

Information Sheet on Ramsar Wetlands (RIS)

Categories approved by Recommendation 4.7 of the Conference of the Contracting Parties.

For office use only.

DD MM YY



Designation date Site Reference Number

1. Date this sheet was completed/updated: 04.12.2001

2. Country: INDIA

3. Name of wetland: Kanjli

4. Geographical coordinates: 31°25'North Latitude
75°22'East Longitude

5. Elevation: (average and/or max. & min.) 210 meters above Mean Sea Level

6. Area: 183 ha

7. Overview: (general summary, in two or three sentences, of the wetland's principal characteristics)

Kanjli Wetland came into formation in 1870 with the construction of Head Regulator near village Kanjli on the Kali Bein rivulet in Kapurthala District. It supports diversity of aquatic, mesophytic and terrestrial flora and fauna including some important species of plants and animals.

8. Wetland Type (please circle the applicable codes for wetland types; in the present document, the "Ramsar Classification System for Wetland Type" is found on page 9)

marine-coastal: A • B • C • D • E • F • G • H • I • J • K • Zk(a)

inland: L • M • N • O • P • Q • R • Sp • Ss • Tp

Ts • U • Va • Vt • W • Xf • Xp • Y • Zg • Zk(b) • Zk(c)

human-made: 1 • 2 • 3 • 4 • 5 • 6 • 7 • 8 • 9

Please now rank these wetland types by listing them from the most to the least dominant:

It is a permanent stream converted into a small reservoir at Kanjli for the purpose of storage for irrigation supplies. It ranks in the order of **M - 6**

9. Ramsar Criteria: (please circle the applicable Criteria; the *Criteria for Identifying Wetlands of International Importance* are reprinted beginning on page 11 of this document.)

1 • 2 • 3 • 4 • 5 • 6 • 7 • 8

Please specify the most significant criterion applicable to the site: 3

10. Map of site included? Please tick *yes* -or- *no*



(Please refer to the *Explanatory Note and Guidelines* document for information regarding desirable map traits).

11. Name and address of the compiler of this form:

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Please provide additional information on each of the following categories by attaching extra pages (please limit extra pages to no more than 10):

12. **Justification of the criteria selected under point 9, on previous page.** (Please refer to the *Criteria for Identifying Wetlands of International Importance* appended to this document)

Criterion 3: Kanjli Wetland is an extremely important ecosystem in the region. It support a diverse kinds of food chains and food webs, help in water recharging and discharging, improve water quality, reduce flooding, etc. It is an important component of socio-religious aspects of the society.

Various species of important plants like *Phragmites*, *Ipomoea*, *Potamogeton*, *Vallisneria*, *Utricularia* and variety of tree species improve the habitat. Good number of birds, fishes, Zooplanktons and Benthic Invertebrates have been reported in the area. However, no endemic species have been reported in the area. The details of the plant and animal speies are provided under item 17 and 18.

13. General location: (include the nearest large town and its administrative region)

The Kanjli Wetland is located on rivulet Kali Bein* near village Kanjli at a distance of four km from Kapurthala Town at 31⁰25'N and 75⁰22'E. It falls under the administrative boundary of Kapurthala district of Punjab. The Kali Bein Rivulet travelling a long distance after originating from Budha Barkat Regulator near village Dhanoa upstream in Hoshiarpur District feeds the Kanjli Lake and the wetland area. It further moves towards Bakarke village, 10 kms. short of Harike Pattan Regulator and joins river Beas. The wetland is located about 20 kms North-East of Harike.

14. Physical features: (e.g., geology, geomorphology; origins - natural or artificial; hydrology; soil type; water quality; water depth, water permanence; fluctuations in water level; tidal variations; catchment area; downstream area; climate)

Kali Bein on which Kanjli Wetland is located had been one of the important tributaries of River Beas. This rivulet has played an important role in the formation of fertile plains by bringing down large sediment loads during floods. Kanjli Lake came into formation with the construction of a small barrage during 1870. The lake is thus fresh water permanent feature. The soils mainly are alluvium in nature consisting of alluvial sand, clay and loam. Maximum depth of water varies from 10 feet to 25 feet depending upon the season and water inflow. Catchment area is mainly under agriculture. Kali Bein ultimately joins Harike Wetland downstream after covering a distance of about 20 kms.

* **Kali Bein** also known as West Bein is a rivulet which travels almost parallel to River Beas and joins this river upstream of Harike Wetland.

Climate

The average annual rainfall in the region is around 700 mm extending from July to mid October. The temperature ranges from an average minimum of 6⁰C, occasionally dropping below the freezing point of water, in winter to a maximum of 45⁰C in summer (Verma *et al* 1994). Hence, water temperature and water depth also vary according to season.

15. Hydrological values: (groundwater recharge, flood control, sediment trapping, shoreline stabilization, etc.)

Kali Bein is a permanent rivulet. It acts both as a ground water discharging and recharging rivulet. Excess water during rainy seasons from the adjoining agricultural crops get discharged into the Kali Bein. It also serves

as an important source of water for agriculture. At the same time it also help in flood management. Since the ground water table in adjoining areas is stable as compared to rest of the State, the Bein is playing a vital role in hydrology.

The Kanjli Lake is an important water sponge performing the functions of recharging ground water. The ground water is in fact fast receding in some districts of Punjab but the observations around this wetland shows that it is playing a tremendous role in enriching the ground water thereby helping the nearby population, which is dependent on ground water for irrigation, industries and drinking supplies, for easy abstraction of water.

Pressure on underground water is also somewhat relieved as a number of farmers do direct abstraction of water from the Kali Bein as it is economical to some extent.

This wetland is in fact very important source of water in the Kapurthala district as such. The Kali Bein which passes almost mid-way through district has much more rewarding potential than ever estimated. Throughout its length, the Kali Bein is recharging the ground water and also it acts as a discharging drain by taking away excessive rainwater from sensitive crops like wheat, potato, etc.

16. Ecological features: (main habitats and vegetation types)

Ecologically Kanjli Wetland has similar values like Harike Wetland. It supports diversity of life forms. 26 ha forest area created along the Kali Bein provide suitable habitat for various organisms. Various species of mammals, fishes, birds, other vertebrate fauna, microfauna and large species populations of plants are important features of this wetland. A variety of plant communities ranging from obligate Hydrophytic to obligate Xerophytic species have established in the area. Dominant trees include species of *Delbergia*, *Acacia*, *Melia*, *Morus*, *Syzygium*, *Salix*, *Zizyphus* etc. Growth of *Phragmites*, *Typha* and *Ipomoea* also predominate the habitat. Aquatic vegetation include species of *Hydrilla*, *Vallisneria*, *Potamogeton*, etc (Ladhar 1995). This Lake is infested with invasive water hyacinth which is removed from time to time. Some under water weeds are also considered to be problematic for recreational activities (PSCST 1992, PSCST 1998). Growth of *Parthenium* is also posing a problem.

Food Chain :-

Kanjli Wetland has both deep water and shallow water features. The food chain is basically of grazing type. The abiotic components of the ecosystems at Kanjli are chiefly sun light, pH, inorganic salts, nutrients and dissolved gases. The organic matter accumulates at the bottom and mainly comes from the death and decay of plants and animals.

The producers are autotrophic plants and some photosynthetic bacteria. These are mainly the rooted submerged, floating and emergent hydrophytes like *Typha sp.*, *Eleocharis sp.*, *Sagittaria sp.*, *Nymphaea sp.*, *Potamogeton sp.*, *Vallisneria sp.*, *Eichhornia sp.*, *Lemna sp.* etc. and minute, floating or suspended lower plants like filamentous algae, diatoms, chlorococcales and flagellates.

The primary consumers at Kanjli are herbivores. These include molluscs, caustaceans, rotifers and some insects. Detrivores, feed upon plant remains and organic matler. Besides, some mammals such as buffaloes, cows etc. also visit the lake and feed on marginal rooted macrophytes. Some birds also feed on some hydrophytes.

The secondary consumers are carnivores, feeding on insects, molluscs, rotifers and crustaceans. Some insects and carnivorous fishes feed on crustaceans, rotifers and molluscs. The tertiary consumers at Kanjli are some snakes and birds which feed on small fishes and insects. The upper most consumer level is occupied by man and fish eating birds. The organic matter which accumulates at the bottom of the lake is decomposed by a variety of heterotrophic microbes such as bacteria, actinomycetes and fungi.

All the areas adjoining Kanjli Wetland are under cultivation. Major crops include Wheat, Rice, Sugarcane, Sorghum, etc.

This Wetland support diversity of fish species as listed in Item 18.

See page 15 for FOOD WEB AT KANJLI WETLAND

17. Noteworthy flora: (indicating, e.g., which species/communities are unique, rare, endangered or biogeographically important, etc.)

This wetland is important for many species of plants which are ecologically significant. Diverse kinds of floral species belonging to hydrophytes, mesophytes, xerophytes, obligatory and facultative representatives have been reported in the area. The original terrestrial vegetation of the area can be classified under Northern Tropical Dry Deciduous Forest type. However, extensive deforestation over the years and conversion of forested area into agricultural lands has resulted in decreased vegetational diversity. Insectivorous plant *Utricularia sp.*, pollutants managers *Phragmites sp.*, *Typha* etc. and other aquatic plants are noteworthy species. The Common flora is listed below :-

COMMON FLORA OF KANJLI WETLAND AREA

Based on PSCST 1992, Handa, 1993, Sharma 1984)

Trees:

Dalbergia sissoo

Acacia arabica

Prosopis juliflora

Eucalyptus hybrida

Mangifera indica

Morus alba

Albizzia lebbeck

Azadirachta indica

Melia azedarach

Ficus bengalensis

Ziziphus mauritiana

Syzygium cumini

Shrubs

Calotropis procera

Ipomoea crassicaulis

Tamarix dioica

Herbs

Saccharum munja

S. spontaneum

Scirpus sp.

and other common herbs.

Aquatic Flora

Typha elephantina

Nelumbo sp.

Eichhornia crassipes

Typha angustata

Cyperus sp.

Potamogeton sp.

Hydrilla sp.

Vallesnaria sp.

Nymphaea sp.

Chara sp.

Trapa sp.

8. Noteworthy fauna: (indicating, e.g., which species are unique, rare, endangered, abundant or biogeographically important; include count data, etc.)

The Kanjli Wetland supports mainly lotic fauna. Islands are usually absent and marshy areas are found along the Kali Bein. The margins of the Bein support a variety of micro and macro flora and fauna. 4 mammals, about 50 species of birds, 12 taxa of fishes and 35 taxa of invertebrates have been reported in the area. The important faunal species are as under :-

a) Avifauna :

Kanjli Wetland supports a large number of resident and migratory birds. It attracts almost the same type of avifauna as that of Harike. It, infact, acts as an important refuelling base for long distant migratory birds. Some of the common resident and migratory birds are listed below :

Common Resident Birds Of Kanjli Wetland Area
(Based on Deptt. of Wildlife, GOP 1993 ; PSCST1999)

Crow	Cormorant	Red munia
Little cormorant	Indian darter or snake bird	koel
Parakeets		
Sparrow-hawk	Shikra	Sparrow vulture
Pigeon	Blue rock	Weaver bird
Ring dove	Turtle dove	Indian robbin
Peafowl	Spotted dove	Field king fisher
Indian button quail	Bush quail	Black-winged kite
Partridge	Common quail	
Common coot	Grey partridge	
Lapwing	Purple moorhen	

Common Migratory Birds Of Kanjli Wetland Area

Various species of goose	White eyed pochard
Wigeon	Tufted pochard
Common teal	Large whistling teal
Pintail	Mallard
Shoveller	

b) **Icthiofauna :**

About 15 fish species have been reported in the District Gazetteer. National Environmental Engineering Research Institute (NEERI) (Handa, 1993) has reported 17 fish species as listed in table given below. The common fish species are *Catla catla*, *Channa marulius*, *C. striatus*, *Cirrhinus mrigala*, *Labeo calbasu*, *L. rohita*.

List Of Fish Species In Bein And Kanjli Lake

<u>Sr.No.</u>	<u>Scientific Name</u>
1.	Labeo rohita
2.	Catla catla
3.	Ctenopharyngodon idella
4.	Channa maurulius
5.	Clarius batrachus
6.	Notopterus chitala
7.	Puntius sophori
8.	Labeo bata
9.	Labeo calabasu
10.	Cyprinus carpio
11.	Wallago attu
12.	Channa striatus
13.	Channa punctatus
14.	Notopterus notopterus
15.	Ambassis bacalus
16.	Mystus seenghala
17.	Mystus tengara

c) **Other Fauna:**

Studies carried out by NEERI, Nagpur shows the availability of diverse kind of Zooplankton Species at Kanjli Wetland as listed in table given below. The dominant zooplankton species include *Diffulgia sp.*, *Vorticella sp.*, *Brachionus sp.*, *Epiphanes sp.*, *Monostyla sp.*, *Testudinella sp.*, *Chaetogaster sp.*, *Diaphanosoma sp.*, *Ceriodaphnia sp.*, *Chydorus sp.*, *Macrothrix sp.*, *Cyclops sp.*, *Mesocyclops leuckartii* and *Chiromomus larvae*. However, their occurrence varies from season to season. The Punjab Pollution Control Board (PPCB) (1993) has reported the dominant presence of some more species like *Notholca sp.*, *Daphnia sp.*, *Diaptomas sp.*, *Nauplius sp.*, *Microstomum sp.* and *Bothromesostomum sp.* Similarly the Benthic Macroinvertebrate species reported in Kanjli Wetland area are given in a separate table below. The dominant macroinvertebrate species are *Branchiura sawerbyii*, *Baetis sp.*, *Chironomus tentans* and *Chironomus tendipediformis*. The PPCB has also reported the dominant presence of *Planorbis*, *Heteroptera* and *Chironomids* in the recent studies.

List of Zooplankton Species recorded in Bein river and Kanjli Lake

Species	
Protozoa	Namatoda
	Monochulus sp.
Amoeba sp.	Monochus sp.
Centrophxis sp.	Rhabdolaimus sp.
Coleps hirtus	Oligochaeta

Diffugia sp.	Chaetogaster sp.
Vorticella sp.	Diaphanosoma sp.
Rotifera	Diplogaster sp.
Anuroeopsis sp.	Ostracoda
Brachionus sp.	Cypris sp.
Cephalodella sp.	
Epiphanes sp.	
Filinia longiseta	Cladocera
Keratella valga	Alona sp.
Lecane sp.	Bosmina sp.
Lepadella sp.	Ceriodaphnia sp.
Monostyla sp.	Chydorus sp.
Platyias sp.	Pleuroxus sp.
Ploesoma sp.	Macrothrix sp.
Testudinella sp.	Copepoda
Trichotria sp.	Cyclops sp.
	Mesocyclops leuckartii
	Chiromomus larvae

List of Benthic Macroinvertebrate species recorded in Bein River and Kanjli Lake

Taxa	
<p>Insecta</p> <p>Hydropsyche sp. Limnephilus sp. Baetis sp. Hexagenia limbata Tanypus sp. Palpomya sp. Chironomus tentans Chironomus tendipediformis</p>	<p>Oligochaeta</p> <p>Aelosoma bengalensis Chaetogaster sp. Branchiura sawerbytii</p> <p>Mollusca</p> <p>Lamellidan marginalis Indoplanorbis exustus Lymnaea lutiola Melanoides sp.</p>

As reported in the District Gazetteer (Sharma, 1984), tortoise is commonly found in the area. Certain other reptiles have also been reported. The mammalian fauna includes Indian Civet, Mongoose, Indian porcupine squirrel and common Indian hare.

Authentic Information about the population size, count data and endemism of various species particularly the birds is not available.

19. Social and cultural values: (e.g., fisheries production, forestry, religious importance, archaeological site, etc.)

26 ha area under forests of native tree species has considerably improved

the ecology of this wetland. No other river in the State is as important from religious view point as this Kali Bein (rivulet) is because it is associated with the first Guru of Sikhs, Shri Guru Nanak Dev Ji.

20. Land tenure/ownership of: (a) site (b) surrounding area

(a) Site :

The are under Kali Bein is under the ownership of the State Govt. Some surrounding marsh areas, areas under orchard and forests are also the property of Govt. of Punjab.

Details have been marked on the enclosed map.

(b) Surrounding area :

Entire area sourrounding Kanjli Wetland is privately owned and is under agriculture.

21. Current land use: (a) site (b) surroundings/catchment

(a) Site :

The details of landuse at site are given on the map attached alongwith.

(b) Surrounding area :

Punjab has a predominantly agriculture based society, and the plains of Sutlej and Beas have been cultivated by generations of local farmers. Presently about 83.5 percent of total geographical area of Punjab is under cultivation, with 3/4th of the population engaged in this activity. Major crops grown are wheat, rice, maize, sugarcane, cotton, oilseeds, potato, barley & pulses.

22. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land use and development projects: (a) at the site (b) around the site

The general problems associated with Kanjli wetland are excessive weed growth (mainly, water hyacinth), reducing inflow of water, increasing pollution levels, deforestation in catchment areas, excessive grazing & soil erosion etc (PSCST 1992, PSCST 1998, PSCST 2000).

23. Conservation measures taken: (national category and legal status of protected areas - including any boundary changes which have been made: management practices; whether an officially approved management plan exists and whether it has been implemented)

To ascertain proper conservation and management of Kanjli Wetland,

several steps have been initiated by the Council under the aegis of Department of Environment, Govt. of Punjab with financial assistance from Ministry of Environment & Forests, Govt. of India. Conservation & management measures were started at Kanjli Wetland during 1988-89. Comprehensive Conservation and Management Plan was prepared in 1990. Again a Ninth Five Year Plan document for conservation of this wetland was prepared in 1998-99 (PSCST 1998). Various programmes taken up are given at Annexure-I.

24. Conservation measures proposed but not yet implemented: (e.g., management plan in preparation; officially proposed as a protected area, etc.)

For continuation of activities during 9th Five Year Plan, a Comprehensive Conservation and Management Action Plan for Five Years has been formulated and submitted to the Ministry of Environment & Forests, Govt. of India. Details are given at Annexure-II.

25. Current scientific research and facilities: (e.g., details of current projects; existence of field station, etc.)

There are three Universities in the State mainly Punjab Agriculture University, Ludhiana Punjabi University, Patiala and Guru Nanak Dev University, Amritsar, where necessary scientific infrastructural facilities are available for undertaking studies on this wetlands. Sludge and Water Quality Monitoring has been done during the year 1991-92, 1992-93 & 1996-97. A project on Management and Control of Aquatic Weed in Kanjli Wetland was taken up by NEERI, Nagpur 1993.

26. Current conservation education: (e.g., visitors centre, hides, info booklet, facilities for school visits, etc.)

Information material in the form of posters, pamphlets, brochures etc. is published and distributed among public. Interpretative hoardings are installed at various locations. Seminars, meetings, workshops and field visits are organised from time to time.

The Council proposes to further carry out this activity in a concerted manner by involving various Voluntary organisations in the state. Camps shall be organised and mass-media and educational material shall be produced for distribution among the public. It is also important that research findings be translated into training programmes.

27. Current recreation and tourism: (state if wetland is used for recreation/tourism; indicate type and frequency/intensity)

A large number of tourists, nature lovers, environmentalists, policy makers, students and senior citizens visit the area every year. This is being considered as a very important picnic area. There are facilities of

boating, nature walks and bird watching etc. The Boat Club functioning in the area does some earning from the visitors. To enhance the recreation facility at site, the district administration has improved the park area. PSCST is planning to provide more facilities for the attraction of school children and general public.

However, the growth of water hyacinth in the lake adversely affect the recreational activities.

28. Jurisdiction: (territorial, e.g. state/region, and functional, e.g. Dept of Agriculture/Dept. of Environment, etc.)

Punjab,
Department of Science, Technology &
Environment, Government of Punjab
and
District Administration,
District Kapurthala.

29. Management authority: (name and address of local body directly responsible for managing the wetland)

Principal Secretary,
Department of Science, Technology &
Environment, Government of Punjab , Through
Punjab State Council for Science & Technology
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Email : nstiwana@hotmail.com

30. Bibliographical references: (scientific/technical only)

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- Ladhar S.S. (1995) Inventory and Ecological Status of Wetlands and Lake Ecosystems of Punjab.
- Punjab Pollution Control Board, (1993). Kanjli Wetland – A report on status of water quality. Patiala.
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- Punjab State Council for Science & Technology (1998): Comprehensive Conservation and Management Plan (for Ninth Five Year Plan) for Kanjli Wetland.
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CONSERVATION MEASURES TAKEN

The Ministry of Environment & Forests, Govt. of India (MoEF, GOI) selected Harike Wetland and Kanjli Wetlands for conservation and management. Subsequently, a State Level Steering Committee was constituted in 1987 to identify the problems of the area and initiate remedial measures. This Committee designated the Environment Division of Punjab State Council for Science & Technology for coordinating and implementing the Wetland Projects. The conservation and management measures so far taken at Kanjli Wetland with the assistance of MoEF, GOI are described as under:-

1. Survey, Mapping and Notification:

A detailed survey of Kanjli Wetland has been carried out and draft map as well as draft notification have been prepared by the Town & Country Planning Department. Draft notification has been submitted to the MoEF, GOI for issuing notification of this wetland as it is important that the Kanjli Wetland be notified as protected area under the Environment Protection Act, 1986.

2. Weed Control:

Water hyacinth is a major problem at Kanjli Wetlands and control of this weed needs to be taken up on priority basis. Excess of weed is seen to cover the entire water surface thus depriving the avian fauna of the very fact, which attracts them to these wetlands - a plentiful water availability. Besides, excessive transpiration by the plant also leads to enhanced water losses. However, this plant is also recognized as a water purifier due to its ability to absorb heavy metals from the water bodies. At the same time, its death and decay within the wetland can lead to re-entry of these chemicals in water further leading to eutrophication.

Excessive growth of water hyacinth in the West Bein and surrounding ponds thus pose a major ecological problem. Since the chemical method of weed removal is not desirable, manual method of weed control has been adopted. The experience of manual removal of this weed has, however, shown that plants reappear after every 3 to 4 months. Hence, weed clearance is required about 3 times in a year. Physical stoppage of this weed upstream of the main lake area has also not helped in bringing this weed under control. Efforts to gainfully utilise this weed for biogas generation also could not provide encouraging outcome. The weed control measures have been carried out by the Irrigation Department and district administration. District Police has also helped for cleaning the lake of this weed at times. During 2000-2001, Army cleared some part of the lake. Now it is planned to use conveyor belt system as a mechanical way to clear this weed.

3. Afforestation:

The wetlands of Punjab are perhaps not the perfect avian paradise though they attract large species of birds. There are perhaps not too many trees for birds to operate from. A good tree cover not only provides adequate space for nesting and roosting and food for some bird species but it also acts as lungs of the ecosystem. Further, it promotes understorey vegetation and helps in preventing siltation since roots of plants act as effective soil binders. Trees need to be grown not only around the ponded area but also on the small islands. Till date about 26 hec. area in Kanjli Wetland has been afforested with mixed indigenous species by the Forest Department. Work needs to be continued for plantation in both wetland zone as well as catchment areas to increase the tree cover.

4. Fencing:

The wetlands need to be protected from excessive grazing by cattle and encroachment by public for the preservation of important pockets providing habitat to wading birds. Encroachments need to be checked by the District Administration and unauthorised occupations removed. Till date 10880 Ln.Ft. fence has been erected around the Kanjli Wetland area by the Deptt. of Forests & Wildlife. It may be pointed out that the purpose of this fencing is not only to protect young plants but also to demarcate habitat for wading birds.

5. Monitoring of Pollution:

The external loading of nutrients is a decisive factor for determining the productivity of lake water. Overloading of lakes by nutrients can lead to eutrophication. For the restoration of wetland quality, preventive and curative steps are required to be undertaken. Hence, monitoring of water quality is an important activity because polluted water from some towns and industries enters into the Kali Bein. Besides, non-point pollution of farm chemicals from the catchment areas is another problem. The Punjab Pollution Control Board has already undertaken monitoring of water quality of Kanjli Wetland during 1991-92, 1992-93 and 1996-97 which shows that the water of this wetland generally conforms to class "B" as per designated best use. It however deteriorates to Class 'D' during December.

PPCB has recommended the following measures :

- i) Intensive afforestation activity is required to prevent the seepage and runoffs from the nearby field. A rich tree cover besides, acting as lungs of the ecosystem will provide adequate space for nesting of some birds species too.
- ii) Weed clearing, manually or by dredging, is frequently required.

- iii) Steps should be taken to prevent the people from making the lake a dumping site.
- iii) proper level of water must be maintained in the reservoir to save the biotic life of the lake in acute summers.
- iv) Deforestation should be strictly prohibited (in catchment along the Kali Bein).
- v) The villages along Kali Bein feeding Kanjli lake must not discharge their sullage into the Kali Bein. The Village Panchayats may use Karnal Technology for use of sullage for irrigation purposes.
- vi) The farmers be educated to use least amounts of fertilizers and pesticides and as far as possible switch over to bio-fertilizers and bio-pesticides.

The extent of water hyacinth in the lake is an indicator that eutrophication has increased over the years especially due to use of farm chemicals in the nearby fields.

What is needed now in view of recommendations of the Board is to continue the detailed study of the cause and extent of pollution in the river water feeding the lakes and plugging the factors responsible for deterioration of water quality.

6. Public Awareness :

The Council has been carrying out public awareness activity by involving NGOs and other departments. Posters, pamphlets and other information material have been published and distributed and educational hoardings have been installed at site. Seminars and meetings are organised from time to time.

CONSERVATION MEASURES PROPOSED BUT NOT YET IMPLEMENTED

The values of wetlands in landscape and their benefits for human kind are increasingly recognized yet economic development continues to destroy or degrade wetland systems. It is accepted that wetlands are functioning in a larger ecological entity. Their management and conservation programmes must, therefore, address to the entire system processes functioning in the landscape as a whole to ensure maintaining the sustainability. Various factors has to be taken into account for both short and long term measures to prevent any further loss and improve their ecological character. A truly holistic approach needs to be implemented after optimising all the system qualities. Efforts to conserve Kanjli Wetland, which is one of national wetlands, have been continuing for the last few years. It is, however, observed that intensive efforts need to be made to restore the ecological character of this wetland. PSCST, therefore, proposes to continue conservation measures at Kanjli Wetland in coordination with various executing departments in the State. Details of all the activities are given below:

1. Afforestation :

Tree cover in wetland area provides suitable microhabitats for diversity of fauna. Besides, the spawning of fish takes place preferably under the shade of trees in aquatic ecosystem. However, the status of tree cover in wetland area is dwindling. Thus efforts are needed to balance the ecosystem by providing more greenery by way of planting diverse kinds of native trees like species of *Acacia*, *Terminalia*, *Syzygium*, *Salix*, *Pongamia*, *Morus*, *Azadirachta*, *Casuarina*, *Delonix*, etc. To extend the area under green cover around the Kanjli Wetland, the Deptt. of Forest and Wildlife, Punjab plans to take up plantation in another 10 hectare area during next five years at a cost of Rs. 7.00 lac.

2. Wildlife Conservation :

Wetlands are the important repositories of the diversity of wild genetic resources extremely important from long-term ecological point of view. But as the wetlands are shrinking the biological resources are also under stress. The wildlife at Kanjli Wetland is also suffering loss due to one reason or the other. To conserve wildlife resources the Wildlife Deptt., Punjab proposes to take up conservation measures like protection of the area by repairing damaged fence already erected around the wetland and by erecting barriers. Besides, the Deptt. plans to put up some wooden nests to facilitate the multiplication of birds. To avoid disturbance to the wildlife it is also planned to put up wooden hideouts for the explorers of nature/wetland. These activities shall require an assistance to the tune of Rs. 6.35 lac.

Recent experiments in some western countries shows that landing of some important birds in wetlands also depends upon the clues and signatures supporting the occurrence of some related birds in that habitat. Since the birds are important ecological components of any ecosystem the results of such experiments may help in artificially encouraging the landing of birds. Punjab State Council for Science & Technology, therefore, proposes to install suitable number of plastic birds initially at Ropar and Kanjli Wetland marshes. For this purpose Rs. 1,00,000/- will be required.

3. Control and Management of Water Hyacinth

Kanjli Wetland is infested with the worlds worst weed i.e. water hyacinth. So far the manual operations have been adopted to bring this weed under control. However, the lake get reinfested with this weed within no time. To safeguard the ecological character of this ecosystem it is planned to take up integrated measures of both physical removal by using conveyor belt mechanical system and control through biological means. The aim of this activity is to establish sustainable long term capacity for maintaining control of water hyacinth. The control programme would rely on manual method for rapid short term control in restricted areas, and biological agents for long term control. The biological control programme would initially rely on release of two weevil species that have been found effective world wide and have already been imported, reared and released in Harike Ecosystem. These species of weevils are *Neochetina bruchi* and *N. eichorniae* which are complimentary in their action. The possibility would also be explored for supplementing the weevils later by releases of moth *Sameodes albiquittalis* if found appropriate. At present no funding estimates are indicated under this project separately as the Comprehensive Proposal for control of water hyacinth from catchment drains of Harike Wetland have already been included under Harike Wetland project. However, to take up physical removal of weed from Kanjli ecosystem area an amount of Rs. 9.50 lacs shall be required for five years.

4. Water Quality Monitoring :

Punjab Pollution Control Board has studied the water and sludge quality of Kanjli Wetland area and has reported that water of this lake generally conforms to Class 'B'. But the quality degrades even to Class 'D' sometimes. Recommendation of the studies have been included in previous pages. One of the important recommendations is to keep vigil on the level of pollution for which the regular monitoring of the lake water must be continued. This shall help to elucidate the nature and dynamics of the lake ecosystem on long term basis. PPCB proposes to continue the water quality monitoring programme during the next five years for which an estimated amount of Rs. 16.00 lacs shall be required.

5. Conservation of Fisheries :

The importance of wetlands has also been linked to the productivity of fish species. Besides, the diversity of fish available in particular ecosystem determines the ecological status and functional values of that particular ecosystem. While the reports shows that their are 17 species of fish existing in the lake water of Kanjli but the degrading water quality may exterminate most or even all of these species in the times to come if curative measures are not initiated. Therefore, a programme aiming at restoring and sustaining the survival of all the species available in this lake has been planned. The programme would address the continuing pressure by introducing more fish species in the lake but would do so by avoiding the unforeseen effects of exotic introductions. With this view the Deptt. of Fisheries would take up necessary steps at Kanjli Wetland for which estimated amount of Rs. 24.95 lacs shall be required.

5. Research Studies :

This programme aims to provide information on the ecology of the lake and its catchment, the biology of its flora and fauna, the impact of environmental factors on the lake system and socio-economic implications of the use of lakes resources. Research programmes oriented in this direction shall contribute towards improved ecological efficiency, greater biodiversity, and ecological balance in the lake system. To analyse the biotic components, foodchain sequence in our wetlands and potential threats to these places and their components, and to make long-term conservation strategies, the research studies on aquatic ecosystems of Punjab are being promoted by the State Science & Technology Department. Certain future programmes for wetland conservation will definitely depend upon the research database. Studies on biodiversity of this wetland and limnological parameters besides habitat characteristics and economic valuation of Kanjli Wetland resources are priority areas of research as are described hereunder:-

- a) Hydrology & productivity: Detailed studies need to be carried out to study the impact of this wetland on hydrogeology of the area. Economic productivity linked with this issue needs to be evaluated and projected.
- b) Fisheries & sustainable use of wild life Population: Due to heavy pressure on the wetland areas on account of various factors like encroachment for agriculture, pollution, etc. the impact on faunal populations is catastrophic. It is clear that unless solid argument based on hard scientific data is presented for maintenance of these sites, this effort is likely to continue. Hence the need of investigation in this area. The fisheries research programme would have five sub-programmes: Studies of fish biology and biodiversity conservation, aquaculture, socio-economics, database establishment and fish stock assessment.

- c) Traditional human use : Wetland conservation practices can be successful only if its social impact is conducive to its use by the people inhabiting around that ecosystem. It is, therefore, important that social impact analysis of developmental versus conservation projects be carried out alongwith environmental impact analysis of various human activities initiated in the wetland area.
- d) Flora & Fauna : Detailed taxonomic studies of plant and animal species of this wetland need to be carried out. This will also help to identify the endemic species, if any, of this region which will invite particular attention for conservation.

A corpus amount of Rs. 10.00 lac for five years will be required for conducting these studies. The research projects can be initiated depending upon the availability of funds.

7. Economic Valuation of Wetland Resources :

Wetlands are as yet least understood or even misunderstood ecosystems from the productivity values and functional points of view in the State. These are being quickly reclaimed under the name of reformation. Both manmade and natural wetland places in Punjab are under severe threats. Although Harike Wetland has been listed as one of the six Indian Ramsar sites of international significance and Kanjli and Ropar Wetlands are of national significance and PSCST has also recognized five more wetlands of state importance, still environmental deterioration of wetlands is on the peak. This has been despite all concerted efforts of the state and union government for their conservation and management to ensure their sustainability so that the Society can derive wide-range benefits from them. Since the environment is simply incomplete without wetlands which provide livelihood on diverse counts, it is extremely essential to understand the role of wetlands in general and each of its components in particular, their ecological functions and values not wetlands as units but in respect of their contributions to agriculture, forestry, recreation etc. for effective integration of such understanding into the overall planning process.

A three-stage wetland valuation approach may be generally applied to completely understand the exact role and values of any wetland. These three steps for evaluation of wetland resources and sustainable development may be described as 'General, Ecological and Economic Analysis', 'Detailed Parameter Analysis' and 'Specialised Issue Analysis' of each wetland ecosystem. Functional values of wetland ecosystems shall involve assessment of 'Life Support Functions' with respect to their critical/vital position and status, 'Social/cultural functions' with respect to recreational, aesthetic heritage, educational values etc., productivity functions with respect to subsistence and commercial outputs and other functions like future roles/values in long range aspects.

Various management aspects shall directly be related to the wetland values/functions and the anthropogenic threats to such ecosystems. So a comprehensive analysis of the systems and environmental impacts is required to be undertaken for planning suitable measures including involvement of general public.

Under General Analysis, the following aspects will be covered :-

- Biological components with respect to importance of wetland wildlife including waterfowl, plant species rarity/scarcity etc. and its rating.
- Hydrological components including water status, erosion & its control, flood impact etc.
- Productivity potential with respect to direct value products.
- Social aspects like local or state heritage.
- Overall rating of wetland significance.

Under Detailed Parameter Analysis, each of the life support, socio cultural and production values will further be critically fractionated and evaluated in terms of their exact values and potential with respect to future needs of the system. Different steps adopted by international organisations will be adopted and followed for this purpose.

As regards specialised analysis, specific working matrices will be followed as recommended by North American Wetland Conservation Council to evaluate use and non-use values, option values, existence values. etc.

For undertaking the economic valuation of resources of Kanjli and Ropar Wetlands and five State level wetlands of Punjab, intensive studies shall be conducted for which an estimated expenditure of Rs. 15.00lac shall be required

8. Public Awareness :

Conservation and Management of wetland ecosystem can best be ensured if the public participates in these programmes. It is possible if the public is aware about the importance of such eco-systems. Awareness can be created through mass-media, educational material, camps etc. Voluntary Organizations can play an important role in translating scientific ideas to public opinion. The informed general public can then become a potent force in developing sound wetland management policies. The public awareness activities would require funds amounting to Rs. 13.75 lac during next five years.