

Research Article

Dying Wetlands: A Threat to Livelihoods of Loktak Lake Dwellers

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ABSTRACT

Loktak lake is regarded as the 'lifeline of the people of Manipur' and soon, will be on the verge of extinction. In this paper, an attempt has been made to assess the causes for this stress and its resultant impacts on the land and environment and on the livelihood of the lake dwellers. The lake dwellers include people living on the lakeshore, islands and on phumdis. The study is mainly based on the primary sources of data which were collected through questionnaire interviews. The total sample size consisted of 500 households sampled from the 10 selected villages located around the Loktak Lake. The result showed that the lake is under severe stress mainly due to human interventions like the construction of Ithai Barrage Dam, weed infestation, pollution, encroachment, overexploitation of resources and siltation thereby causing flooding of the agricultural fields and villages, decrease in fisheries production and loss of biodiversity. The resultant impacts on the livelihoods of the lake dwellers showed change in their occupational structure and income, increase in unemployment and health problems.

Key words: Wetlands, eutrophication, Manipur, agriculture, flooding, Loktak and *Phumdi*

INTRODUCTION

Lakes have great significance in terms of physical, ecological, economical and social benefits. Physically, they act as reservoirs for storing water and filtering it for recharging ground water storage; ecologically they sustain a wide variety of life forms (migratory birds, mammals, fish, amphibians, reptiles and many plant species); economically they provide a wide range of valuable products and socially a large number of people sustain their livelihood by making use of them (Down to Earth, 2001). But inspite of performing so many important functions many of these lakes are under severe stress and are becoming ecologically dead for example in India, about 40 per cent of the inland lakes and ponds have been lost in the past 10 years (SACON, 2005). The beautiful Dal Lake of Kashmir is dying too, with a burden of 100 hamlets, floating gardens, hotels and lodges and lack of sewage disposal system. Thus, the lake water is turning a murky grey - green instead of its splendid blue. The Kodaikanal Lake in Tamil Nadu, one of the largest freshwater lakes has shrunk to nearly 20 per cent of its size over the past decade due to excessive construction work in the town. The Wular lake of Srinagar is facing the problem of siltation and shrinkage (Ishfaq-ul-Hasan, 2001). Pushkar Lake of Rajasthan, which attracts thousands of pilgrims/ tourists across the world, has almost dried up (Mohanty, B.C., 2005).

Loktak, the largest freshwater lake in the North-eastern India, is also called the 'floating lake' because of floating '*phumdis*' (local name for floating mats) in it. This lake plays an important role in the economy of Manipur. It is considered to be the 'lifelines for the people of Manipur' due to its importance in their socio-economic and cultural life (Tombi, H. & Shyamananda, R.K., 1994). It serves not only as the source of water for drinking, power generation and irrigation but is also a source of livelihood for the people living in the surrounding villages, islands and on the *phumdis*. Considering, its ecological status and biodiversity values, the lake was initially designated as a 'Wetland of International Importance' under the Ramsar Convention on March 23, 1990. But Loktak lake, which acts as an economic security for the region is under severe stress. The people living around the lake, on the islands and on the *phumdis* survived by engaging in different economic activities like fishing, agriculture, fish farming, trading of lake products, traditional handicraft made of lake products such as mats, baskets and other woven goods etc. So, keeping these aspects in mind, an attempt has been made to assess the causes for this stress and its resultant impact on the land and environment and on the livelihoods of the lake dwellers.

Loktak lake (24°25' N to 24°42' N latitude and 93°46' E to 93°55' E longitude) is located in the north-eastern corner of India, in the Central Valley of Manipur, about 38 km from Imphal city (fig. 1). It covers an area of 287 sq. km. and has an average height of 800-2,070 m above mean sea level (WISA and LDA, 2004). It has a direct catchment area of 1,040 sq.km (of which, 35 per cent is under agriculture, 15 per cent under settlement and 50 per cent under forest cover) whereas, the indirect catchment area is 7,157 sq. km. (which includes the catchment of 5 important rivers viz. Imphal, Iril, Thoubal, Sekmai and Khuga) (Anon, 2003). According to remotely sensed data of IRS 1D, Jan. 2002, nearly 134.6 sq. km. (47 per cent) is covered by *phumdis*, 43.9 sq.km. (15 per cent) is under open water area, 40.8 sq.km (14 per cent) is waterlogged area, 33.87 sq.km (11 per cent) is dry area with or without vegetation, 31.03 sq.km (10 per cent) is area under other vegetation and 2.04 sq. km (0.7 per cent) is hillocks with scrub or without scrub (Manipur Remote Sensing Application Centre, 2005) (Fig. 1). The lake receives water from the inflow of various rivers/streams mainly from the western catchment (52 per cent), direct precipitation (25 per cent) and link channels (23 per cent) (WISA and LDA, 2004). About 34 streams, coming from the western hills and the Imphal River drains into the lake.

The Central Valley region (covers 10 per cent of area of the state of Manipur) has 490 villages and 32 towns and nearly 61 per cent of the total population of Manipur lives here. This is one of the most densely populated regions of the state. Most of the settlements are concentrated around the lakes. There are about 55 settlements (both rural and urban) around the lake with a total population of 100,000 (Census of India, 2001). Around 15 per cent of the valley population is concentrated around the Loktak lake alone. On the basis of place of settlement, the lake dwellers are known as, the lakeshore communities, the island communities (are those people who live on the islands) and the *phum* dwellers *khangpok* (are those people who live either permanently or temporarily on the *phumdis* by making small huts).

DATA BASE AND METHODOLOGY

The study is mainly based on the primary sources of data which were collected through intensive survey of Loktak Lake, selected villages and sampled households as no other researcher has conducted surveyed and written comprehensive environmental and economic assessment although there are primary sources on Manipur and Loktak lake. In order to assess the causes leading to stress and the resultant impacts on land, environment and livelihood conditions of the people, data was collected through personal questionnaire interviews. The survey was conducted during the year 2007-08. For getting accurate information, the lake and villages were visited frequently. Secondary sources of data have been collected from various Govt. offices, private institutions etc.

1. Booklets, Official records, documents of Fishery Department, Manipur
2. Various Journals, magazines, papers, data of Loktak Development Authority, Imphal, Manipur.
3. Manipur Remote Sensing Application Centre, Imphal (MRSAC).
4. Libraries of Manipur University, Manipur; Jawaharlal Nehru University, New Delhi; Delhi University, Delhi; ICSSR, New Delhi and Maulana Azad Library, A.M.U., Aligarh.

The following methods were used,

1. To map the structure of Loktak Lake and its flood prone area - Two satellite data sets were used i.e. IRS-1D LISS III Jan., 2002 and IRS LISS III MSS data of data of 2004. Digital classification technique was used on these data sets for preparation of land use/land cover map to know the structure of Loktak lake from 2002 and 2004. NRSA (1995) classification scheme level 1 was adopted for making six major land use classes i.e. (i) hillocks with scrub or without scrub (ii) dry area with or without vegetation (iii) other vegetation (iv) waterlogged area (v) *phumdis* (vi) open water area. The area of interest (AOI) was subset from the entire scene from both satellite data. The satellite data were enhanced before classification using histogram equalization for the better interpretation and to achieve good classification accuracy. The images were geo-referenced with the help of survey of India top sheets at a scale of 1: 50,000 using Universal Traverse Mercator (UTM) projection/coordinate system, zone 44. IRS 1D satellite data was re-sampled to 6 m spatial resolution using nearest neighborhood re-sampling technique in Erdas Imagine software to make it comparable to IRS 1D data which has 6 m cell size. The supervised classification was performed using maximum likelihood algorithm (MLC) on the two satellite data sets of 2002 and 2004. The classified data was recoded to remove the spectral mixing and it was validated using Google Earth image for about 35 locations covering whole study area, where there were doubts about the classification. Then, finally the structure map of Loktak lake was mapped in the Arc GIS 9 version and also flood prone areas of Loktak lake was also mapped.

2. A questionnaire was developed with the help of questionnaires used in similar studies (Maltby, E., 1986; Bahar-ud-din, S.M., 2005, Moirangleima, Kh., 2010), consultation of other relevant literatures, discussion with Govt. officials, NGOS, local peoples etc for gathering information regarding the causes of stress on the lake and the resultant impacts.
3. For in-depth investigation, ten villages (fig. 1) namely, Phubala, Thinungei, Ningthoukhong, Ithing, Sendra, Moirang, Thanga, Nongmaikhong, Laphupat and Komlakhong were selected on the basis of their location and dependency. From every selected village, 15 per cent of the households were randomly sampled. The head of the family (either male or female) were taken as respondents. The total sample consisted of 500 households from the 10 selected villages.

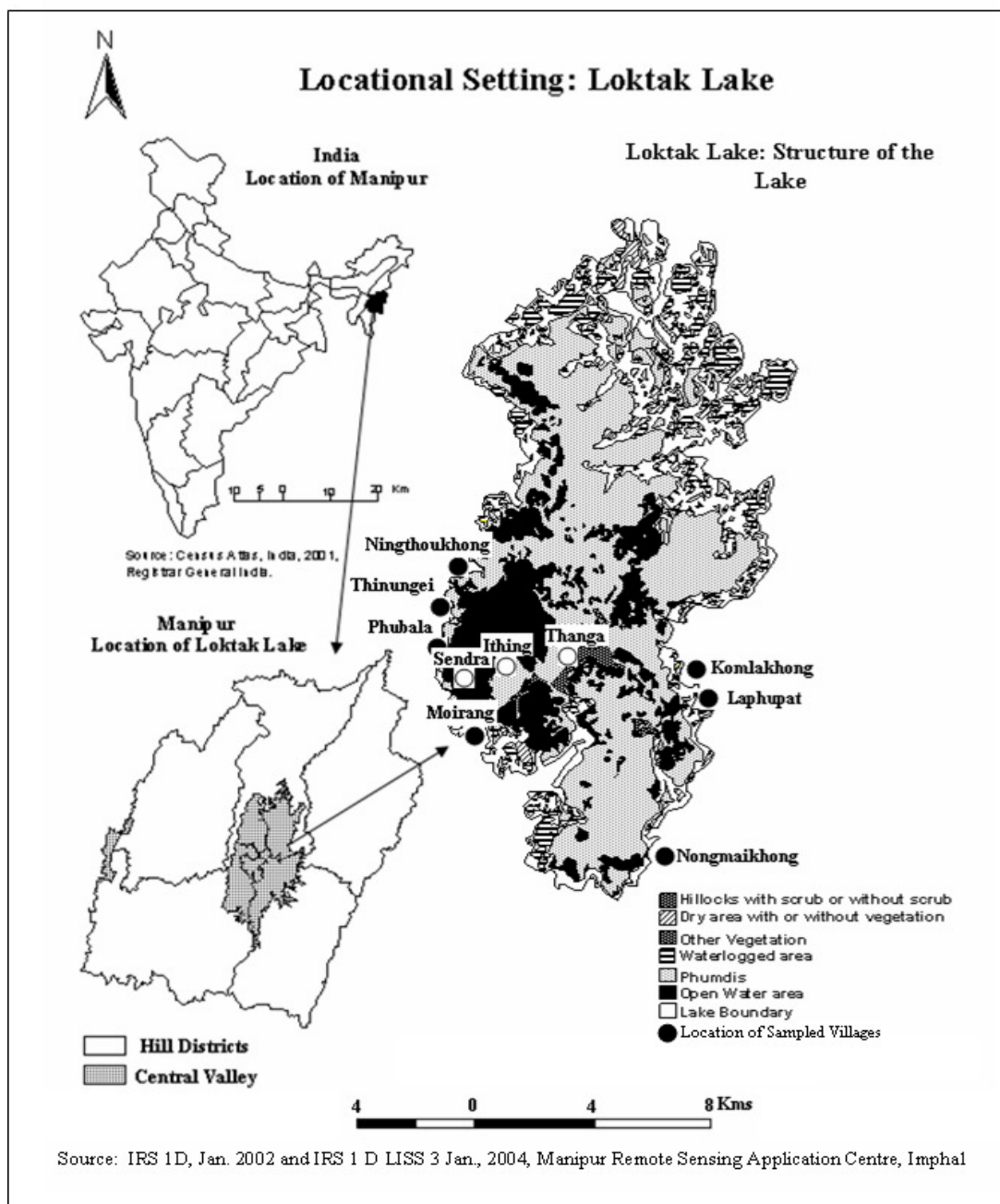


Figure 1

RESULTS

1. Causes for the Stress on the Loktak Lake

Field surveys have revealed that the lake is under severe stress due to both natural and anthropogenic factors (Singh, A.L. and Moirangleima, Kh. 2009). Here we will be discussing the important causes,

(i) Construction of Ithai Barrage Dam

The Ithai Barrage Dam (1979) was constructed on the Imphal River as part of the National Loktak Multipurpose Hydroelectric Project (1983) for the purpose of irrigation and power generation. It was installed to generate 105 megawatt of power; irrigate 24,000 hectares of land; earn Rs. 20-30 cores (1\$ = Rs. 50/-) as state revenue and enhance economic development. But the planners did not take into account the complex drainage pattern and the fragile ecosystem. They realized that the lake did not have depth to generate power. As a result, they had to commission the Ithai Barrage further down the Imphal river. The high level of water in the lake is flooding the surrounding area. It inundated agricultural land more than twice the area it proposed to irrigate, uprooted and deprived about 10,000 people of their livelihood. The construction of the plant has threatened the fragile ecosystem which sustains more than 1 million people. Since its inception, about 20 aquatic species have disappeared, the populations of migratory birds and waterfowls have dwindled and the only habitat (*phumdis*) of the *sangai* (Indian dancing deer) is on the verge of destruction. The water level in the Loktak lake is rapidly declining due to curbs on the inflow which has been caused by the Ithai Barrage due to this fishes are hard to come and this has made nearly 25,000 fisher folk jobless. Now their nemesis has come in the form of Loktak Hydro Electric Project. The Loktak lake will be soon on the verge of extinction by the barrage.

(ii) Weed Infestation

Phumdis is a unique feature of the Loktak Lake. The *phumdi* is no ordinary swamp, it consists of thick mat of soil, humus and dead vegetation in different stages of decay, upon which reeds and grasses grow up to a height of 5 metres. The thickness of the mat varies from a few centimeters to about three meters. It is porous and spongy bio – mass capable of floating due to buoyancy. The *phumdis* house a large number of aquatic, semi – aquatic and terrestrial flora and fauna. But, more than this there is a unique phenomenon associated with the *phumdis* which makes the *sangai* habitat unparalleled in the world. These *phumdis* are threatened by the power project in Loktak lake. In the dry December to February months, the *phumdis* sink to the floor of the lake, and gather nutrients from there. After the rains, they resurface again. With the construction of the barrage, the high level of water in the lake is flooding the surrounding area. As a result, the rise and fall of the *phumdis* has been adversely affected. They no longer sink and are deprived of nutrients so they are dying. The considerable increase in practice of *athaphum* (making of artificial floating mats) and fishing has also led to increase of *phumdi* area. Now, it covers about 134.6 sq. km (47 per cent of the surface area of the lake). The overall area of *phumdis* in the lake has increased from 116.4 sq. km to 134.6 sq. km during 1989 – 2002 (Singh, A.L. and Moirangleima, Kh., 2009a). Construction of the Ithai barrage Dam brought an increase in the practice of *athaphum* fishing and culture of *phums*. The proliferation of *phumdis* and aquatic weeds has led to reduced water holding capacity, deterioration of water quality and interference in navigation and fishing. With the increase of *phumdi* area and aquaculture in the Loktak Lake, the open water area has ultimately decreased. In 1989, the open water area of Loktak Lake was 84.6 sq.km. But it has decreased to 43.9 sq.km. In 2002 (Singh, A.L. and Moirangleima, Kh. 2009 b)

(iii) Encroachments

The Loktak lake is on the verge of extinction due to encroachment on the peripheral areas of the lake mainly for the purpose of expansion of agricultural fields, human settlements, construction of roads, pisciculture/aquaculture etc. While, inside the lake it is due to the practice of *athaphum* fishing which involves two set of activities – *phum thaba* (the construction of circular *phumdi* enclosures) and *phum namba* (the harvesting phase). As the income from *athaphum* operation is significantly higher than any other forms of traditional fishing, there has been a rampant increase in their numbers. As per remote sensing data the number of *athaphums* in Loktak lake has increased from 217 (92 hectares) in 1989 to 2,286 (967 hectares) in 1999 and 2,642 (1,118 hectares) in 2002 (Sustainable Development and Water Resources Management of Loktak Lake, 2003). Field surveys revealed that about 8 per cent of the lake dwellers were engaged in *athaphum* fishing. Large areas of the lake have been converted for aquaculture leading to problems of salinization eutrophication and decrease in bio-diversity. Fish ponds have been created by making of bunds. The addition of fish feeds, manures and antibiotics have resulted in the formation of

algal blooms and drastic reduction in oxygen concentration. Aquaculture activities are mushrooming in Loktak lake mainly due to non availability of land for practicing agriculture and demand of fish in the local market.

(iv) Pollution

Uncontrolled use of toxic chemicals, insecticides and pesticides in the catchment areas of the lake and discharge of effluents, sewage, garbage etc. in the lakes and its feeder streams are the major contributors polluting the water and endangering the aquatic life of the lake. The high amount of mineral nutrients and organic matter accelerates the growth of *phumdis*. A large population of 0.28 million people living within Nambol catchment daily generates 72.23 million tonnes of solid waste and 31,207 cum. of sewage. Nambol also contributes 4.9 million tones of solid waste and 2,121 cum. of sewage annually (WISA and LDA, 2004). The chemical fertilizers used in the agricultural fields in the catchment area of the lake also pollute the lake water. Tourists also contribute in polluting the lake by throwing garbage in the lake. Among the debris floating on the water, plastics and a variety of refuse can be identified. All the wastes directly or indirectly find their way into the Loktak lake. The physico-chemical parameters of the lake indicated that this lake is eutrophic and polluted lake.

(v) Overexploitation of Lake Resources

Field surveys revealed that the people living around the Loktak Lake (about 86 per cent of the sampled households) are totally depend on them for their livelihood. They are mainly engaged in fishing as well as harvesting of lake vegetation for the use as food, fodder, vegetables and fuel. As majority of the lake dwellers are uneducated and have poor livelihood, they are compelled to use the lake resources which is their easiest and quickest means of earning livelihood. With the increasing population and lack of unemployment, there is overexploitation of lake resources by indiscriminate methods of fishing which resulted in decrease of fisheries production. Traditionally, it was an accepted norm among the *ngami* (fishermen) that the fingerlings would not be caught, but today nobody cares for the *pat* (lake), they caught whatever found. Very little modernization has taken place in traditional fishing crafts of the fishermen. There are about 4,080 crafts used for fishing and navigational purposes in the lake. Several types of fishing gears are also used in the lake including gill nets (mesh sizes ranging from 15 – 140 mm), multi – pronged spear, dip nets, lift nets, cast nets, scoop nets, hooks and gorges, traps, drive in nets etc. Among the fishing gears, gill nets are most efficient. There are about 50,400 *ngami* (fishermen) living in and around Loktak lake of which, 80 percent are from lakeshore villages, 16 percent are from island villages and 4 percent from *phum* villages. They entirely depended on fishing for their livelihood.

(vi) Siltation

Deposition of silt has been another major problem. Severe soil erosion in the catchment areas due to *jhumming* (shifting cultivation), deforestation, landslides and construction of roads in the hilly areas contribute to soil loss. The rivers and streams (Imphal, Iril, Thoubal, Nambol, Nambul, Sekmai, Khuga etc.) which fall into the lake add heavy amount of sediments from catchment areas thereby causing high rate of siltation and shallowing of the lake in an accelerated rate. It is estimated that the annual average sediment input into the Loktak lake is 650,000 metric tonnes. The rivers from the western hills account for 65 per cent of the total sediment input into the lake and the rest 35 per cent is from the link channels (WISA and LDA, 2004). Thus, making Loktak Lake shallow continually

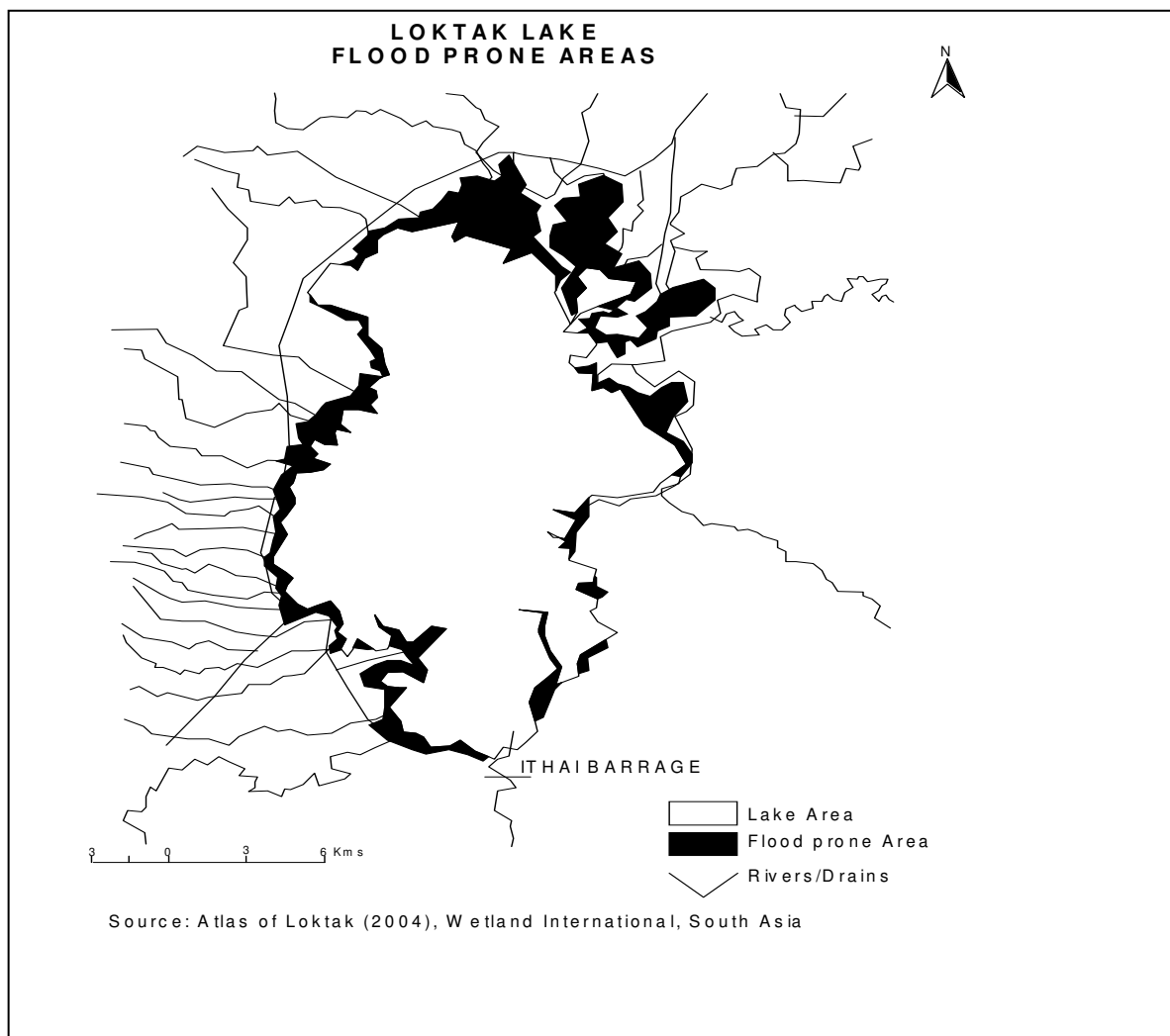
2. Resultant Impacts on the surrounding land and biodiversity

The Loktak lake will soon be on the verge of extinction mainly by human interventions by the construction of Ithai Barrage dam, weed infestation, encroachment, pollution, overexploitation of lake resources and siltation. All this has degraded the land and threatened the biodiversity. Field surveys have revealed some of the key impacts which have been discussed here,

(i) Flooding of Agricultural Fields and Villages

For the maintenance of constant water level in the Loktak lake, the Ithai Barrage was constructed and this has flooded the agricultural land and villages around the Loktak lake, which were previously utilized for cultivation. Figure 2 is showing the flood prone areas in the periphery of the Loktak lake. It was reported by the villagers at the time of survey that about 41 villages around the Loktak lake are often got flooded during every rainy season i.e. 11 in the northern zone (Nambol, Isok, Waheng Khuman, Top Upokpi, Irom Meijrao, Samushang, Shantipur, Wangoi, Mayang

Imphal, Yumnam Khunou and Keinou), 12 in the western zone (Toubul, Khoijuman, Kwasiphai, Potsangbam, Nachou, Toupokpi, Upokpi, Ningthoukhong, Thinungei, Phubala, Sinusiphai and Thamnapokpi), 11 in the southern zone (Moirang, Moirang Khunou, Keibul, Keirenphabi, Thanga Lawai, Kumbi, Wapokpi, Ithai Khunou, Nongmaikhong, Laphupat Tera and Khordak) and 6 in the eastern zone (Uchiwa, Hayel, Hangul, Thongam, Phoubakchao and Komlakhong).



It was also reported that about 80,000 hectares of agricultural areas lying beyond the Ithai Barrage on the other side of Loktak lake flooded with the water from the Chakpi river due to the blockage of the counter current by the Ithai Barrage. Most importantly with the construction of the Barrage the high level of the water in the lake is flooding the surrounding areas. About 80,000 hectares of agricultural lands have been submerged. So, the land owners have become daily wage earners. It has uprooted and deprived about 10,000 people of their livelihood (WISA & LDA, 2004). Hence, this has greatly affected the practice of agriculture in the surrounding areas of Loktak lake.

(ii) Decrease in Fisheries Production –

Overexploitation with increasing human pressure, indiscriminate use of fishing techniques, extensive growth of *phumdis* and weeds are the factors responsible for decrease in fisheries production in the lake. More than 75 per cent of the state's population consumes fish; about 60 per cent of the state's fish demand is met by the Loktak Lake. The production of fish in Loktak lake has declined at an annual rate of 2.72 per cent during 1991 – 2001 (1,790 Mt in

1991 to 1,358 MT in 2001) (WISA and LDA, 2003). Loktak lake previously served as breeding and spawning grounds for *Osteobrama belangiri* (*pengba*) and some other migratory fishes. Fishes from Chindwin – Irrawady system constituted around 40 per cent of capture fisheries of the lake. However, the population of river fishes in Loktak Lake has drastically reduced and species recorded earlier like, *Labeo bata* (*Ngaton*), *labeo angra* (*Khabak*), *Osteobrama belangiri* (*pengba*) etc have disappeared from the Loktak Lake due to blockage of their migratory route by the Ithai Barrage Dam. Moreover, natural recruitment of Indian major carps has also stopped due to absence of flow in lake water.

(iii) Loss of Biodiversity

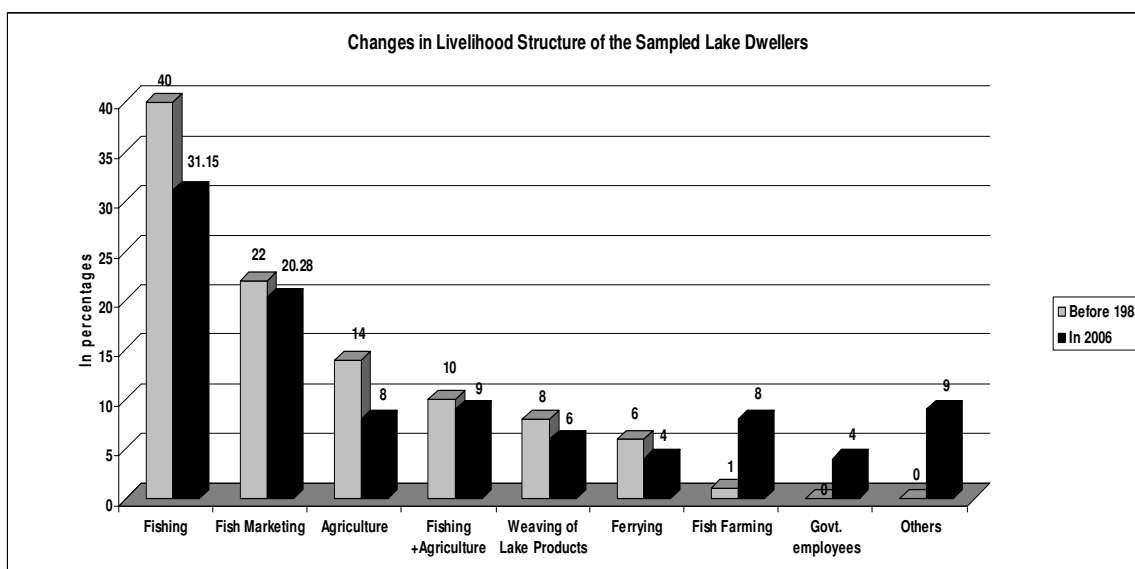
The increase in the water level of Loktak lake due to Ithai Barrage has caused a great damage to the production of aquatic food plants (of commercial importance). For instance the production of 23 aquatic food plants like, *heikak*, *thangjing*, *tharo*, *thamabal*, *loklei* and *pullei* etc. have been significantly reduced due to the failure in the germination and extension of their roots to the bottom soil of the lake. Besides this, a number of plants of commercial importance like *tou*, *singnut*, *imom*, *charot* etc have also disappeared or greatly reduced due to the increase in the water level of the lake which caused a heavy loss in the state's economy. The construction of the Loktak Hydro-Electric Project has threatened the fragile ecosystem. The disappearance of 20 aquatic species has been reported since the inception of the project. The populations of migratory birds and resident waterfowl's population have dwindled (Down to Earth, Sept. 15, 1999). Of the faunal species of Loktak lake, 34 species (11 fishes, 9 reptiles, 5 mammals, 3 amphibians, 3 birds, 2 molluscs and 1 annelid) which reported to be abundant in the past, have declined and are now gradually disappearing. The maintenance of constant water in the Loktak lake, has affected the ecology and existence of the *sangai* which plays an important role in nutrient cycle of the vegetation.

3. Impacts on the Livelihood of the Lake Dwellers

Field surveys revealed that, due to the stress on the Loktak lake, the important resultant impacts on land and biodiversity were the flooding of agricultural fields and villages, decrease in fisheries production and loss of biodiversity. This has affected the livelihood of the lake dwellers. In-depth investigations of the selected villages and sampled households revealed some of the key impacts on livelihoods which have been discussed here,

(i) Changes in Livelihood structure –

There has been considerable change in the livelihood structure of the lake dwellers due to flooding of agricultural lands, decrease in open water area of the lake i.e. nearly 51 per cent has been lost from 1989 to 2002 (Singh, A.L. and Moirangleima, Kh., 2009 b), decrease in fisheries production, loss of biodiversity. Figure 3 is showing the changes in the livelihood structure of the sampled lake dwellers before 1983 and in 2006 taken from the 500 respondents. A perusal of this figure shows that the lake dwellers in 1983, they were mostly involved in fishing (40 per cent), fish marketing (22 per cent), agriculture (14 per cent), fishing and agriculture (10 per cent), weaving of lake resources (8 per cent), ferrying (6 per cent) and few were involved in fish farming (1 per cent). They were not involved in govt. occupations and other activities (like carpenters, shopkeepers, drivers etc.). But after a lapse of 23 years i.e. from 1983 and in 2006, change in their livelihood structure was observed, i.e. in fishing (from 40 per cent to 31 per cent), fish marketing (from 22 per cent to 20 per cent), agriculture (from 14 per cent to 8 per cent), fishing and agriculture (from 10 per cent to 9 per cent), weaving of lake products (from 8 per cent to 6 per cent) and ferrying (from 6 per cent to 4 per cent). Lake dwellers have shifted to other economic activities which was not directly related with the lake resources i.e. making of artificial fish farms (from 1 per cent in 1983 to 8 per cent in 2006), govt. employment (nil in 1983 to 4 per cent in 2006) and other economic activities (nil in 1983 to 9 per cent in 2006). This shows a shift from being dependent on lake resources to other economic activities. Although the shift is marginal but it is observable.

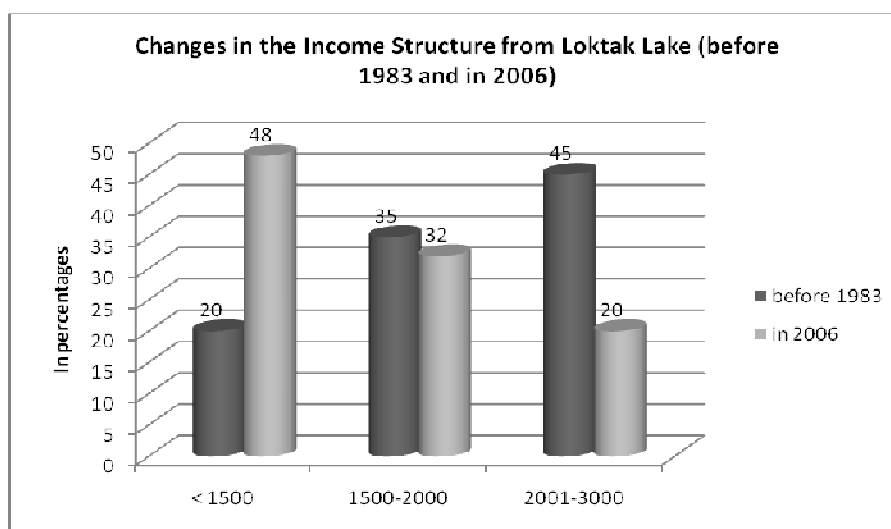


Source: Based on field survey, 2007-08.

Fig. 3

(ii) Changes in Income Structure

It is difficult to establish an income differential by taking into account the inflation over time past to the present. Nevertheless, the average income before commissioning of the Ithai Barrage (1983) to the present (2006) income status reveals that the earning capacity from the Loktak lake has reduced to a significant extent. Fig. 4 is showing the changes in the income structure from the Loktak Lake (before 1983 and in 2006). A perusal of this table shows that before 1983 about 35 per cent respondents used to earn about Rs. 2,001- Rs.3,000 per month, 45 per cent earned Rs 1,500 – Rs 2,000 and about 20 per cent earned < Rs 1,500 only from the lake resources by engaging in fishing, fish marketing, agricultural activities near the periphery of the lake, fish farming etc. But in 2006 the income coming from the lake had decreased as only 20 per cent got about Rs. 2,001- Rs.3,000 per month, 32 per cent earned Rs 1,500 – Rs 2,000 and about 48 per cent earned < Rs 1500.



Source: Based on field survey, 2007-08

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Fig. 4

(iii) Unemployment problems

High incidence of floods, especially in the eastern and southern periphery of the Loktak lake has led to the damage of agricultural crops and decline in the overall yield and decrease in open water area of the lake has caused loss of the livelihoods. It was reported that inundated cultivable land and decrease in open water area of lake uprooted and deprived about 25,000 lake dwellers of their livelihood (Trisal C.L. & Manihar Th., 2002). Field surveys revealed that about 60 per cent of the lake dwellers were farmers but only 30 per cent are engaged in agriculture. Apart from the failure in agriculture, cattle rearing were also not possible since there is no grazing ground for the animals.

(iv) Health Problems

The contamination of water due to increasing population and direct discharge of human wastes, untreated sewage and garbage in the lake and absence of adequate sanitation facilities in the peripheral settlements has led to severe health hazards. At present around 5,000 households depend on Loktak lake water for domestic use. Safe drinking water facilities are available to only 51 per cent of the lake communities (WISA & LDA, 2004). Field surveys also revealed that about 54 per cent of the sampled households around the Loktak lake depend on the lake water for drinking and domestic uses. This led to frequent incidence of diseases like gastroenteritis, hepatitis, measles, diarrhea, jaundice, typhoid, cholera and cold fever within these communities. Fishers, especially womenfolk, who spend considerable amount of time in the lake water, complained of being affected by skin infections and also reported of muscle pain and back problems due to pulling of heavy nets for fishing. The reduction in fish productivity has meant that now they need to spend more time in checking the available resources for their survival but less attention is paid to health and family needs.

CONCLUSION

This study points towards the fact that Loktak Lake will be soon on the verge of extinction mainly due to human interventions and this has severely affected the livelihood of the lake dwellers. The important causes for the stress on the lake emerged to be the construction of Ithai Barrage Dam, weed infestation, encroachment, pollution, over exploitation of lake resources and siltation. The resultant impact of this was flooding of agricultural lands and villages, decrease in fish production, loss of biodiversity etc. The lake dwellers, either living on the lakeshore or on the islands or on the *phum* totally depend for their livelihood on this lake. They were involved in fishing, fish marketing, agriculture, fishing and agriculture, weaving, ferrying etc. But as a result of submergence of agricultural lands, decrease in open water area and lowering of water level, decrease in fish production ecological imbalances, a sea change in the livelihood pattern of the lake dwellers was observed. The lake dwellers who were mostly involved in fishing, fish marketing, agriculture, fishing and agriculture, weaving, ferrying etc are now also involved in other economic activities (as carpenters, shopkeepers, drivers etc.), fish farming and govt. occupations. Loktak has a unique ecology, which sustains more than 1 million people. But with the Ithai Barrage being constructed, the lake will be left without water thus, not only affecting the lake dwellers but also the whole bio-diversity. Therefore, it is essential that we preserve and conserve these resources before it is too late. Following measures have been suggested,

- Opening of Ithai Barrage Dam - with the onset of monsoon, the water level in the lake rises and the direction of the water flow is from Loktak lake to the Manipur/Imphal River enabling automatic flushing of the *phumdis*. So, the gates of the Ithai Barrage Dam should be opened especially during initial period of rainy season to flush out *phumdis*, nutrients and silt rich water from the lake.
- Prohibition of *athaphum* fishing - due to the increase in *athaphum* (artificial making of *phumdis* for fishing) fishing number of *phumdis* spread at a fast rate so this has to be strictly prohibited.
- Removal of *phumdis* by mechanical and manual means - it involves pulling of the *phumdis* near the lakeshore either manually or mechanically and them removed by Hydraulic Excavators and dumped in the lakeshore areas. The *phumdis* (including *athaphums*) could be flushed out of the lake by cutting into small pieces through Khordak channel into the Manipur/Imphal River, manually, involving the local communities.

The best way to protect the wetlands is by legislation as well as by making people aware of what they stand to lose if these ecosystems perish. Education and awareness campaigns to conserve these fragile environments are vital. It is time that policymakers woke up to the irreparable destruction taking place. All this requires comprehensive surveys of wetland areas, identification of biodiversity, promoting scientific cultivation of plants and fishes, introduction of new species introduction of co-operatives, assisting fisher folk and marketing support and promoting other avenues of employment.

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