

Shrinking Water Area in the Wetlands of the Central Valley of Manipur

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Abstract: A key to future sustenance of human societies lies in the sustainable management and wise use of wetlands. Human lives are invariably intertwined with these ecosystems. More than three quarters of the food required for mankind is still being derived directly from wetlands in the form of rice and fish alone. But they are threatened both from natural and from anthropogenic forces. These wetlands have been altered for other usages. In this paper, an attempt has been made to examine the open water area in the two bigger lakes i.e. Loktak and Pumlun of the Central Valley of Manipur. The study is based on remotely sensed data of 1989, 1999 and 2002. To understand the different uses of the lake by the local people, village and household surveys were conducted. The total sample size consisted of 10 villages and 401 households. The results showed that the open water area in both the lakes have shrunk, from 1989 to 2002 almost 50 per cent. It was the human pressure that has affected the open water area of the lakes.

Keywords: Lakes, shrinking, encroachment, over exploitation, fishing, fish farming.

INTRODUCTION

Wetlands represent the interface between land and water' (Dugan, P.J., 1990) [1]. They are not only a vital link between land and water but are the most important and productive ecosystems on the earth. They have great significance in terms of ecological, economical and social benefits. Economically, wetlands provide a wide range of valuable products (food, fisheries, fodder etc.), socially a large number of people sustain their livelihood by making use of them and ecologically they sustain a wide variety of life forms – migratory birds, mammals, fish, amphibians, reptiles and many plant species. A key to future sustenance of human societies lies in the wise use and sustainable management of these highly fertile ecosystems.

Wetlands cover about 6 per cent of earth's land surface (Bazilevich, N.L., *et al.* 1971) [2] and are distributed in all climatic zones of the earth except Antarctica. In India wetlands are distributed in different geographical regions ranging from cold arid zone of Ladakh to wet Imphal, from the warm and arid zone of Gujarat – Rajasthan to the tropical monsoon based regions of Central India and the wet and humid regions of southern peninsula (Parikh, J., Datye, H., 2003) [3]. According to MOEF (Ministry of Environment and Forest, 1990) [4] wetlands occupy 4.1 million hectares, of which 1.5 million hectares are natural and 2.6 million hectares are man-made.

Wetlands are threatened and are fast disappearing. They are subjected to both natural and human forces. About 50 per cent of the world's wetlands have been lost in the last century, primarily through drainage for intense agriculture, overgrazing, over fishing, excess hunting, urban develop-

ment and water system regulation. It has been reported that 90 per cent of the wetlands in New Zealand, 80 per cent each in U.K. and in West France, 70 per cent in Portugal and 54 per cent in USA have been lost due to excessive use in agricultural and industrial developments (Dugan, P.J., 1993) [5]. Wetlands in India are among the least protected ecosystems and are threatened and fast disappearing. In this paper an attempt has been made to examine the open water area of two bigger lakes i.e. Loktak and Pumlun of the Central Valley of Manipur.

DATA BASE AND METHODOLOGY

The study is based on both primary and secondary sources of data. Primary sources of data were collected through survey of all the wetlands and in-depth survey of Loktak and Pumlun lakes located in the Central Valley of Manipur. To understand the different uses of the lakes, data was collected through questionnaire interviews. The survey was conducted during the years 2005 and 2006 (Moirangleima, Kh. 2007) [6]. For getting accurate information the lakes were visited frequently. Secondary sources of data have been collected from various government offices, private institutions and Manipur Remote Sensing Centre, Imphal.

The following methods were used in the study,

1. Mapping of the wetlands was done with the help of field surveys; toposheets number 83 H/14 and 83 L/2, 1970; and satellite imageries of IRS 1 D, Feb. 1989, Feb. 2002; IRS 1B L2, March 1999; and IRS L2 LISS 3, Feb. 1999.
2. A questionnaire was prepared for collecting the data. It was prepared with the help of questionnaires used in similar studies (Donald, M.K., 2000 [7]; Ishwarjit, E., 2005 [8], Bahar-ud-din, M., 2005 [9]) and other relevant literatures, discussions with govt. officials, NGOs, local people etc. The first part was focused on general observations of the selected villages and households and the

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sampled respondents seeking information about their age, religion/caste, educational status, size of family etc. The second part sought information on their livelihood pattern, occupational status, source of income, income status etc.

3. For the purpose of selecting the sample, multistage stratified sampling procedure was adopted. It consisted of four steps.

- All the nine wetlands lying in the Central valley of Manipur were sampled, Loktak the largest, Pumlén, the second largest and the seven smaller lakes, namely, Ikoppat/Kharungpat, Waithoupat, Utrapat, Poiroupat, Sanapat, Loushipat and Ushoipokpipat. Since, all the smaller lakes are very old, eutrophic, seasonal and marshy land areas which are flooded only during the rainy season and during rest of the year they dry up, they were not selected for assessing the changes in the open water area. Only the two bigger lakes Loktak and Pumlén were selected.
- Villages lying around these lakes were selected on the basis of their location and dependency (fishing, agriculture, vegetables, domestic uses etc.) on the lakes. The total sample size consisted of 10 villages i.e. 8 villages (Phubala, Ningthoukhong, Ithing, Sendra, Thanga, Nongmaikhong, Laphupat and Komlakhong) located around the Loktak lake and 2 villages (Tokpa Cheeng and Khoidum) located around the Pumlén lake were selected for sampling.
- From every selected village, nearly 10 per cent of the total numbers of households were randomly sampled. The total sample size consisted of 9 lakes, 10 villages and 401 households.
- From the selected households the head (male or female) were selected as respondents.

4. In order to find the changes in the open water area of the two bigger wetlands Loktak and Pumlén, satellite images of two periods were used. For mapping the changes in the open water area of Loktak lake, landsat imagery of Feb. 1999 and Feb. 2002 and for Pumlén lake landsat imagery of Feb. 1989 and Feb. 1999 (based on availability) were used. The imageries were registered and re-sampled to make them uniform and enable comparison. Then through visual interpretation the boundaries of the lakes were drawn over different periods. The visual interpretation has resulted in the approximation of the lake areas. The lake boundaries of different periods were overlaid to determine the changing lake surface area over these periods. Since false colour composites were placed in the imageries for visual interpretation the open water area has been depicted in black, area under different types of vegetation and *phumdis* (a thick floating masses of rotting aquatic plants and animals) have been depicted by different shades of grey (deep grey, light grey, very light grey).

STUDY AREA

Manipur is an isolated hill grit state lying in the extreme north-eastern corner of India along the Indo-Myanmar border. The total geographical area of the state is 22,327 sq. km

and the total population is 2,388,634 (Census of India, 2001) [10]. The state could be divided into 2 parts, the hilly region (5 districts) and the valley region (4 districts). About 90 per cent of the state is mountainous and the rest is shared by lacustrine plains of the Central Valley.

The study area comprises of the wetlands located in the Central or Imphal valley of Manipur (93°42' to 94°11' E and 24°41' to 25°06' N). It is an intermontane basin about 70 km long (north to south) and 30-35 km wide (east to west), oval shaped with irregular outline enclosed by hills. The valley is high flood plain with an elevation of about 760 m above mean sea level. Major physiographic features of the valley are the numerous streams and rivers arising from the hills on all sides and many shallow wetlands and marshes in the interfluvial areas. The important perennial rivers flowing in the Central Valley is the Imphal river and its tributaries (Iril, Thoubal, Khuga, Sekmai, Chakpi etc.). Other small rivers (Nambol, Nambol, Kongba, Merakhong etc.) dry up during the lean period.

The lacustrine plains of the Central Valley was site of an ancient lake which was subsequently filled up and uplifted to its present position, the remnant of which is the Loktak lake which occupies the south-east corner of the valley is the Loktak lake (Singh, R.P., 1982) [11]. A number of lakes are located on both sides of the Imphal river. Loktak is the largest and is located on the right side of the Imphal river while on the left side lies the Ikoppat/Kharungpat, Waithoupat, Khoidumpat, Lamjaopat and Pumlénpat. During the rainy season (May to August) most of these lakes become contiguous and merge under a large sheet of water but during the dry season they can be distinguished separately. All the smaller lakes Ikoppat/Kharungpat, Waithoupat, Utrapat, Poiroupat, Sanapat, Loushipat and Ushoipokpipat are very old eutrophic and seasonal marshy land areas.

DISCUSSION

Of the total geographical area of Manipur, wetlands cover nearly 2.5 per cent. There are about 155 wetlands of which, 153 (nearly 99 per cent) are located in the Central Valley while 2 are located in the hill districts. Of the total wetlands located in the Central Valley (153), 21 are lakes spread over 43,358 hectares (82.03 per cent), 130 water-logged areas spread over 9,466 hectares (17.91 per cent) and 2 are cut off meanders/oxbow lakes covering an area of 35 hectares (0.07 per cent) (Manipur Remote Sensing Application Centre, 2005) [12]. This shows that area under lakes is much higher than area under any other type of wetland.

Lakes are locally known as '*pats*' and they play a significant role in the socio-economic and cultural life of the people. Field surveys revealed that there were 9 lakes. Loktak, the largest freshwater wetland, Pumlén, the second largest and seven smaller lakes namely, Ikoppat/ Kharungpat, Waithoupat, Utrapat, Poiroupat, Sanapat, Loushipat and Ushoipokpipat. But for analyzing the changes in open water area only the two prominent lakes Loktak and Pumlén could be considered. These two lakes cover nearly 32,694 hectares (75 per cent) of the area under wetlands in the Central Valley. All the smaller lakes are old, eutrophic, marshy and seasonal i.e. they remain flooded only during the rainy season

and rest of the year they dry up and the land is used for agricultural purposes.

BACKGROUND

Loktak Lake

Loktak lake is situated about 38 km south of Imphal city. The lake is oval in shape with its long axis running north to south. It has no definite shoreline and its extent and depth varies with season. The lake covers an area of 288 sq. km and has an average height of 800 – 2,070 m above mean sea level. The direct catchment area of the lake is 1,040 sq. km which is under settlement (45 per cent), agriculture (35 per cent) and forest (15 per cent). The indirect catchment area is 7,157 sq. km. It includes the catchment of five important rivers viz. Imphal, Iril, Thoubal, Sekmai and Khuga. The southern part of the lake has 14 hills of varying sizes and elevation appearing as islands. The most prominent among them are Sendra, Ithing and Thanga. These islands cover 17.2 sq. km of the surface area of the lake (Tombi, H.S. and Shyamananda, R.K., 1994) [13].

The characteristic feature of the Loktak lake is the presence of floating islands covered with vegetation, locally known as *phumdis*. These floating islands, occurring in all sizes and thickness are heterogeneous mass of soil, vegetation and organic matter at various stages of decomposition. They float on lake water with about one-fifth thickness above and four - fifth under the water surface. Generally their thickness varies. The maximum thickness is 8 ft. (Trisal, C.L. and Manihar, T., 2002) [14]. The *phumdis* cover an area of 206.51 sq. km.

Loktak lake comprises of 63 smaller lakes and beels. Until eighties the area used to experience large water level changes. This resulted in the separation of several lakes during the low water phase and merging of the lakes into one at the time of high floods. But with the commissioning of the Ithai Barrage (on the Imphal river in 1983) the lake remains permanently flooded with relatively small water level changes regulated by the withdrawal of water by the Loktak Hydel Project.

The water regime of the Loktak lake is determined by the inflow from various streams and channels (Nambul, Nambol, Nongthoukhong, Khujairok, Thongjaorok, Potsangbam, Moirang, Naga, Sekmai etc.) and direct precipitation in the lake. The total water inflow into the lake is 1,687mcum (streams contribute 52 per cent, direct precipitation 25 per cent and the link channels contribute 23 per cent), while 1,217 cum flows out (69 per cent by the National Hydro Power Co-operation, 14 per cent through link channels, 10 per cent through evapotranspiration and 7 per cent through evaporation). The lake is rich in nutrients due to sedimentation carried down from the rivers. The lake with its numerous floating mats covers a variety of habitats, which sustains rich biological diversity. Vegetation plays an important role in the ecological processes and functions of lake ecosystem being of great economical and cultural significance to the people.

Field surveys revealed that the density of population was very high around the lakes because people depend on the lake. More than 85 per cent of the communities living

around the lake in permanent and temporary houses and in floating huts depend on the lake. The lake water is used for drinking and domestic purposes, irrigation, generation of hydro-electricity power, bio-diversity, recreation etc. Most of the communities were involved in fishing, fish marketing, fish farming, agriculture and ferrying, weaving products of the lake etc.

Pumlen Lake

Pumlen, the second largest freshwater lake is situated about 40 kms from Imphal city. It is situated towards the southern lowlands of the Central Valley. The total area of the main Pumlen lake is 32.26 sq. km and it lies at an elevation of 765.5 m above mean sea level. The direct catchment area of the lake is 127.75 sq.km and includes the total area of the inlets that run off their water into the lake basin. It consists of agricultural lands (52 per cent), marshy lands (20 per cent), rural areas (15 per cent) and forested hill ranges (13 per cent). The indirect catchment area covers about 33.45 sq.km. (Jaichandra, M.S.,1998) [15].

The Pumlen *pat* is a conjoined lake formed by Khoidumpat in the north, Lamjaopat in the north-east and Pumlen main basin in the south. The deep water area lies in the main basin, whereas, Khoidumpat and Lamjaopat are the marshy areas. During the rainy season all these merge into a single water body. It is associated with 26 different lakes from all sides. All these sub-basins are separated from each other during the dry season and are used as low lying paddy fields. But after the commissioning of the Ithai Barrage it became a permanent flooded lake. Most of the peripheral agricultural areas are merged with the lake which is used for fish culture.

Pumlen lake receives water from precipitation, surface run-off from the south-eastern denuded hills and from the northern agricultural fields. Indirectly from Sekmai river through Khoidumpat on the northern side and from the impounded Imphal river which runs along the western shoreline. There are 25 feeder streams which flows directly and indirectly into the Pumlen lake.

Pumlen lake also plays an important role in the socio-economic life of the people. Field surveys have revealed that more than 87 per cent of the communities living in the nearby villages and floating huts were dependent on it. The water of the lake was utilized for various purposes. Most of the people were seen involved in fishing, fish marketing, fish farming, ferrying and agriculture.

Shrinking Open Water Area

Remote Sensing data shows that the open water area in Loktak lake in 1989 was 84.6 sq.km but it decreased to 43.9 sq.km in 2002 (Anon, 2003) [16] while, in Pumlen and its conjoined lakes the open water area was 16.05 sq.km in 1989 but it decreased to 7.70 sq.km. in 1999 (IRS 1D, 1999) [17]. Likewise the open water areas in other smaller lakes of the Central Valley have also reduced and some of the lakes have completely dried up.

Mapping over time periods is not adequate as rainfall regimes and usage may differ from year to year. A rainfall regime over a period of 20 years (7,098 mm to 2,400 mm for the Central Valley of Manipur) has not changed so drastically as to reduce the open water area of both the lakes. The

open water area is almost half of what it used to be 10 to 12 years before.

If rainfall is not playing truant then we can safely conclude that it is human pressure that has affected the open water area of these lakes. The high density of population (628 persons per sq.km, Census of India, 2001), high dependency on the lakes (dependency ratio > 80 per cent) has lead to overexploitation of the lake water (for irrigation, domestic purposes, fishing, recreation etc.) and alteration of wetlands to other land uses like for agriculture, pastoral, forestry, settlement and industries, construction of roads and dams etc.

Field surveys and interviews were conducted to understand the use of lake by the local communities. Eight villages (Phubala, Ningthoukhong, Ithing, Sendra, Thanga, Nongmaikhong, Laphupat and Kamlakhong) located around the Loktak lake were selected for in-depth investigation. Data were collected with the help of questionnaire interviews from 377 sampled households. Results showed that 54 per cent of the households were dependent on the lake water for the purpose of drinking and other domestic uses. Most of the households were involved in fishing, fish farms and fish marketing (57 per cent), fishing and agriculture (24 per cent), weaving lake products (6 per cent) and boat ferrying (4 per cent). This shows that > 90 per cent of the households were dependent on the Loktak lake. Two villages (Tokpa Cheeng and Khoidum) located around the Pumlen lake were selected for in-depth investigation. Data were collected from the 234 sampled households. Results showed that 21 per cent of the households were dependent on the lake water for drinking and other uses. Most of the households were involved in fishing, fish marketing, fish farms (52 per cent), both fishing and agriculture (32 per cent) and boat ferrying (4 per cent). This shows that about 88 per cent of the households were dependent on the Pumlen lake. Speaking to the respondents about the shrinking open water area of the lakes showed that they were alarmed at its shrinkage because their livelihood depended on these lakes and was threatened.

Field surveys have revealed the greatest threats to these lakes is from encroachment of the peripheral areas of the lakes mainly due to the expansion of agricultural fields, human settlements, construction of roads, pisciculture/aquaculture etc. most of the smaller lakes have been reduced or have been fully converted into agricultural fields. While, large areas of Loktak and Pumlen lakes have been converted for aquaculture. Fish ponds have been constructed by making of bunds. This has led to the problem in oxygen concentration etc. More than half of the populations living around the lakes are engaged in fishing, fish farming, fish marketing etc. This is mainly due to high rise in population and the demand for fish.

Other threats are from eutrophication (water temperature, turbidity, electrical conductivity, PH, DO, BOD. Free CO₂, inorganic phosphate phosphorous and Nitrate N₂), siltation (Nambul, Nambol, Awang Khujairok, Thongjaorok, Ungamel, Khordak and Potsangbam rivers annually deposit 336,325 tons of silt into the Loktak Lake Manipur, Sekmai rivers and other streams deposit silt into the Pumlen lake), weed infestation (47 per cent in Loktak lake and 58 per cent in Pumlen lake), pollution (bacteria ranged from 12,000/ml

to 58,000/ml and total coliform bacteria 8.8 – 25.6 in Loktak Lake), and construction of Dams (Ithai Barrage Dam was constructed in the downstream of the Manipur river as a part of Loktak Lift Irrigation Project for generating Hydro Electricity by maintaining the water level of the Loktak and Pumlen lake as a reservoir).

CONCLUSION

The open water areas of the two bigger lakes i.e. the Loktak and Pumlen are shrinking while few of the smaller lakes have fully dried up and some are on the verge of extinction. Field studies have shown that this was mainly due to alteration of wetlands to other land uses like for agriculture, settlements, forestry, fish farms, construction of roads etc., overexploitation of lake water for fishing, fish farming, harvesting vegetation etc. and construction of dams. Since these wetlands are of immense value and support thousands of lives they have to be conserved and managed. So what are the remedies?

- A strict zonation may be in place so that encroachment activities are kept at bay.
- Planned construction of a dyke encircling the lakes, dredging of a major portion of the lake bottom, a large number of sluice gates, culverts, bridges and canals etc. should be taken up.
- There should be a strict rule against the settlements inside the lake, establishment of large pen culture farms, dumping of large quantities of floating *phums* and the encircling of the lake by an artificial dyke with boulder rib-rabbling along the shoreline
- Emphasis should be given more on communication, education, public awareness like educating the local communities, organizing consultative meetings with authorities, awareness generation programmes etc.

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