
Strategies for Sustainable Development of Wetland Resources: Lake Ousteri, Puducherry

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Abstract

Sustainable development is development meeting the needs of the present without compromising the ability of future generations to meet their emerging needs. The fact that environmental damage hurts people both today and in the future provides additional grounds for rethinking our measurement of progress. Sustainable development is the process of change in which the exploitation of resources, the directions of investment, the orientation of technological developments, and the institutional change are all in harmony and enhance both current and future potential to meet human needs, wants and aspirations. However, ever increasing, multiple demands on water resources for agriculture, irrigation, domestic and industrial supplies have greatly impacted upon the ecosystems. Yet little attention is paid to the restoration, conservation and sustainability of wetland ecosystems which contribute significantly to the food security and economy of the local community. In Puducherry, well-known wetlands are Ousteri and Bahour. During the year 2008, Ousteri wetland, the largest lake in Puducherry, was declared as a bird sanctuary, home for hundreds of species of migratory birds, variety of fishes, mussels and crabs, and breeding site of the common coot in South India. Physiographically, the lake Ousteri, located around 11° 56'–11° 58' N and 79° 44'–79° 45' E, is a large shallow wetland situated along the eastern boundary of Puducherry. However, recently the lake and its surroundings have been facing threats from anthropogenic

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activities such as pollution, urbanization, deforestation, encroachment and poaching, which have degraded the lake's ecosystem. Water governance arrangements should protect ecosystems and preserve or restore the ecological integrity of all natural water bodies and their catchments. This will maintain the wide range of ecological services which healthy ecosystems provide, and the livelihoods that depend on them. With this backdrop, the study deals with primary and secondary sources with survey methods on socio-economic and biological, flora and fauna parameters in and around the lake area. Conservation and sustainable management is urgently required with appropriate institutional arrangements for sustainable development, implementation of policy, and long-term planning strategies with sustainable management action plans, with the aim of achieving the desired objectives with the help of community involvement.

Keywords

Sustainable development · Wetland ecosystems · Planning strategies · Bio-physical · Anthropogenic · Food security

1 Introduction

Water and bio-diversity are resources of life and livelihood or the options for poverty reduction and enhancing the human welfare. Water is a prime natural resource, a basic human need for life and a precious national asset; hence its conservation is everyone's duty and human beings like to live near water. Wetlands are defined as "lands transitional between terrestrial and aquatic eco-systems, where the water table is usually at or near the surface or the land is covered by shallow water" (Mitsch and Gosselink 2000). The value of the wetlands are of increasing interest because their contribution to environment health in several ways has been experienced through conservation. Conservation means careful use of resources which may even lead to the sacrifice of present economic interests on behalf of posterity (Zimmermann 1951). Conservation also has the twin objectives of prevention and improvement so as to meet the need of future generations. Wetlands retain water during dry periods, thus maintaining the water table high and relatively stable. The removal of such wetlands in the name of globalisation, urbanisation and other human interventions can cause severe threat to such resources and supporting species diversity. Wetlands are areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed 6 m (Ramsar Convention 1971). In India, wetlands estimated at 58.2 million ha distributed in almost all bioclimatic regions are an important repository of aquatic biodiversity. Puducherry, well known for water bodies, especially wetlands numbering 82 major and minor located around Puducherry,

provides a livelihood for the local residents in the form of agriculture, fishing, fuel, fodder and other daily needs. In Puducherry there are two major wetlands—Ousteri and Bahour. The Government of India has been implementing the National Wetlands Conservation Programme (NWCP) in collaboration with the States and UTs since 1956. Under this programme, 115 wetlands had been identified (Anon 2009). In Puducherry, the Ousteri wetland had been selected and declared as a wetland of national importance and also as a bird sanctuary in the year 2008. The sanctuary is also known for a wide variety of fish, mussels and crabs. In the past, the lake has also served as the largest breeding site for the common coot in South India (Chari and Abbasi 2008). Recently, the lake has been facing serious threats and pressure from several anthropogenic activities such as poaching, unsustainable fishing and pollution. Encroachment, hunting of birds, dumping of solid wastes in and near the lake embankments, littering around the lake by tourists and local visitors, frequent vehicular movements by light and heavy motor vehicles, wastewater discharge into the lake, and rapid urbanization, infrastructural developments in the vicinity of the lake, agro chemicals, pesticides, weed infestation and soil erosion all call for an extensive field study which is urgently needed to ensure sustainable development and strategies for maintaining effective ecological balance, and, at the same time, achieving the objectives of sustainable wetlands in Puducherry, particularly Lake Ousteri.

2 Wetlands as Water Resources: Challenges and Concerns

There has been widespread failure to recognize the vital role of water resources in providing food, energy, disaster relief and environmental sustainability, the reason being that there are no proper markets or values for the goods and services derived from the water ecosystems. The competition and conflict for water by divergent users in the society and community both upstream and downstream are an emerging issue. Wetlands provide many services and commodities to humanity, and they perform numerous valuable functions such as recycling nutrients, purifying water, maintaining stream flow, restoring groundwater levels, attenuating floods, providing potable water, fish, fodder, fuel, wildlife habitat, buffer shorelines, leisure, recreation and tourism activities to society and the local community. Wetlands are often considered as “Kidneys of the landscape” (Gosselink and Mitsch 1986). The interaction of human beings with wetlands during the last few decades has been of concern, largely because of the rapid population boom, intensified industrial growth, real-estate and commercial activities, residential development, tourism, and promotional activities, leading to pollution by air and water (fertilizers, weed killers and insecticides). Unfortunately, pollution from agriculture often constitutes a greater total pollutant load for the water bodies and proper management options are not in place. Hydrologic conditions can directly modify or change chemical and

physical properties such as nutrient availability, degree of substrate anoxia, soil salinity, sediment properties and pH. These modifications of the physiochemical environment, in turn, have a direct impact on the biotic response in the wetlands (Gosselink and Turner 1978). Wetlands loss refers to the physical loss in the spatial extent or loss in the wetlands function. The loss of 1 km² of wetlands in India will have much greater impact than the loss of 1 km² of wetlands in low population areas of abundant wetlands (Foote et al. 1996). The demand for wetland products will increase with increasing population. However, the fact that the wetland products are overlooked has resulted in a threat to the resources and benefits which finally results in the degradation of wetlands. Realizing the importance of wetlands, the Ramsar Convention in 1971 has urged member countries to designate noted wetlands as Ramsar sites or wetlands of international significance. Many conservationists recognised this and a wetland conservation strategy should therefore receive widespread support (Choudary 2000). Investments for the conservation of wetland resources from private and public are insufficient. The strategy for sustainable development not only conserves precious aquatic biodiversity but also reserves of ecologically and economically useful flora and fauna genetic resources. The present study is a humble attempt to assist with initiating the green off-campus project on Lake Ousteri, a well known wetland in Puducherry, conducted by the Department of Tourism and Travel Management, under the direct supervision of the author.

3 Objectives of the Study

- To estimate the current status of the lake
- To study the socio-economic and flora and fauna values of the lake
- To create a conservation model for the lake
- To develop strategies for sustainable development of the lake

4 Methodology

The methodology adopted during the study is through primary and secondary sources. The primary data is collected through survey techniques by preparing questionnaires. Apart from this, community interaction is conducted so that perception and attitude towards the lake are also identified. The study period is short in duration, 2 months, November and December. Hence an in depth analysis of the study has its own limitations. More than 111 samples had been tested with the questionnaire, but 100 respondents had been taken for the study.

5 Lake Ousteri at a Glance

Ousteri lake is situated near the village Ossudu, at 11° 57' N, 79° 45' E, partly in Puducherry and Tamil Nadu state (Fig. 1). Whereas much of the Ousteri lake is located in Tamil Nadu, which consists of rural settlements and in Puducherry, the lake is predominantly suburban. Ousteri lake is the largest freshwater lake of Puducherry region, covering some 700 ha when full after a normal monsoon. It can store 540 million cubic feet of water, capable of irrigating close to 3,800 ha of land. According to the legend, in recognition of Oosi's selfless service, the lake was named Oosteri which, in due course of time, was rechristened Ousteri. The resulting lake has a perimeter of 7 km and 15 km² of catchment area. During the rainy season, the lake would resemble an ocean with a vast span of bluish water. During the French regime in Puducherry, the lake continued to be a major source of water resource and irrigation to more than seven villages. However, the command area of the lake has rapidly dwindled over the years; practically speaking, nothing is now irrigated by the lake. The local farmers of that region, encouraged by subsidies from the government and bank loans, have shifted to bore well irrigation. With the help of these bore wells, more groundwater is withdrawn, creating a major threat to the groundwater level table in terms of loss of height, salinity intrusion and pollution and disuse of canal networks to the surrounding areas. Despite this, the lake has its physical structures intact and stable ecosystems with moderate disturbances which need sustainable development to maximize its benefits for the future (Figs. 2, 3 and Table 1).



Fig. 1 Lake Ouster

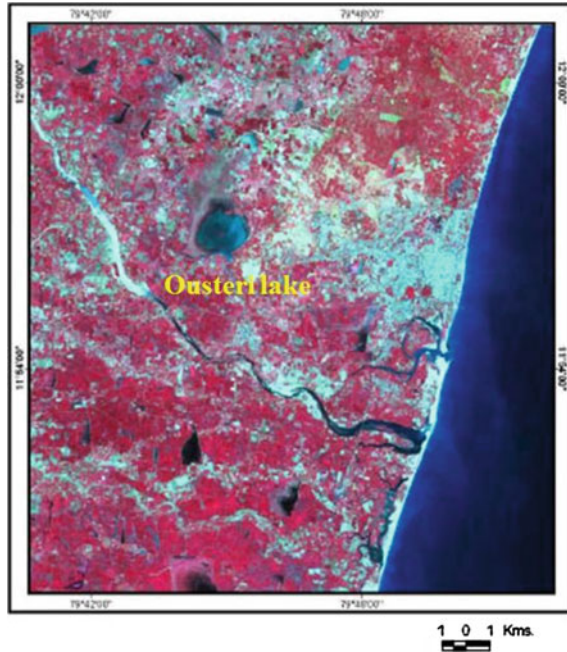


Fig. 2 IRS IC LISS III satellite imagery of the study area



Fig. 3 Classified land use/land cover map of the study area

Table 1 Facts about Lake Ousteri

S. no.	Particulars	Details
1	Longitude	11° 56'–11° 58'
2	Latitude	79° 44'–79° 45'
3	Elevation above Mean Sea Level	~ 15 m above MSL
4	Name of the sub-taluk	Villianur
5	No. and name of the village	29-Oussudu
6	Survey field no.	8
7	Extent and capacity	390 ha–00A-39Ca.
8	Boundaries	South: Oussudu and Koodappakkam villages, West: Ramanathapuram and Thondamanatham villages; and North: Tuthipet and Karasur villages
9	Climatic conditions	Annual Mean Max Temp: 33.1 °C Annual Mean Min Temp: 24.1 °C Annual Total Rainfall: 1,338 mm
10	Major land use types around the lake	Agriculture, cash crop plantation and human habitation, Scrub jungle, water body
11	Nearest highway	State highway Pondicherry-Thirukkanur-Viluppuram (~ 35 kmSW)'
12	Nearest Railway Station	Puducherry RS (~ 13 km, NW)
13	Nearest Airport	Lawspet, Pondicherry (~ 12 km, NW)
14	Nearest Port	Chennai (~ 165 km, NE)
15	Nearest major habitation	Villianur (~ km, SW)
16	Nearest major town	Pondicherry (10 km, SE)
17	Reserved Forests	Nil
18	Historically important places	(Auroville, ~ 10 km), Pondicherry Museum and Library and Arikamedu (~ 8 km), Gokilambal Thirukameshwara Temple at Villianur (~ 4 km), Sri Aurobindo Ashram (~ 10 km), Promenade (~ 10 km), Lighthouse near the sea (~ 10 km)
19	Rivers/streams around the lake	Sankarabharani river (~ 2 km, South) and Pennaiyar (~ 7 km S)
20	Major dams and barrages	Suthukeni barrage (~ 6 km, NW) Vidur dam
21	Other major industries (with distance from the lake in parentheses)	ABC Engineers (~ 1 km) REIL Electricals (~ 1.5 km) Hindustan National Glass and Industries Ltd (~ 1 km) Sunbeam Generators Pvt Ltd (~ 0.5 km)
22	Survey of India Topo sheet covering the lake and surroundings	58 m 1/16
23	Seismic zone	Zone-III

Wetlands play a vital role in maintaining the overall cultural, economic and ecological health of the ecosystem; their fast pace of disappearance and threats from the landscape is of great concern. The Wildlife Protection Act protects a few of the ecologically sensitive regions whereas several wetlands are becoming an easy target for anthropogenic exploitation. However, from a practical conservation planning and sustainable development point of view, the immediate need is to identify and classify the biological habitats and aquatic vegetation.

In the study area, and its environs, among the 480 species, 191 herbaceous plants are present (41 %), 103 tree species (21 %), shrubs 63 species (13 %), climbers 40 species (8 %), 20 species (4 %) and grasses 63 species are growing (13 %) in and around lake Ousteri. Of the 480 species, 11 are found to be endemic (*Andropogon pumilus*, *Asystasia dalzelliana*, *Barleria acuminata*, *Cynodon barberii*, *Drypetes roxburghii*, *Iseilema antheophoroides*, *Jatropha tanjorensis*, *Maba buxifolia*, *Phyllanthus rotundifolia*, *Sarcostemma brunonianum* and *S. intermedium*) and are distributed only in the Indian sub-continent, More than 20 species found to be on the endangered list have medicinal values. Ousteri is not only rich in flora but also in fauna. It has become a major attraction for tourists and visitors to the lake for watching butterflies, amphibians, reptiles, birds, mammals. There are 63 species of butterfly under 46 genera and spread over 5 families, Nymphalidea is dominant with 21 species (34 %), followed by Pieridea with 14 species (22 %) and Lycaenidea 10 species (16 %). Wetlands such as Ousteri have become a resting site for migratory birds and Lake Ousteri has been declared as a bird sanctuary because of its wealth of avifauna, 166 species of birds belonging to 47 families being recorded and spotted in the lake zone, both of terrestrial and aquatic habitats. Of the 47 families, Muscicapidae is the dominant one with 16 species followed by Accipitridae (12 species), Ardeidae (11 species) and Anatidae (10 species). Of this 166 species, the spoon-billed sandpiper is “critically endangered” and the white-bellied sea eagle comes under the category of “endangered”. Apart from these, birds such as the flamingo, darter, spot-billed pelican, great white pelican, painted stork, Eurasian spoonbill and pallid harrier are approaching the threatened category (Balasubramanian and Vijayan 2004). The lake and its surroundings are rich in amphibians with 10 species such as cricket frog, common Indian toad, Indian bullfrog and 29 reptile species recorded, including turtles, lizards, snakes. There are 25 species of fish in the lake. Species such as *Catla Catla*, *Mystus vittatus*, *Heteropneustes fossilis*, *Channa orientalis*, *Clarias batrachus*, *Etrophus suratensis* and *Mystus gulio* are vulnerable species. Two species, namely *Channa striatus* and *Gambusia affinis*, fall in the low risk—least concern category. Three species, namely *Oreochromis mossambica*, *Cyprinus carpio* and *Hypophthalmichthys molitrix*, are exotic. The remainder of the ten species are included in the less risk category. Fourteen species of mammals are also present in and around the lake. Species such as spotted deer, jackal, jungle cat, common mongoose, black napped hare, bonnet macaque, Indian porcupine, bandicoot rat, three stripped palm squirrel,

Indian pangolin, Asian palm civet, mice, short nosed fruit bat and flying fox appear. From the ecological point of view, the diversity of species present in the wetland is an indication of its relative importance and its significant value to the overall ecosystem. The study is based on the primary data collected from the respondents and interaction with the population living near the lake. More than 21 villages are dependent directly and indirectly on the lake for several reasons of their own, especially for the socio-economic benefits. The lake is useful to the people in several ways, namely for providing potable water, irrigation, recharging ground-water level, climate regulation, pollination, water regulation, natural hazard regulation, commercial fishing, fodder and grass for cattle grazing, desilting, reed cutting, recreational, tourism, aesthetic reasons, water sports, nutrient cycling, soil formation, watershed and agriculture.

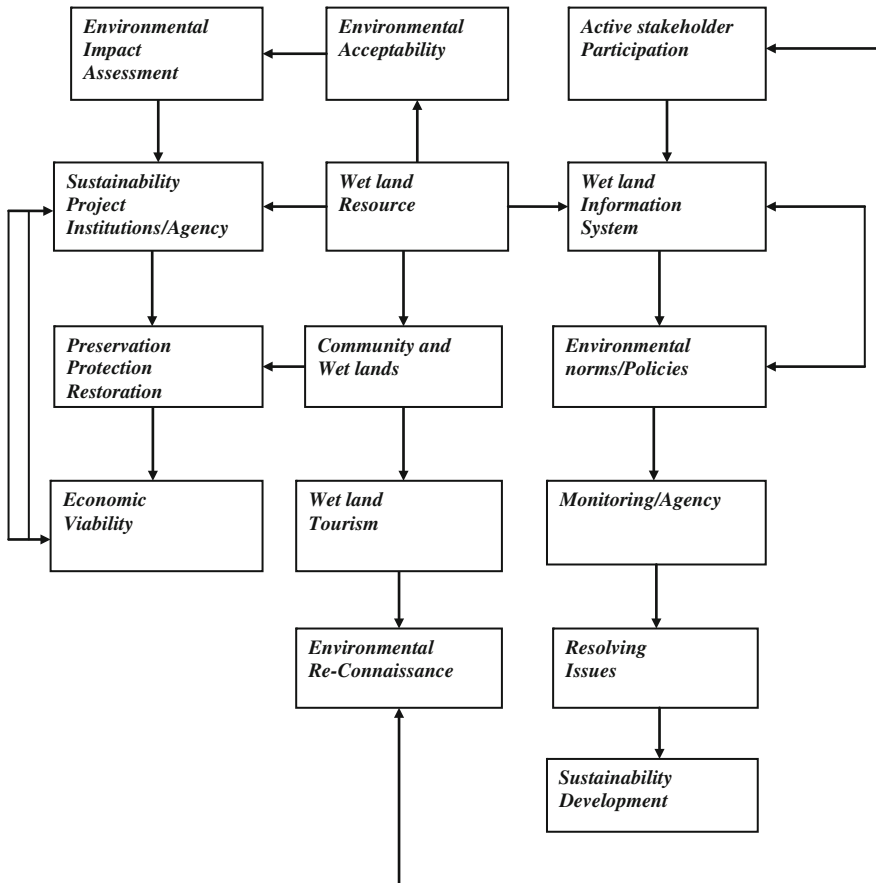
6 Some of the Findings of the Study

The important findings relevant to the study are:

- 44 % of people say that monoculture cropping is practiced, especially in paddy and sugarcane, casuarinas, coconuts and teak
- 21 % say the lake is the only livelihood for them
- 33 % believe that their alternative livelihood is self-employment, entrepreneurship and livestock rearing
- 24 % started poultry farms and aqua culture
- 55 % of the farmers around the lake are involved in organic farming instead of fertilizers; they are using eco friendly manures such as dried cow dung, azo-spirillum, vermicompost and phosphobacteria
- 12 % of the nearby population uses the lake for potable purpose
- 23 % of the population use it for agricultural irrigation
- 16 % of the population are involved in direct fishing from the lake, 10 % are involved in hunting and poaching birds (pelicans, coots, darters and frogs)

From the findings we are able to assess the necessity for a sustainable development module for the lake.

Module 1: Off - campus sustainability development module for wet lands: Lake Ousteri



Source: The Author

7 Shift from Obligation to Strategy Towards Sustainable Development

The general principle of sustainable development adopted by the World Commission on Environment and Development that current generations should “meet their needs without compromising the ability of future generations to meet their own needs” has been widely accepted. A society may in many ways compromise its ability to meet the essential needs for the future generations by over-exploiting resources. Sustainable development requires promotion of values to encourage

consumption standards within the bounds of the ecologically possible and to which all can reasonably aspire. Long-term sustainable development requires an understanding of the interaction between human activities and natural processes. It means managing resources efficiently and maximising the benefits we get from them so as not to overload the water ecosystem. A strategy is “a combined set of participatory and continuously improving processes of analysis, debate, capacity strengthening, planning and investment which integrates the economic, social, cultural and environmental objectives of society, seeking trade-offs where this is not possible”. The strategies designed for the study area, Lake Ousteri, after considering the perceptions and opinion of the local population, government, NGOs, local bodies, planning departments, forest and environment authorities, are as below.

To ensure the sustainability of the natural resource base, the recognition of all the stakeholders in it and their roles and responsibilities in its protection and management is essential.

The traditional approaches to natural resources management in lake water harvesting and management system should be revived by creating institutional mechanism with ecological wisdom and the spirit of inherent community management.

To establish well-defined and enforceable rights and security of tenure and to ensure equal access to land, water and other natural and biological resources, to local communities, women and other disadvantaged group of the population.

Good water governance and restoring the ecological integrity of all water bodies and catchment areas and their livelihoods.

Lake clean development mechanism strategy (LCDM) can be achieved by providing financial assistance to sustainable development programmes with clear-cut objectives.

Education on Sustainable Development Strategy initiatives with functional literacy to create a responsible citizen for sustainable livelihoods with awareness, attitudes, skills and concerns is of paramount importance.

User community pyramid strategy by using integrated and appropriate technological solutions and the applications thereof for the success of the sustainable development of the people.

Societal Radar Development strategy should be applied to monitor and view how the targeted community had benefitted from the user community pyramid (Kalam 2012).

The objective of the pyramid model was providing safe drinking water and water for irrigation in a sustainable way, reducing pollution, and thereby bringing peace and economic prosperity to the dependents of the lake.

Adopting a 3R strategy—Reduce, Reuse, Recycle—will solve major issues in conserving water bodies is an ideal solution to address the sustainable development.

Value-based environmental education encompassing ethical standards of earth centric rather than human centric is urgently needed.

Change in lifestyle of the citizen should go a long way to attain sustainable development and water body conservation.

Empowering civil society through integrated participation management, by creating genuine partnership between government, business, community, voluntary organizations, panchayats, local bodies and municipalities since the problems are too complex to be otherwise resolved.

Create a pragmatic tool box for government sustainable development managers and policy makers.

Landscape beauty for the lake's scenic view, space for tourism, recreation and for the local residents with eco-friendly attitudes.

The need for a holistic and integrated approach to biodiversity and water management through developing an ecosystem approach strategy for integrated management of water, land and living resources, without compromising the sustainability of aquatic ecosystems, should be the benchmarks.

8 Conclusion

Our unique wetlands, which are rich in aquatic diversity and bird life, providing food and shelter as also the breeding and spawning ground for the freshwater fishes, are facing problems of pollution and over-exploitation. The excessive use of fertilizers and pesticides threaten the local population and the genetic stocks of the water bodies, and reduces the natural soil fertility in the long run. The water table is receding because of over use of ground water in the surrounding areas of the lake. Large numbers of industries and other development projects have resulted in pollution of water bodies, which is an undesirable phenomenon for the lake ecosystem. However, the benefits derived from the business are not shared equally by the local communities, so access and benefit sharing is the success mantra for preserving natural biodiversity such as wetlands.

To conclude, development has to be sustainable and all round, whether for the poor, village folk or urban people, and the sustainable development models have to be reviewed and followed. Hence the classification, zoning and regulations for maintaining the quality of water bodies to protect and enhance their capabilities to support the various designated use of wetlands must be considered. Promotion of tourism should be based on careful assessment of the carrying capacity and support facilities without affecting the lifestyles of the local people. Strengthening local bodies, panchayats, samitis, for optimal resource management and contingency plans is advisable for micro-level planning to develop appropriate methodology and implementation of action plans by involving people at village level in social forestry, land use planning, afforestation, watershed management through catchment treatment of drainage areas, protection of vegetal cover, fishing activities, environmental sanitation, GIS tools for monitoring, strengthening enforcement machinery, and the importance of water bodies renewable resources should be recognized. Therefore the task of sustainable development is never daunting if people's changes in concern over environment, the media, public, youth and

children are effective and this beautiful Lake Ousteri, recognized as Oosi's selfless service, can appear on the international map of Ramsar as important "must see" wetlands of the world. Therefore, meaningful sustainable development can be achieved, and the people's involvement in managing water and other natural resources is very crucial.

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