

Conservation and Management of Khechuperi Holy Lake, West Sikkim

Description of Site:

The Khechuperi holy lake is located in the west district of Sikkim. It is situated in the midst of forest revealing its pristine set up at 27° 22'24" N and 88° 12' 30" E with an altitude of 1700 m amsl in the West Sikkim. It is reported that the lake is being formed by the scooping action of hanging glacier (Raina, 1966). The lake watershed has mixed broad leaved forests and agricultural land with a total area of 12 km² having two villages, which includes 91 ha area specifically as the lake watershed. There are two perennial and five seasonal inlets to the lake and one major out let. The land use cover pattern of the Khechuperi lake watershed is as below.

1. Dense Mixed Forest	: 22.53 %	: 272.20 ha
2. Open Mixed forest	: 40.69 %	: 492.01 ha
3. Degraded forest	: 21.00 %	: 254.00 ha
4. Cultivated land and settlements	: 13.44 %	: 162.50 ha
5. Rock out crop	: 1.45 %	: 17.50 ha
6. Lake water surface	: 0.31 %	: 3.79 ha
7. Bog area	: 0.58 %	: 7.01 ha

Although there are few settlements, the high influx of tourists has led to some disturbances of the lake and its watershed. There are two perennial and five seasonal inlets to the lake and one major out let. The lake has been a resting place for trans-Himalayan migratory birds and supports commercial and recreational tourism. Geologically, the local rocks belong to the Darjeeling group. This group mainly comprises high grade gneisses containing quartz and feldspar with streaks of Biotite (GSI, 1984). The lake surroundings had dense mixed broad leaved forests and poorly developed ground vegetal growth. This is indicated by exceedingly pollen values of *Quercus*, followed by *Alnus*, *Pinus* and other arboreal elements. The soil is sandy loam in nature. Climate of the area is monsoonic and divisible into three seasons, rainy (June- October), winter (November-February) and summer (March-May). Annual precipitation was 3837 mm and mean daily temperature ranged from

4⁰C to 24⁰C during 1997-98. The lake Khechuperi is considered sacred hence pilgrims come to pay respect.

This lake is also known as the wishing lake. This unusually tranquil lake, surrounded by verdant forest is considered as one of the sacred lakes of Sikkim both by the Buddhist and the Hindus and no water sport or other activities besides prayers are allowed around it. It is believed that birds do not permit even a single leaf to float on the lake surface. The lake is being visited by more than 10,000 foreign and domestic tourists in a year. There is no regular management practice followed by an identified agency. However, the forest, environment and wildlife management department and the tourism department takes care of the essential needs of the lake and it's surrounding as and when required. There is a local committee called Khechuperi lake welfare committee composed of local people to take care of cleanliness and sanctity of the lake.

Problems and Threats:

There is a significant land-use/cover change occurred in the past 4 decades, which in turn causes threat to the long term existence of the lake. The bog area expanded by 67%, while the area under agriculture land in the lake watershed grew by 63% between 1988 and 1997. Overland flow was highest on the bare land (4.77% of the precipitation) and lowest in areas of cardamom-based agro forestry (1.79%).

Soil and nutrient losses were highest in the cultivated area and least in the cardamom agro forestry system. Sediment loads of 345 mg per year were recorded at the lake inlet and of 316 mg per year at the outlet. Annual soil loss from the lake watershed was 502 mg per km and a net sediment deposition in the lake was 141 mg per year. The lake received high nutrient loads (organic carbon of 10.2 mg per year, total nitrogen of 1.01 mg per year and total phosphorus of 0.51 mg per year) from soil erosion and overland flow. The pH, total phosphorus and bulk density of the peat increased from the lake towards the bog-forest edge. This reflects the trapping of sediments and nutrients around the bog forest margin, although their retention is limited. Agricultural practices should be minimized in the upper part of the watershed and agro-forestry practices should be encouraged to maintain the health and longevity of the lake. The following are some of the problems faced by the lake in addition to the above.

- Construction activities
- Agriculture in the catchment
- Biotic interference such as grazing
- Unregulated tourism
- Change in the composition of the water.
- Increase of BOD in the water.

Management Objectives:

The lake needs to be developed to the desired extent in order to conserve the lake environment, its catchment, etc., The lake also needs attention to provide required amenities for conduct of traditional rights and rituals and also the required tourist amenities in order to encourage tourism and well understanding of the importance of the lake. With the above view in mind this project is prepared for the holistic development of this great sacred lake in west Sikkim with the following objectives.

Short Term Objective

- ❖ To improve the catchment areas of the lake through vegetative soil conservation measures in order to sustain the water drainage and to avoid siltation in the lake.
- ❖ To right size the Bog area of the lake
- ❖ To provide tourist amenities in the vicinity of the lake.
- ❖ To beautify the ways and surroundings of the lake with ornamental plants and flowering plants.
- ❖ To establish a mechanism and system for regular cleaning and maintenance of the lake.
- ❖ To periodically assess and monitor the changes in the lake particularly on the pollutants and planktons.
- ❖ To provide infrastructures to carry out traditional functions and rituals.

Long Term Objective

- ❖ To improve the lake environment to sustain the importance of the lake
- ❖ To establish mechanism to regulate/avoid biotic pressure particularly cattle grazing on the surrounding forests and in the lake.
- ❖ To maintain the ecology, biodiversity of the lake and its catchments.
- ❖ Conservation of Oak forest type.
- ❖ To establish an interpretation centre in the vicinity of the lake.

Strategies for Achieving the Objective

A comprehensive Management Action plan will be prepared after through field survey and discussion with the local communities. The demarcation of the project area through survey and demarcation process then the areas vulnerable to biotic pressure will be fenced.

Watershed and Biodiversity Management

The catchment area of the lake is the main focus of the project. The catchment area will be adequately protected in order to sustain the water drain into the lake. Multi-dimensional approaches to improve and protect the catchment and the lake are proposed in this project.

The following components are proposed.

1. Vegetative Contour bunding
2. Small Check dams
3. Bench Terracing
4. Hand Packed Wall inside Sausage
5. SMC works
6. Creation of Nursery
7. Maintenance of Nursery
8. Aided Natural regeneration
9. Afforestation
10. Silvi-pasture
11. Control and regulation of biotic pressure

There are two perennial and five seasonal inlets to the lake and one major out let. At the point where runoff concentration occurs, the erosion control measures have to be provided. At these points following control measures can be installed.

Vegetative Contour Bunding:

In order to reduce the velocity of the surface run off and trap sediment in the upper reaches, vegetative contour bunding will be made at the appropriate location in the catchment.

Small check dams: These structures will be used both on the uplands as well as channel flow. On the upland hills and small gullies are formed and erosion is active .The structure intercepts the runoff and works as a sediment traps. As per the site requirements appropriate design of the check dam will be selected and constructed using locally available materials.

Bench Terracing

Bench terracing is a most common practice in the Himalayan Mountains. These terraces are made in such a design that field are level but the longitudinal grade match without ward terraces. Strengthening would be down by rearrangement of stones and packing up with soils. Bench terracing will be made to break the slope and stabilize the slope in order to conserve soil erosion.

Hand Packed Wall inside Sausage

In open land slide areas of the catchment will be held in place with stones inside GI wire mesh. To prevent the bank erosion and train the flow of the water in the channels and streams, these hand packed walls will be made at vulnerable locations. After stabilization of moving land mass through this technique, the area will be later further reinforced with biological measures.

SMC Works:

The steep slope would be broken by first making the terraces. These terraces would be planted with soil binding species like *Agave*, *Amliso*, etc., Mulching will also be done as and where required.

Creation of Nursery:

In order to carry out the plantation activity, there is a need to develop a temporary nursery near to the lake premises to raise local species. A 0.60 ha of nursery is proposed in order to supply of saplings for the project period.

Aided natural regeneration:

The catchment area consists of 492 ha of mixed open forests. In these lands, the scope for practice of aided natural regeneration to improve the forest cover is very high. It is proposed to under take aided natural regeneration activities in the open forest land in addition to plantation of local tree species to increase the forest cover in the catchment area of the lake

Afforestation of the degraded forest lands:

Afforestation of the degraded forest lands in the lake catchment is proposed to be taken up using the indigenous local species of the trees.

Regulate/avoid biotic pressure:

- Support to the local JFMCs and other NGOs for regulation and control of grazing in the lake catchments.
- Support for the voluntary eviction/relocation of cattle sheds in the catchments of the lake.
- Creation of awareness on the impact of biotic pressure on the lake environment and the catchment.

Pollution Control Measures

Solid Waste Management is the major pollution threat in the lake premises as lot of tourists visits the lake. As a result, lot of garbage is generated. Hence, solid management through placing of dust bins at appropriate locations to collect them and dispose them through decomposing pits and incinerators. Bio degradable and Non-biodegradable wastes will be separated at source using different dust bins. Public convenience/ Toilet Facility will also be provided to keep the premises clean and pollution free. It will be provided with regular water supply with a tank and will have a proper septic tank.

Collection and Disposal of Waste

A local organization will be created and registered in order to manage the lake and its establishment. The organization will be of dynamic one and will be constituted in consultation with the local people. There will be mechanism sorted out to share the benefit arising out of this lake and its establishment with that organization. A portion of the revenue collected will be circulated back to the maintenance of the lake and a portion will be shared for the benefit of the organization and the remaining portion of the revenue will be deposited into the Government. The mechanism to be established for the maintenance of the lake will take care of the cleaning, collection and disposal of the wastes. The community organization will be given the responsibility of all these functions. One vermi-composting unit will also be established.

Provision of Tourist amenities:

Resting Sheds:

All visitors prefer to spend their time in the lake location and exchange the beauty of the area while resting/sitting in the resting sheds. These sheds will also form a place for photography. It is proposed to have one resting shed outside the entrance, one on the way and one near to the lake.

Visitor's bench:

The bench for sitting is proposed on various locations. These benches will increase satisfaction especially for the elders, children, etc., it is proposed to have Visitors bench along the way, outside the lake and near to the lake and Pooja areas as well.

Avenue Plantations:

Avenue plantations with ornamental and flowering plants along the footpath and in the area surrounding the lake entry points are proposed to increase the beauty of the area.

Traditional Entry Gate:

One traditional style entry gate is proposed at the entrance of the lake in order to provide welcome and also to increase the appreciation.

Awareness, Education and Community Participation

Participatory planning will be done to execute the activities of the project. The local community will be actively involved. Local JFMCs, EDCs, Watershed Committees, SHGs will also be involved in the process.

- Training of selected educated youth on the subject matter
- Development of proforma and linking the assignments with the beneficiaries of the project.
- Publication of the findings of the monitoring annually.

Exposure trips is also proposed to be organized in order to learn first hand information and practice on the wetland conservation management issues from the successful wetland sites.

Monitoring and Evaluation

Monitoring of conservation parameters will be undertaken with the involvement of the Regional and local research institutions working in the filed of wetland and environment conservation such as GB pant Institute, BSI, etc., For the purpose of Patrolling and Surveillance, a field assistant will be engaged to look after the project activities. Monitoring and evaluation findings will be published for the benefit of the regular monitoring and research.

Implementing Mechanism

The Implementing Agency:

Environment and Pollution Division of the Forest, Environment and Wildlife Management Department, Government of Sikkim.

Duration: Five Years.

Sustainability/ Exit protocol

Local people's participation will be encouraged from the beginning of the project. Once the establishments are made, a community organization will be established in consultation with the local people. That organization will have to take care of the continuity of maintaining the lake and monitoring the lake. That organization will get adequate financial support out of the revenue generated.

Work Programme for Conservation and Management of Khechuperi Lake

S. No	Activity	Unit	Unit Rate in Lakhs	2006-07		2007-08		2008-09		2009-10		2010-11		Total	
				Phy	Fin	Phy	Fin	Phy	Fin	Phy	Fin	Phy	Fin	Phy	Fin
1	Micro Planning and Preparation of Management Action Plan and Annual Plan of Operation	LS	0.300	1	0.30	0	0.00	0	0.00	0	0.00	0	0.00	1	0.3
2	Survey and Demarcation	LS	0.500	2	1.00	5	2.50	0	0.00	0	0.00	0	0.00	7	3.5
3	Fencing	Km	3.000	1	3.00	0	0.00	0	0.00	0	0.00	0	0.00	1	3.0
4	Watershed and Biodiversity Management														
	Vegetative Contour bunding	ha	0.120	5	0.60	10	1.20	10	1.20	10	1.20	5	0.60	40	4.8
	Small Check dams	Nos	0.200	16	3.20	10	2.00	10	2.00	10	2.00	10	2.00	56	11.2
	Bench Terracing	ha	0.120	6	0.72	6	0.72	6	0.72	6	0.72	6	0.72	30	3.6
	Hand Packed Wall inside Sausage	meter (std dimation)	0.044	100	4.40	50	2.20	50	2.20	50	2.20	50	2.20	300	13.2
	SMC works	ha	0.230	0	0.00	10	2.30	5	1.15	5	1.15	5	1.15	25	5.7
	Creation of Nursery	ha	1.940	0.6	1.16	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	1	1.1
	Maintenance of Nursery	ha	1.840	0.6	1.10	0.6	1.10	0.6	1.10	0.6	1.10	0.6	1.10	3	5.5
	Aided Natural regeneration	ha	0.083	0	0.00	20	1.66	25	2.08	25	2.08	20	1.66	90	7.4

	Afforestation	ha	0.149	0	0.00	10	1.49	15	2.24	15	2.24	15	2.24	55	8.2
	Control and regulation of biotic pressure	LS	0.250	2	0.50	2	0.50	2	0.50	2	0.50	1	0.25	9	2.2
5	Pollution Control Measures														
	Solid Waste Managment	LS	0.300	3	0.90	1	0.30	1	0.30	1	0.30	1	0.30	7	2.1
	Public convenience/ Toilet Facility	Nos	2.000	0	0.00	1	2.00	0	0.00	0	0.00	0	0.00	1	2.0
6	Tourism Amenities														
	Resting Sheds – 3 nos	Nos	0.800	1	0.80	0	0.00	1	0.80	1	0.80	0	0.00	3	2.4
	Visitors bench – 25 nos.	Nos	0.100	0	0.00	10	1.00	5	0.50	5	0.50	5	0.50	25	2.5
	Avenue Plantations with tree guards	LS	0.600	1	0.60	1	0.60	1	0.60	1	0.60	1	0.60	5	3.0
	Traditional Entry Gate		3.000	0	0.00	0	0.00	1	3.00	0	0.00	0	0.00	1	3.0
7	Awareness, Education and Community Participation														
	Community Organization	LS	0.300	2	0.60	1	0.30	1	0.30	1	0.30	1	0.30	6	1.8
	Publications of pamphlets, Brochures	LS	0.200	1	0.20	1	0.20	1	0.20	1	0.20	1	0.20	5	1.0
	Exposure trip		0.500	3	1.50	2	1.00	0	0.00	0	0.00	0	0.00	5	2.5
8	Monitoring and Evaluation													0	
	Monitoring of conservation parameters	LS	0.400	1	0.40	1	0.40	1	0.40	1	0.40	1	0.40	5	2.0
	<i>Patrolling and Surveillance</i>														
	Field Assistant	Nos	0.030	1	0.03	1	0.03	1	0.03	1	0.03	1	0.03	5	0.1
	Vehicle for PIA	Nos	8.000	1	8.00	0	0.00	0	0.00	0	0.00	0	0.00	1	8.0
	Publications of the findings	LS	0.300	1	0.30	1	0.30	1	0.30	1	0.30	3	0.90	7	2.1
9	Adminstrative Expenses														
	Project Assitant	Nos	0.060	1	0.06	1	0.06	1	0.06	1	0.06	1	0.06	5	0.3

	Office Establishment	LS	1.200	2	2.40	1	1.20	1	1.20	1	1.20	1	1.20	6	7.2
	TA/DA	LS	0.900	1	0.90	1	0.90	1	0.90	1	0.90	1	0.90	5	4.5
	sub total				32.68		23.96		21.77		18.77		17.31	0	114.5
10	Contingency Expenditure 2% of the cost		2 % of the total cost		0.65		0.48		0.44		0.38		0.35	0	2.2