exposure to migration of any member within the reference period. Forty households from a sample village, including 20 migrated and 20 non-migrated households, were surveyed using snowball sampling. The households nearest to the migrated households were chosen for the control group. The samples were collected from 10 census villages out of 55 settlements distributed over three distinct zones- northern, central, and southern- of the wetland (Map 1). Two census villages, each from the Northern and Southern zones, three from the Central zone, and three island villages, Ithing, Thanga and Karang, were selected for the study. The household survey was conducted with the help of a structured schedule. Apart from the household survey, 10 key informant interviews (KIIs) were conducted with the help of two sets of semi-structured questionnaires for different stakeholders. The interviews were conducted in the local language, Manipuri, and were later transcribed into English.

Methods

The study is a blending of both qualitative and quantitative approaches. 'Thematic mapping' using web-based artificial intelligence (AI) based on transcripted information of KIIs is adopted to unveil fishers' concerns, the impact of ecological changes on their means of living, and their livelihood strategies. To assess the subjective risks of fisherfolk' participatory risk mapping' is incorporated. Smith et al. (2000) are the pioneers of participatory risk mapping. Later, many scholars notably can be mentioned- Doss et al. (2008), Inskip et al. (2013), and Nnaji et al. (2023) modified and successfully incorporated it into their study for assessing risk at the unit level, i.e., household level. The equation is-

$$\mathbf{R_{ij} = 1 - \left[\frac{(r_{ij} - 1)}{n_i}\right]} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (\mathbf{1})$$

Where R_{ij} is the risk index for household, i , for the risk, j; r_{ij} is the ordinal rank of risk, j, made by the household, i, and n_i is the total number of risks identified and ranked by a household, i. After the computation of R_{ij} for a particular risk for an individual household, summing the $R_{ij,}$ a risk perception index (RPI) is constructed for each household.

$$\mathbf{RPI = \sum_{i=1}^{n} R_{ij}} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (\mathbf{2})$$

Finally, to examine the likelihood of labour migration from a household underlying different predictors, a binary logistic regression (BLR) model based on the sustainable livelihood approach (SLA) is designed. The equation of the model is-

$$\mathbf{logit\ (P) = \ln \frac{P}{1-P} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n} \dots\dots (\mathbf{3})$$

Where P is the probability of migration from the household, (1–P) is the non-probability of migration, P/(1–P) is Odd Ratio (OR), and logit (P) or log (P/1-P) denotes Log of Odd. X refers to predictors.

3. Results

Threats in fishing

Respondents were asked what risks they have experienced/perceived in fishing in Loktak Lake over the last 05 years. If they could not properly articulate or memorise risks, a predefined list transcripted in the local language was produced to choose the risks they were concerned about. A risk chart had been prepared after reviewing published articles, news and reports and interacting with villages during the

pilot survey. After identifying the risks, the respondents were asked to rank these according to the severity from most significant to the least. A simple ordinal ranking scheme was used- rank 01 for the most severe risk to the following severe risk as 02, and so on. The risk index (R_{ij}) of each household (i) for a particular risk (j) has been computed based on the identification of risks and ranking of these, and the scores vary between 0 (zero), which means no concern, and 1 (one), which means the greatest concern. The mid-value of the scale is 0.5. A household with a risk score of 0.50 is deemed to be an average level of concern.

Table 1. Risk Perception in Fishing in and around Loktak Wetland

Sl No.		Risk Exposure	n	$\bar{x}$	SEM	Test value (μ) =0.5		
						($\bar{x}$ -μ)	*t*	*p*
Ecological Risk								
R1		Water pollution- inflow of organo-chlorine pesticides and chemical fertilisers, domestic effluent from urban areas, etc.	234	.687	.015	.187	12.44	.000
R2		Phumdi proliferation and high concentration of water hyacinth and weeds	252	.728	.017	.228	13.70	.000
R3		Lowering the depth of water	170	.545	.020	.045	2.23	.027
R4		Decrease in fishing areas	207	.652	.019	.152	8.09	.000
R5		Risk of sudden onset climatic events: gusty winds/ windy weather /cyclone and associated lake current, and other sudden onset hazards	200	.667	.020	.167	8.16	.000
R6		Flooding/submergence of fish ponds/farms	157	.683	.024	.183	7.59	.000
R7		Seasonality in fish availability/production	165	.687	.021	.187	9.02	.000
R8		Decline of fish species and availability	275	.720	.015	.220	14.26	.000
Non-Ecological Risk								
R9	Input Risk	High price of fishing contrivances, like net, hook, canoe, etc., and fish feed, fish icing and smoking, and other inputs	292	.642	.015	.142	9.55	.000
R10		Lower availability of inputs	84	.508	.025	.008	.33	.740
R11	Market Risk	Market accessibility- inadequate marketplaces/ keithel, time limitation of the market, transportation problems– higher fare and time taken, frequent bandh, strikes and curfew	211	.501	.017	.001	.05	.957
R12		Price issue- low price of catch, price lowered by the middlemen, imported fish and other factors	117	.424	.020	-.076	-3.86	.000
R13	Institutional Risk	Rules and regulations in fishing and mark controlling	40	.492	.044	-.008	-.18	.861
R14		Physical infrastructure- lack of proper storage facilities, ice plans, packing, market areas, and others	131	.424	.021	-.076	-3.57	.000
R15		Credit/financial support/DBT facility for fishing	255	.472	.017	-.028	-1.62	.106
R16	Personal Risk	Occupational health hazards: musculoskeletal disorders, respiratory and dermatological, eye, gynaecological and others	231	.335	.014	-.165	-11.48	.000

Source: Computed from Field Survey Data

Table 1 shows the mean ($\bar{x}$) risks of fishing households for 16 risk exposures. A one-sample *t*-test is used to examine the significant difference (at 5.0 per cent level) between the sample mean ($\bar{x}$) and hypothesised population mean (μ=0.5), i.e., the mid value of the risk scale- 0 to 1. A risk exposure with a sample mean score ($\bar{x}$) less than 0.5 is considered a low-risk perception by fishing households or a low impact of that particular risk. On the contrary, a mean score above 0.5 is considered a higher risk perception. In addition, the mean difference ($\bar{x}$ - μ) expresses how much lower or higher the $\bar{x}$ is compared to μ (0.5). The standard error of the mean (SEM) infers how precisely the sample predicts the true mean of the population or is closer to the true population mean.

Out of 16 risk exposures in fishing, including ecological and non-ecological risks, the highest mean score ($\bar{x}$=0.73) of perceived risk is for risk-2, i.e., *phumdi* proliferation and high concentration of water hyacinth and weeds (Table 1). It is significantly different from μ=0.5, and the mean difference ($\bar{x}$-μ=0.23)

is quite higher, and SEM is also lower (SEM=0.017). The risk-2 is followed by (R8) decline of fish species and availability ($\bar{x}$=0.72, $\bar{x}$-μ=0.22), water pollution of the lake from different sources (R1, $\bar{x}$=0.69, *t*=12.44, SEM=0.015), seasonality in fish production (R7, $\bar{x}$=0.69, *t*=9.02, SEM=0.021), flooding or submergence of fish ponds or farms (R6), and decrease in fishing areas (R4). It is noticed that these are all ecological risks that rank at the top of the subjective risk of fisherfolk.

Among the non-ecological risks, all are not significant, except risk-9, all score below the mid-value (μ=0.5) of the risk scale. Risk-9, hiking input costs in fishing, like fishing nets, hooks, canoes, and other contrivances, fish feed, fish preserving and smoking, and other inputs, is a wide concern among fishers and affects to a greater extent too ($\bar{x}$=0.64, $\bar{x}$-μ=0.14, SEM=0.015). Market risk (R12), i.e., low price of catch, interference of middlemen, imported fish and other factors, R14- infrastructural issues and R16- occupational health hazards, such as musculoskeletal disorders, respiratory and dermatological, eye, gynaecological and others, are widely recognised by the fishers, but the degree of impact, i.e., severity is not equally high. Overall, compared to non-ecological threats in fishing, ecological issues have been portrayed predominantly in the subjective risk of fishers- in terms of wider concern and impact

Thematic mapping- livelihood strategies in the changing ecology

A total of 10 KIIs were conducted, three in a group and the rest individually. The key informants include stakeholders ranging from fishers and family members of fishers indirectly involved in fishing to social activists, local teachers, doctors, scholars and experts. The KIIs were conducted in the local (Manipuri) language, and later, recordings were transcribed in English. The AI-based thematic analysis generates different codings related to livelihood strategies in the context of hampering fishing due to ecological changes in the wetland. These codings are deducted/collated into three broad themes- job transformation, job diversification and migration (Fig 1).

The predominant codings, which indicate job transformation, include conversion of agricultural land to fish farm or fully engaging in open water fishing, labour-intensive effort in fishing and higher investment, starting fishing with precarious techniques and voracious extraction, and other strategies like curtailment of family expenses by discontinuation of children education and insist them to entire into work or assist in fishing, and reduction of family expenses other ways for investing more in fishing. Manipur Govt and its nodal authority, LDA, strive to delist the wetland from the Montreux Record. From the expert opinions of KII-10 (professor) and KII-2 (local school teacher), it is revealed that the environmental activism of the Loktak authority hardly considers the livelihood of the locals. Some instances indicate how desperate they are- in November 2011, an eviction drive set fire to 1,132 floating huts and displaced 5,000 fishers from floating villages within Loktak Lake (AHRC 2011). In July 2022, by publishing an order, the LDA imposed a sudden ban on floating *phumdi* huts and *athaphums* (Samom 2022). When fishers seek alternative means of living, floating homestays (*phumdi* huts) with the scenic beauty of the lake may be the best alternative. But the government eviction notice spoiled that hope nip in the bud. Moreover, temporary *phumdi* huts for halting or night stays reduce the transit time to be grounded for fishing, spend more time to catch, and reduce occupational health risks. The locals alleged that the government was removing the existing local ones to widen the pave for big investors to commercialise tourism in the Loktak (Bhattacharya 2022). However, implementing rules and regulations from time to time under the Manipur Loktak Lake (Protection) Act of 2006 is skewed toward environmental sustainability rather than the economic and cultural interest of the fisherfolk (Anand 2019). When fishing in the Loktak has been severely hindered by ecological and non-ecological risks, the fisherfolk have tried diversifying their work

in local areas. Along with fishing, they are engaged in multiple activities- local transportation and services, opening up shops in their locality, and running restaurants on a part-time basis. Most fishing households have at least one handloom, and women are engaged in waiving traditional clothes. They are also involved in other creative manufacturing and handmade (CMH) activities using raw materials from the wetland. But nowadays, raw materials are very scarce due to ecological problems. Sometimes, the government assists with animal husbandry, distributes handlooms and sewing machines, and provides other support for alternative livelihood opportunities, but it is very selective and limited to small scale.

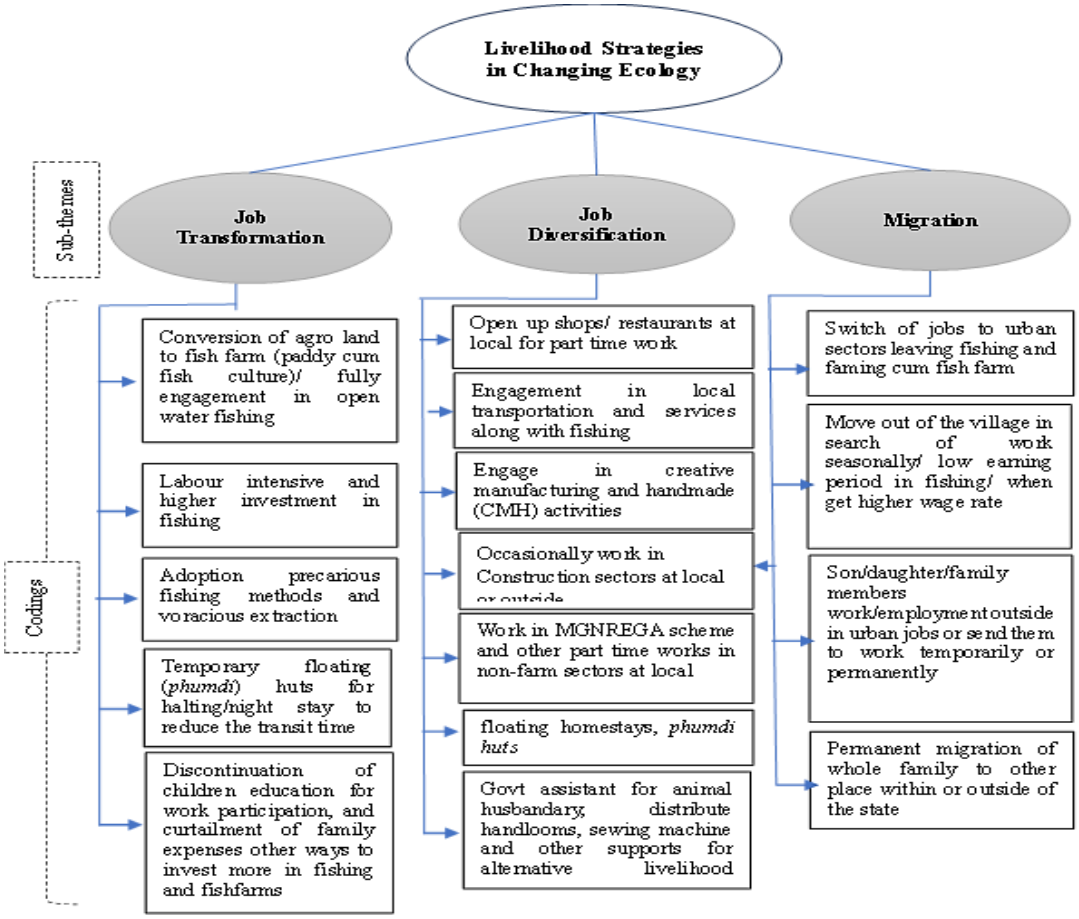


Figure 1: AI-Based Thematic Mapping of Livelihood Strategies in Changing Ecology in Loktak Wetland

Source: Developed by authors based on Key Informant Interviews (KIIs)

While there is less hope for work transformation and alternative means of living locally, the best option is migration to the nearest urban agglomeration (UA), Imphal UA or out of the state. Key informants univocally opined that the crisis in fishing and farming due to ecological deterioration induced the people, specifically the young generation, to migrate out of the region in search of jobs. The success of migration is less as their skill is concerned. They hardly find higher-salaried jobs and have to absorb low-paid work at destinations. Moreover, they face language problems outside of the state of Manipur. They are often cheated by employers and intermediaries and return in empty hands. Racial astrocytes against northeast Indian migrants in mainland Indian states are also a concern. But, one benefit of labour migration is that,

unlike fishing, one does not need any lump sum initial investment to be engaged in work and recurring capital expenses for fishing round the year.

According to the Census of India 1991-2011, Manipur witnessed rampant intrastate migration, including intra- and inter-districts, for work/employment. A migration stream, from the hilly districts to the Imphal Valley districts, is the most predominant, contributing around 60 per cent of the state's internal migration in the 2011 Census. The most preferred destination is the Imphal Municipal Council (IMC) and adjoining outgrowths (OGs), spreading mostly over the Imphal West district and partially over the Imphal East district. The study area, lakeshore and islands, is spread mostly over Bishnupur and partially over Imphal West. The wetland is 40-45 km from IMC and very close to its OGs. Hence, the attraction of the villagers from the lakeshore to the state capital city is quite natural. The field investigating data shows that the macro pattern of migration from the lakeshore villages and islands is very temporary or short-duration. They frequently move out and return; very few migrate for a long duration or permanently. The seasonal variation of the catch in the lake widely influences their temporary migration.

Micropattern of migration

Of 200 migrated households, 294 people, i.e., on average, two migrants from a family migrated out of wetland for work/employment. Nearly 60 per cent are inter-district migrants. A majority, almost 82 per cent of workers, preferred to migrate for work to urban areas, particularly urban areas of other districts (48 per cent). Imphal West is the most preferred district (47 per cent), followed by Imphal East (14 per cent). The capital city, IMC, which spreads over the district Imphal West (mostly) and partially Imphal East, attracts the most. On the other hand, nearly 18 per cent of workers migrated to other states, namely Karnataka (especially Bangaluru), Delhi, West Bengal, and three sister NE Indian states- Assam, Tripura and Nagaland. For inter-state migration, Manipuri labour migrants prefer mainland Indian states over neighbouring sister states (Mistri 2022). International migration is negligible.

Table 2. Work Engagement before and after Migration from Loktak Wetland

Work Engagement Before Migration				Work Engagement at the Destination			
Category	**Work engagement**	**Mig.**	**Per cent**	**Category**	**Work engagement**	**Mig.**	**Per cent**
Non-worker	Students	156	53.1	Primary sector	Agro labour/fishing labour/forestry/other casual labour	2	0.7
	Other non-worker: household duties/ dependent/ pensioner/ other	5	1.7	Non-farm	Seller/salespeople/shop assistants and related workers	21	7.1
Worker	Cultivator, agricultural labourer, and livestock rearing	17	5.8		Construction labour	128	43.5
	Capturing fisheries and fish farm	87	29.6		Transportation and storage	20	6.8
	Non-farm sector	29	9.9		Regular wage/salary earning	72	24.5
					Other non-farm sector	51	17.3
	Total	294	100		Total	294	100

Source: Field Survey Data

Table 2 shows that 53 per cent of students discontinued their studies and entered the job market. Their family decided to migrate them. Over one-third (35 per cent) of migrants reported that they were engaged in fishing, farming and related activities before migrating to urban areas. It directly infers the crisis in

their traditional activities. In work participation at destinations, more than 60 per cent were engaged in the unorganised sector. Around 44 per cent of migrants worked as construction labourers, 7.1 per cent were sales assistants or sellers on the street side or shop assistants, and 6.8 per cent were engaged in transportation and storage. A quarter of workers were also absorbed in regular wage or salary earning. Around 50 per cent of workers used family members/relatives/friends as a source to find a job at destinations, followed by self-contact or enquired at the workplace (18 per cent), uptake government/private jobs (13 per cent) and through intermediaries/contractors (9.2 per cent).

The pattern of migration from the wetland is short-term or temporary and circular in nature. An overwhelming proportion, around 61 per cent, reported the duration of migration was less than three months but more than 15 days, followed by 14 per cent for 3-6 months and 18 per cent for 6-12 months. Only eight per cent of workers reported that migration duration was 12 months or more. The mean return of migration in the last 730 days is ten times, and the median is eight times. It means they frequently return and migrate again. Frequently, in- and out-migration and being involved in more or less the same place of destination is characterised as circular migration (Hugo 2013). This type of migration is associated with short-distance migration, where migrants can afford the transportation cost and have a good bond with the origin, which helps to flow a good amount of remittances regularly.

Determinants of Migration

Migration is a complex phenomenon influenced by a broad spectrum of socio-economic, political, demographic, geographic and physical aspects. Like climatic or environmental migration, ecological change-induced migration study begins with a fundamental question- is the impact of ecological change on migration linear or non-linear? There is little evidence of a direct effect of ecological changes on contemporary migration patterns. Most often, it affects through/via livelihood issues, especially affecting means of living, i.e., occupation. As ecological change is a slow onset process or hazard, the intensity of the effect may be low, but the influence is prolonged and covers a broad scale or masses. When ecological stressors hamper occupation, household assets and policies and structures may help to protect or make the livelihood capable of coping with the adverse situation. According to the SLA, in the counter interaction of stressors by livelihood assets and govt policies and measures, different livelihood strategies are adopted by households to cope with adverse situations (DFID 1999). In the study, migration from households is a prominent livelihood strategy to cope with adverse situations posed by the stressors to the principal means of living.

To examine the likelihood of labour migration from a household over the non-migration of the same, a BLR model based on the SLA has been designed (Table 3). The model helps to understand the influence of ecological risk on migration in a case-controlled study. The response variable is the migration status of the household, i.e., households with no migration experience in the last 370 days are coded ‘0’, and household with a migrant member/experienced migration is coded ‘1’. A total of 13 predictors have been incorporated into the BLR model. Out of 13, seven predictors, such as the location of households, number of youth members, highest education attainment of the family, household monthly income, land holding size, wealth quantiles and ecological risk perception, significantly predict the likelihood of migration from the fishing households.

Table 3. Likelihood of Migration from Fishing Households in and around Loktak Lake

Response variable: non-migrated household- 0 and migrated household-1.			
Predictors	**Category**	***Odd***	***p***
1. Location	Northern Zone®		
	Central Zone	1.781	.184
	Southern Zone	2.578	.024
2. Youth Members (15-29 yrs.)	No of Youth	1.341	.007
3. Gender	Male®		
	Female	.798	.391
4. Highest Education Attainment	Secondary & Below®		
	Higher Secondary	.455	.035
	Graduation & Above	.537	.059
5. HH Size	No. of family members	1.003	.964
6. Social Group	SC®		
	OBC	1.196	.577
	Non-SC/ST/OBC	1.610	.306
7. HH Income	Income (₹)/month	1.000	.000
8. Land Holding	<0.5 hac.®		
	0.5 to 1.0 hac.	.706	.329
	1 to 2 hac.	.317	.010
	>2 hac.	.071	.004
9. Livestock	Standard Livestock Unit Index (SLUI)	.727	.159
10. Wealth Quintile	Poorer®		
	Poor	.533	.107
	Middle	.331	.005
	Rich	.280	.002
	Richest	.379	.014
11. Uptake of Public Welfare Policies	Policy Index	1.054	.315
12. Ecological Risk Perception	Ecological Risk Index	1.654	.014
13. Non-Ecological Risk Perception	Non-Ecological Risk Index	.968	.800

Note: ®- Reference Category, n-400, Nagelkerke R Square-0.62

Source: Computed from Field Survey data

The probability of migration from households in the southern and central zones is 2.478 and 1.781 times, respectively, higher than in the northern zone. The northern zone has better connectivity and infrastructure and is closer to IMC. The southern and central zones are far from Imphal UA. The southern zone includes KNLP and Ithai barrage. The central zone includes three islands. The dwellers settling in these zones belong to the backward class, Scheduled Caste (SC), and depend solely on fishing. These two zones face infrastructural issues, are far from big urban centres, and lack access to the market for their catches and livelihood opportunities.

The likelihood of migration from a household increases (Odd=1.341) with the number of youth members, 15-29 years. It is observed that young members are sent to work outside, and the decision is taken at the household level. Moreover, the young generation dares to take challenges in the unknown place. The probability of migration from lower-educated families is comparatively higher than that of higher-educated families. The Odds for households with higher secondary, and graduation and above education are 0.455 and 0.537, respectively. Children's education is a costly affair in the region. Higher-educated families are economically well-off, less dependent on fishing, and often engaged in non-farm sectors at

the local level. The odd value of the household monthly income is 1.00, which infers the chances of migration and non-migration from a household is 50-50 in terms of income. Households with very-marginal land holding (less than 0.5 ha) reported more migration compared to small (1-2 ha) and semi-medium (greater than 2.0 ha) land holding. Due to the commissioning of the Ithai barrage and agro-land submerging, the marginal land holding (less than 1.0 ha) families were more affected. There is a significant difference in the likelihood of migration from households in terms of the wealth index. The wealth index, comprised of 24 variables ranging from housing conditions, basic amenities and tangible assets possessed by households, suggests the standard of living. The likelihood of migration from middle, rich and richest wealth quintile households are 67, 72 and 62 per cent, respectively, lower than the poor wealth quintile. Higher wealth quintile households can take better livelihood strategies to cope with adverse situations with the help of their resources. Ecological risk perception significantly predicts the likelihood of migration from households. With the increase of risk perception by one unit, the probability of migration from a household will increase by 0.45 log of odd, or around 60 per cent probability of migration over the non-probability of the same.

Discussion

Like climatic or environmental migration, defining ecological change-induced migration is a big question- in what degree or strength of effect should the impact of ecological change be compared with other influencing factors? Or, to what extent will the ecological stressors have to act/impact to be a primary driver? As ecological change is a slow-onset hazard, the ecological agents, in association with socio-economic, demographic, and political factors, e.g. government measures to access the resources, opportunities for alternative livelihood, and levels of development, can balance for or deter the migration or induce the migration. It is very hard to single out the ecological change effect from the non-ecological issues. In the study, there is wide consensus about the ecological change effect on fishing in the Loktak wetland, and migration from households is witnessed as a predominant livelihood strategy. *Phumdi* proliferation, deterioration of water quality, decline of endemic fish species and production, and lowering of the lake's depth are grave concerns among the fishers' community, and these have been reflected through their subjective risk perceptions in their occupation. In the case-controlled study, ecological risks also exert a significant influence on the likelihood of migration from fishers' households. Apart from ecological risks, non-ecological issues, like hiking input costs in fishing, market risks, rules and regulations, structural issues, and personal health hazards also affect fishing. Overall, compared to non-ecological risks, ecological issues have been portrayed predominantly in the subjective risk mapping of fishers- in terms of broader concern and impact. However, ecological and non-ecological threats in fishing are hardly mutually exclusive- one leads to another. For instance, *phumdi* proliferation and high concentrations of water hyacinth and weeds lead to water pollution, decrease the open areas for fishing, affect fish breeding and decline the fish stock, resulting in low catch per haul or production and low income of fisherfolk. Low income in fishing induces to curtail household expenses by compromising the standard of living, discontinuation of children education, and underestimating the occupation health hazards. To escape economic distress, fishers work hard and start practising precarious methods of fishing and voracious extraction, which ultimately leads to loss of biodiversity, water pollution and further decline of fish stocks. However, both types of risks need to be addressed in the policy arena to mitigate the livelihood crisis of fisherfolk and better conserve the Ramsar Site.

In the wake of the ecological change affecting fishing, fishers try hard to transform and diversify their economy at the local level. But, they encounter many issues ranging from economic constrain, inadequate

support from the government, lack of balanced measures for conservation, and the state's law and order situation. In addition, Manipur has witnessed lower economic growth vis-a-vis the growing unemployment rate touches double digits both in rural and urban areas (Mistri 2022). Against this backdrop, fishing households make the decision to send members outside of the village to work in the non-farm sectors in urban areas. Thus, the household diversifies their income by distributing their labour portfolio across space and time and coping with the adverse situation at the origin posed by the ecological changes. This type of migration is characterised by the new economics of labour migration (NELM) theory. The NELM theory emphasises household-level migration decisions and ensures remittances from that sector, upon which their families are not currently dependent. Here, workers hardly permanently migrate. Migrants frequently return and migrate around the year. Hence, they have strong bonds with the family, and the family gains a good amount of remittances. In the study, a generational shift of occupation is observed- fishers' children are not willing to engage in their parents' or grandparents' traditional occupations, i.e., fishing and farming cum fish farm. The younger generations prefer to go to work outside, but not permanently. It characterises the migration pattern as short or temporary and cyclic in nature.

Commissioning of the Ithai barrage is one of the main reasons for ecological changes in the lake. There have been many demonstrations for decommissioning the barrage from time to time. Even the Chief Minister of Manipur requested the PM of India to review the Ithai dam project (Saikia 2017). On 12 June 2017, Manipur's Principal Chief Conservator of Forests (Wildlife) wrote to the union environment ministry to constitution an expert committee to conduct an environmental impact assessment due to commissioning the Ithai Barrage for the Loktak Hydro Electric Project. In Indian history, there is no record of any dam being decommissioned yet. Moreover, after 40 years of commissioning a barrage, the sudden breakdown may have another serious adverse effect. A thorough impact assessment is essential before decommissioning. However, at present, ecology conservation is a prerequisite for the sustainable livelihood of the locals. The LDA and state govt are very serious about delisting the wetland from the Montreux record. The central government is also concerned and sanctioned ₹500 crore fund to clean the lake and revive the ecology (Northeast Now 2018). But there is a mass grievance against government measures and budget utilisation practically. Fishers alleged that authority is only concerned about ecology, not the livelihood interest of the people. Their coercive measures- eviction of floating villages, ban on *phumdi* huts and homestay- are its reflections. The public grievances often bust into hostile conditions and lead to prolonged demonstrations in and around wetlands. A coordination gap between the authorities and local people has been observed. Sometimes, good initiatives by the LDA fall fat on the face without the locals' participation or cooperation.

Conclusions

The change in the lake's ecology in recent decades poses a severe threat to the life below water, leading to the livelihood crisis of the fishing community in and around Loktak Lake, and migration from households is the predominant livelihood strategy to cope with adverse situations. Ecological risks along with non-ecological issues need to be addressed to mitigate the livelihood crisis and conserve the wetland. In the crisis in fishing activities, people have limited livelihood options at the local and support from the administration is almost negligible. Migration to the capital city- Imphal, is the all-time option for migration for work/employment. The migration from the Loktak wetland follows the presumption of the NELM theory, where migration decisions are taken at the household level, and adult members are sent to urban centres for work in non-farm sectors. Diversifying work portfolios and switching jobs in sectors

other than fishing and farming cum fish farm to secure constant income flow. If one sector faces any crisis, another sector will save. The micropattern of migration in the study is characterised by cyclic and temporary. As they prefer to migrate short distances, there is no issue with returning frequently and again migrating out.

Migration is a complex process that can hardly be standardised and has many factors associated with it. In the study, ecological risk perception exters a huge push and is significantly associated with migration in a case-controlled study. Apart from ecological risk, geographic location of households, youth members, highest education attainment of the family, household monthly income, size of land holding and standard of living are significantly associated with the migration from fishers' households. Migration from Loktak Lake is a win-win solution- on the one hand, it helps to reduce pressure on the limited resources of the wetland and facilitate better conservation; on the other hand, it plays a significant role in eliminating poverty and promotes good health and well-being being of the households.

Finally, an integrated natural resource management approach involving the locals in the conservation process and sustainable use of resources is the essential. Authority is busy with treating the symptoms of the problem rather than resolving the root causes of ecological changes. This is reflected in the rigorous advocacy of the regulations and short-term measures to gain instant benefits. The management plan hardly takes livelihood into consideration, keeps the fishers and other stockholders aside, has a smaller marker mechanism, and lacks long-term visions. An integrated natural resource management approach is the utmost need of the hour.

Acknowledgement-

The author would like to acknowledge the Indian Council of Social Science Research (ICSSR), New Delhi, to provide fund for conducting the field-based study.

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