

STRATEGIES FOR MANAGEMENT OF PICHOLA LAKE AND ITS CATCHMENT AT UDAIPUR, RAJASTHAN

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ABSTRACT

Pichola Lake at Udaipur is the nerve center for social, economic, and cultural activities of City of Udaipur in the state of Rajasthan of India. Pichola Lake is interconnected with mirage of other lakes in Udaipur to fulfill fresh water requirement of living beings in different parts of the city. Pichola Lake receives water only during monsoon season as runoff from its hilly catchment. Over last decade water input to Pichola Lake has reduced considerably thereby causing shrinkage of the lake. Increased siltation in the lake has also caused reduction in the storage capacity of Pichola Lake aggravating the problem arising due to ever reducing water input and increasing water demand. In this presentation, present state of health has been depicted, causes of deterioration of the lake have been investigated, concerns for improving health of the lake have been expressed and strategies for management of lake and its catchment area have been discussed. Social and community forestry, people's participation in water conservation, soil conservation based agricultural practices for cash crops, mass awareness for maintaining quality of lake water, periodic program for cleaning of the lake have been suggested for monitoring and management of Pichola Lake.

Keywords: Pichola Lake, socioeconomic values, water withdrawal, insufficient governance, deforestation, sedimentation, litter, garbage, aquatic biodiversity, management

INTRODUCTION

Pichola lake at Udaipur in Rajasthan is a medium size manmade reservoir located at an altitude of 587 meter above mean sea level in the west of city of Udaipur at 24° 34' N of latitude and 73° 41' E of longitude. It is the oldest and biggest of waterbodies of Udaipur city. It was constructed during the end of 14th century (1382-1418 A.D.). Its embankment was further raised by Raja Udai Singh in 1560 who established the town of Udaipur on its bank. The lake has two islands and many inlets. At the northern end of the lake is the old town with numerous ghats. Along the eastern bank is the long range of the City Palace and to the south is the hill known as Eklingarh. A great masonry dam holds the lake water back from the Samor Garden. The lake is mainly rainfed. River Sisarama is the only source of water for this lake. Water spread area of the lake is about 3 km² as on today which used to be 10 km² in the beginning of twentieth century. Catchment area of the lake is about 130 km². Maximum depth of water in the lake has reduced to 6.0 m from 10.5 m about 100 years ago. Presently average depth of water, just after the monsoon, is about 2.5 m.

PRESENT CONDITION OF PICHOLA LAKE AT UDAIPUR, RAJASTHAN, INDIA



Figure 1 : Pichola Lake at Udaipur, Rajasthan, India

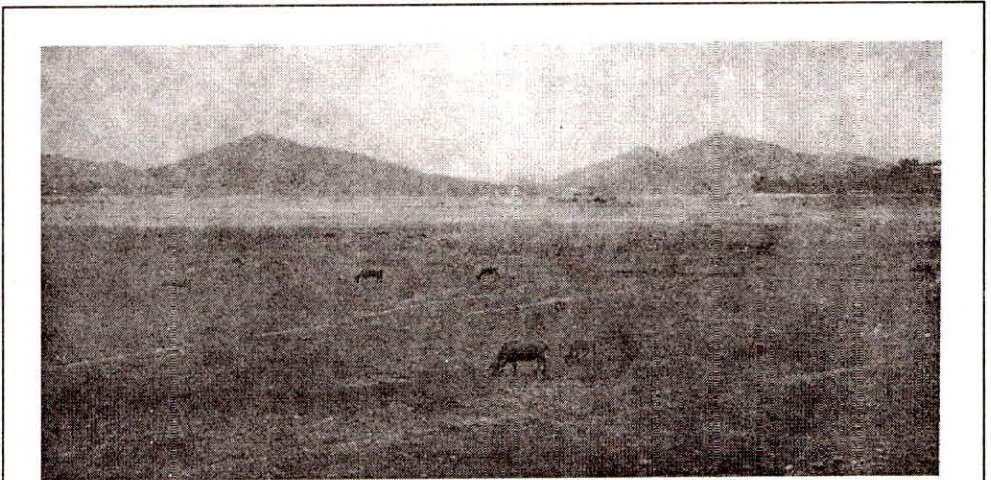


Figure 2 : Present condition (Dried) of the Pichola Lake (As in April 2005)

CAUSE OF DETERIORATION OF PICHOLA LAKE



Figure 3 : Deforestation in upper reach of the catchment of Pichola Lake



Figure 4 : Lack of vegetation in middle reach of catchment of Pichola Lake

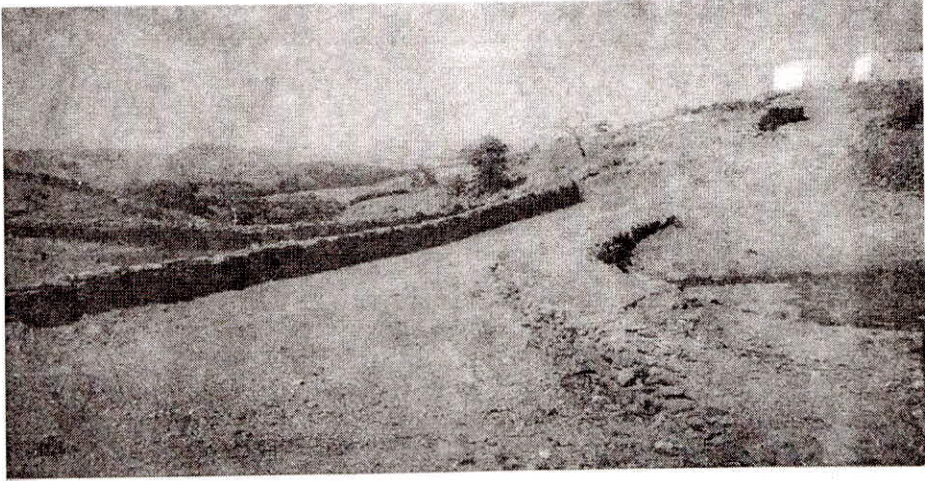


Figure 5 : Heavy sediment load from catchment coming to Pichola Lake

CONCERNS FOR IMPROVING CONDITIONS OF PICHOLA LAKE

Socioeconomic Values of Pichola Lake

Livelihoods of people of Udaipur city directly depends on Pichola Lake for their food and basic economic well-being. Economy of Udaipur is fully based on the water availability of Pichola Lake.

Increased Demands of Lake Resources

Excessive water withdrawals from Pichola Lake has caused significant water-level fluctuations directly affecting the lake ecosystems and questioned the very existence of the lake itself. Pichola Lake has shrunk significantly in surface area and volume, experienced a major increase in salinity, and undergone fundamental changes to its biological communities. Water withdrawals for the purpose of land reclamation has profound impacts.

Insufficient Governance and Accountability Systems

The lack of proper accountability on the part of citizens and governments is one of the most significant root causes of unsustainable lake use. Poor public consultation, inadequate stakeholder participation, and a lack of appropriate and effective governmental institutions and regulatory mechanisms are major hindrances to sustainable use of Pichola Lake.

Increased Erosion and Sedimentation

Increased erosion and sedimentation has resulted from deforestation and other land and soil disturbances associated with clearance and conversion of land to agricultural and urban

purposes, producing large quantities of sediment that enters lakes, degrade water quality, and destroy lake habitats. Sedimentation has rapidly filled Pichola Lake, reduced the water storage capacity and recreational potential, interfered with flow control mechanisms, and reduced the flood control capacity.

Loss of Aquatic Biodiversity and Habitats

Pichola Lake provides habitats for many aquatic organisms (fish, crustaceans, mollusks, turtles, amphibians, birds, mammals, insects, aquatic plants, etc.) and support biodiversity in the surrounding hills and land areas, including many migrating bird species. These native species are well-suited to local conditions and typically live in balance with other aquatic life. These species have become extinct in recent decades.

Human Health Risks

Waterborne disease is the single greatest cause of human illness and death in the area surrounding Pichola Lake. Unbalanced lake ecosystems provide enhanced survival opportunities for disease-causing organisms that have an aquatic phase in their life cycle (e.g., mosquitoes). Human diseases, such as typhoid and cholera, are being readily transmitted via contaminated water, with poor sanitation facilities and contaminated drinking water supplies, being major pathways for the spread of both the disease and the disease-causing organisms. Because human wastes also contain large quantities of aquatic plant nutrients, particularly phosphorus and nitrogen, lack of proper sanitation facilities also contributes to the accelerated eutrophication of Pichola Lake.

Accumulation of Litter and Garbage

The consequences of accumulated litter (durable goods, biodegradable items, containers and packing materials, etc.) include physical obstruction and reduction of the natural beauty of the lake systems, and the less-obvious impacts associated with chemicals leaching from the litter. Macro pollutants or solid wastes such as litter and garbage has contributed to the spread of human disease organisms and adversely affected native wildlife and domestic animals, particularly waterfowl. In areas where refuse collection is unavailable, discarded wastes from households, farms and marketplaces are often dumped into nearby ditches and streams. Where these water systems drain into the lake, they can cause oxygen depletion in its bottom water, contributing to a "mucky" lake bottom, and decreasing the lake's aesthetic values. Indiscriminate dumping of solid wastes has clogged waterways of the lake.

Loss of Natural Beauty

Over-development or inadequate control of construction activities, particularly along lake shorelines, has degraded the natural beauty of lake landscapes, and has negative impacts on lake water quality and near shore biological communities. Although difficult to categorize in a quantitative sense, the aesthetic quality of the lake has readily disappeared over time as a result of increasing human settlement and related activities in its drainage basin.

Climate Change

The predicted impacts of climate change, particularly global warming, has manifested themselves in the form of altered precipitation patterns and drainage basin hydrology. Pichola Lake is particularly vulnerable to changes in climatic parameters. Variations in such climate variables as air temperature and precipitation has directly caused changes in water evaporation, lake levels and water volumes, water balances, and biological productivity. Under changing conditions over last decades, most parts of Pichola Lake has disappeared. Pichola Lakes being in semi-arid region of India is more sensitive to climate change impacts than those in other regions.

STRATEGIES FOR MANAGEMENT OF PICHOLA LAKE AND ITS CATCHMENT AREA

There is no single action for the instant reconciliation of the impacts of unsustainable use of Pichola Lake and its resources. Rather, this section provides a menu of promising actions and strategies for applying the principles of management of lakes for the purpose of developing visions of management for Pichola Lake. They can be undertaken by individuals, organizations and other stakeholders working at the local, national, regional and/or global levels – all have important roles to play in the process. Implementing the principles as well as the immediate actions and long-term strategies outlined requires a systematic approach of the type outlined in figure 6.

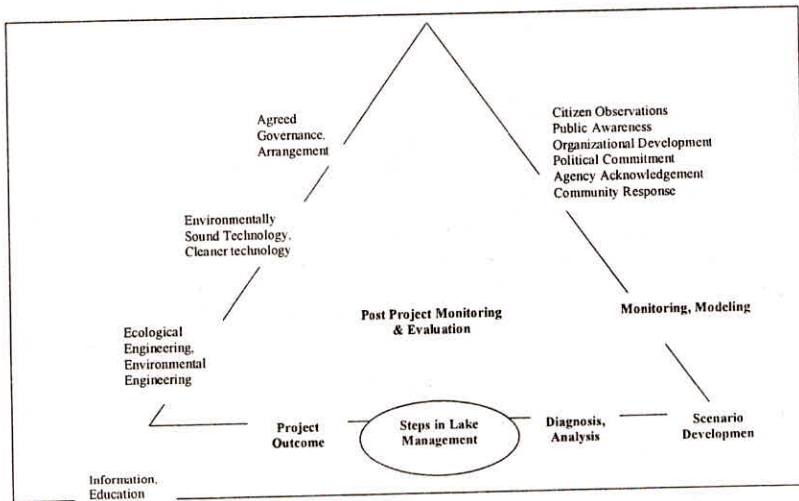


Figure 6. Management cycle for developing, implementing and refining Pichola Lake

MANAGEMENT ACTIONS FOR TACKLING MAJOR THREATS FACING PICHOLA LAKE

Many different entities, including citizens, governmental agencies, decision-makers and managers, non-governmental organizations, the private and agricultural sectors, educational and research institutions, and the media, will have to play a role in addressing threats to the sustainable use of Pichola Lake and its resources.

Developing Accurate Water Budgets for Pichola Lake and Its Drainage Basins

This include the quantity of water needed to preserve life-supporting or economically important ecosystem functions. Development of an accurate water budget is a critical step in prioritising water uses on a drainage-basin scale, with the goal of developing a realistic management framework for sustainable lake use.

Implementing Technical Water Conservation Measures to Reduce Water Use

Substantial water savings are possible by implementing more efficient industrial and domestic water use, upgrading urban water delivery systems that lose large amounts of water through leakage, and using low-flow or dry toilets in individual households. Additional water savings can be realized with the implementation of other innovative local or regional water conservation approaches, including reuse of gray water and of treated water from municipal wastewater treatment plants, rainwater harvesting, etc.

Applying The Lessons Learned From Past Experiences In The Future Construction and Operation of Check Dams In Drainage Basin of Pichola Lake

Preventing and Controlling Water Pollution

Implementing wastewater treatment within lake drainage basins

The construction of adequate wastewater treatment facilities should be a top priority. In sparsely-populated areas, small community based projects for meeting local sanitation needs, including the use of constructed wetlands, can be just as effective, less expensive and more practical than large infrastructure projects. Depending on the specific circumstances, septic tanks or low water volume toilets may be the most appropriate actions in other areas. Ecological sanitation that separately recovers urine and faeces for fertilisers may also be a promising approach for reducing water pollution.

Limiting or banning the use of phosphate-based detergents

Pichola Lake still receive substantial phosphorus loads from detergents. Accordingly, management plans for sustainable lake use should include comprehensive phosphorus reduction strategies, combined with monitoring programs that identify baselines and track changes in nutrient pollution loads and levels over time, as well as information programs to inform consumers of appropriate alternatives.

Protecting forests and vegetation in catchment area of Pichola Lake

A key to reducing excess sediment and pollutant loads reaching to Pichola Lake is to protect natural vegetation, often in the form of forests along in-flowing tributaries, from development pressures. Different forms of forestry has to be applied to catchment of Pichola Lake.

Developing and implementing land use plans to limit the use, generation and transport of water pollutants

Providing accurate and timely information to local and regional decision-makers about the importance of Pichola Lakes and its resources, and about effective planning principles to protect lake drainage basin, is an important means whereby corporations, non-governmental organisations, and individuals can help shape local and regional land use choices.

Protecting and Restoring Bio-Diversity in Pichola Lake

Careful evaluation of the endemic species in Pichola Lake is important for efficient and effective conservation, and should go beyond the relatively common practices of fish and bird counts. Designation of special protected areas at the local, national and/or global levels can offer at least partial protection to aquatic organisms in Pichola lake and its in-flowing tributaries.

Establishing protected areas within lake drainage basins

It is important that local, provincial and national governments, as well as international agreements and programs (e.g., Ramsar Convention, Convention on Biological Diversity, International Union for the Conservation of Nature (IUCN) protected areas program, UNESCO Biosphere Reserve and World Heritage Site Programmes), work expeditiously to ensure that critical areas within the Pichola Lake drainage basin landscape mosaic are identified and protected.

Undertaking Anti-Litter Campaigns

Undertaking local anti-littering campaigns will provide a mechanism for protecting Pichola Lake from garbage and trash. Careful siting of refuse disposal points, the use of sanitary landfills constructed to provide treatment of leachates and gases, and implementation of street sweeping and refuse collection programs, for example, should be used to control environmental pollution from litter, debris, and discarded human materials.

Considering Creation of New and Alternative Employment Opportunities

Encouragement of alternative employment opportunities (e.g., eco-tourism) can provide economic incentives for communities and individuals within lake drainage basins and along lakeshores. Such opportunities can include adopting environmentally-sound technologies, such as using locally-grown organic products, introducing recreational management programs based on consideration of a lake's carrying-capacity, restricting the numbers of visitors to sensitive sites, and providing appropriate informational materials regarding areas frequented by tourists and others.

Coordinating Lake Management and Poverty Alleviation Programs

The provision of environmentally sustainable economic opportunities will provides a primary mechanism for encouraging the sustainable use of lake resources for meeting beneficial human needs.

Implementing and maintaining lake monitoring and assessment activities

Monitoring activities can be undertaken by individuals, governmental agencies, non-governmental organizations, corporations, and academic institutions at all levels. Monitoring and assessment programs should be specifically designed to recognize and incorporate the hydrological, biological, chemical and physical similarities. Citizen monitoring should be done in collaboration with, or independent of, monitoring and assessment activities undertaken by professionals in governmental agencies, non-governmental organizations and academic/research institutions.

Creating Web-Based Information, Online Databases and Other Readily-Accessible Materials About Management of Pichola Lake and Its Resources

A primary goal of this is to facilitate information sharing, training and exchange of experience among technical and non-technical lake management practitioners alike. For regions of the catchment where electronic communication possibilities are difficult to implement, printed newsletters, reports, and mailings based upon traditional postal mailing lists will be an equally effective means of sharing lake data, information and experiences.

Implementing A Public Education and Awareness Program About Pichola Lake and Its Drainage Basin

Use of the educational system, the media, non-governmental organizations, and the religious community will be helpful in carrying out this task, providing practical information, guidance and inspiration regarding sustainable lake use. They can help shape positive public attitudes about the threats facing lakes, and the need for their participation in implementing practical solutions to them.

CONCLUSIONS

Present state of health of Pichola Lake has been depicted, extent of deterioration of fresh water bodies of Udaipur has been highlighted, causes of deterioration of the lake have been investigated, present hydrological status of the lake has been put forward, concerns for improving health of the lake have been expressed and conceptual strategies for rejuvenation, conservation and management of Pichola lake and its catchment area have been suggested and future hydrological scenario under managed and unmanaged conditions have been projected. Social and community forestry, people's participation in water conservation, soil conservation based agricultural practices for cash crops, mass awareness for maintaining quality of lake water, periodic program for cleaning of the lake have been suggested for monitoring and management of Pichola Lake.

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Web-based Resources

- Global Water Partnership (<http://www.gwpforum.org>)
- Inter-American Water Resources Network (<http://www.iwrn.net>)
- International Lake Environment Committee Foundation (<http://www.ilec.or.jp>)
- International Water Association (<http://www.iwa.org>)