

PARTICIPATORY NATURAL RESOURCE MANAGEMENT PLAN FOR KEENJHAR LAKE WITH PARTICULAR EMPHASIS ON FISHERIES

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DOI: <http://doi.org/10.5281/zenodo.23159085>

Keywords

Natural Resources Management Plan, Keenjhar lake, Freshwater Fishery

Article History

Received: 19 January 2023

Accepted: 04 March 2023

Published: 18 March 2023

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Abstract

Keenjhar Lake (Kalri Dhand) is known to be a 2nd largest freshwater lake in Sindh situated in Thatta district longitude 24°56'49.30" N and latitude 68°03'27.64" E on global map. A total of eight significant villages of Keenjhar lake namely; Jhimpir village, Nabi Bux Palari village, Chul site village, Sonheri village, Adam Gandro village, Bhambra village, Hilaya village and Lal Bux Manchari were visited for study of the lake biodiversity and other related resources. The collection of biodiversity samples and community focus group discussions (FGD) were carried out to prepare NRM plan for fisheries. Through the results of FGDs, it was reported by communities that 40 years earlier lake had great assets of natural resources and currently most living resources have vanished. The communities demanded that concerned government departments and private companies should come in action and facilitate us in terms of set up of alternative livelihood options in terms of attention for installation of fish preservation and processing industries, fish seed production units, macrophytes utilization in handicrafts and matmaking units, vocational centers, training centers, small cottage type industries, local product utilization trade centers and international market linkages among local and national perspectives. About 60% of native communities are involved in fishing by profession. However, 40% Keenjhar community people by the profession are concerned with agriculture, cattle farming, stone extraction, mat making, and serving for NGOs, Mills and government sector. Community raised their voice that capacity should be built to manage their natural resources in terms of technical trainings and applied nature interventions at the site. Immediate stop of rock excavation from surrounding the lake to ensure protection and conservation of biodiversity and the habitat. Historically Jhimpir town has great resources of Date Palm (Baluchistan Palm) and this has been a great source of their livelihood but nowadays due to water scarcity Date Palm is making their survival hard. Small boats are used for fishing by local communities. The government should provide fishing trollers for deepwater fishing purposes. A technical training vocational center for capacity building of youth, women and old age group of peoples. Women as whole

complained that we are facing non availability of water must bring water from 1-2 km distance. Government should build here a small water reservoir to harvest rainwater. Health care facilities are also not available here. When discussion started community raised the concern that we should be given the small projects of fisheries extension. Page and Cage culture should be introduced here, and zero size nets must be installed at canal gates so that fish cannot escape back. They also demanded that we really need capacity building trainings on fisheries and NRM. Government should hold regular cleaning campaign through different technological advances for excessive growth of macrophytes. Sindh fisheries department should strong control on undersize fish catch, using illegal and uncertified gears as well as illegal fishermen involvement for fishing by implementation the Ordinance 1980 amended 2021. The industrial effluents and wash downs of harmful chemical dumping in lake causing greatly damaged the lake biodiversity. The pollutants should immediately be stopped. Sindh EPA and the law enforcement departments should take immediate actions to control pollution. Strongly follow up the rules and regulations of Ramsar convention as Keenjhar lake is most important need of the era. As the Keenjhar lake is declared a Ramsar site as a wetland of international importance but due to ignorance of law enforcement lake is facing different environmental problems. Lake can be better managed if all the environmental stipulations are strictly enforced

Introduction

Keenjhar Lake (Kalri Dhand) is known to be a 2nd largest freshwater lake in Sindh situated in Thatta district situated North and North - East of Thatta town longitude 24°56'49.30" N and latitude 68°03'27.64" E on global map (fig.1). It is a freshwater lake with a maximum length 24 km and maximum width 6 km, however an area of about 145 km². The maximum depth of the lake is 8m. This lake is available at stony desert, composed of alternating layers of limestone and sandstone. It was originally established in the 1950s when an embankment was constructed on the eastern shore of the Sonehri and Keenjhar lakes. When the River Indus changed its course and cut them off, these lakes were initially formed. Before the barrier was constructed, the lakes on the western side were supplied by twelve hill torrents. It now gets most of its water from the Indus River through canals. Keenjhar might be regarded as a semi-natural lake in this perspective. In addition to the Kalri Baghar canal, which starts at Kotri Barrage and enters at the northwest corners, the lake is fed by several small seasonal streams that arrive on the western and northern sides. The only outlet is the Jam branch canal in the southeast part of

the lake (WWF, 2006). The lake, the largest freshwater lake in the country, receives most of its water from the Indus River. However, a little amount is also provided by runoff from neighboring hills and streams. People who live close to the lake utilize water daily (WWF, 2006). Keenjhar Lake is the main source of water for Karachi and parts of the Thatta district. The lake was once about 18.5 meters deep, but later siltation from the River Indus reduced its depth to only 5–6.5 meters. The sixty-two small and large communities around the lake are divided among the four Union Councils of Sonda, Oongar, Jhimpir, and Chatto Chan of Tehsil and District Thatta. Sonheri, Chill, Ghandri, Chakro, Moldi, Dolatpur, Chilliya, Khambo, and Hilllaya are the main villages. On the northwest side of the lake is also the village of Jhimpir. Before the separation, more than 40,000 fishermen who resided in the aforementioned areas bordered it. More than 50,000 people depend on the lake. Fish land in four different places: Lake Viz, Khumbo, Chilya, Sonheri, and Jhimpir. In the area, eight hundred fishing boats are in operation. The fishermen's fishing areas were

suitably defined by the local community (Ali,1999). For example, the people who live in the Sonheri hamlet have their own fishing grounds and have never gone fishing in the Jhimpir areas. The main castes and tribes represented include Palari, Shora, Kapai, Gandara, Hilaya, Turk, Katiyar, Khaskheli, and Sarki. The primary industries in the community are farming and fishing. Members of the Palari, Shora, Hilaya, and Turk tribes are employed in agriculture around the lake. Pesticides are used

extensively in the farmed area. In the buffer zone and surrounding the lake, people graze their livestock, including goats, cows, and buffaloes. Fishing is the activity of other casts, known as Mirbahar. The fishing practices used by the local communities are generally sustainable. The villagers hardly ever use small mesh nets to catch fish. The permanent circular nets known locally as "Gol Jaar" that are placed in the lake are another sustainable fishing technique.

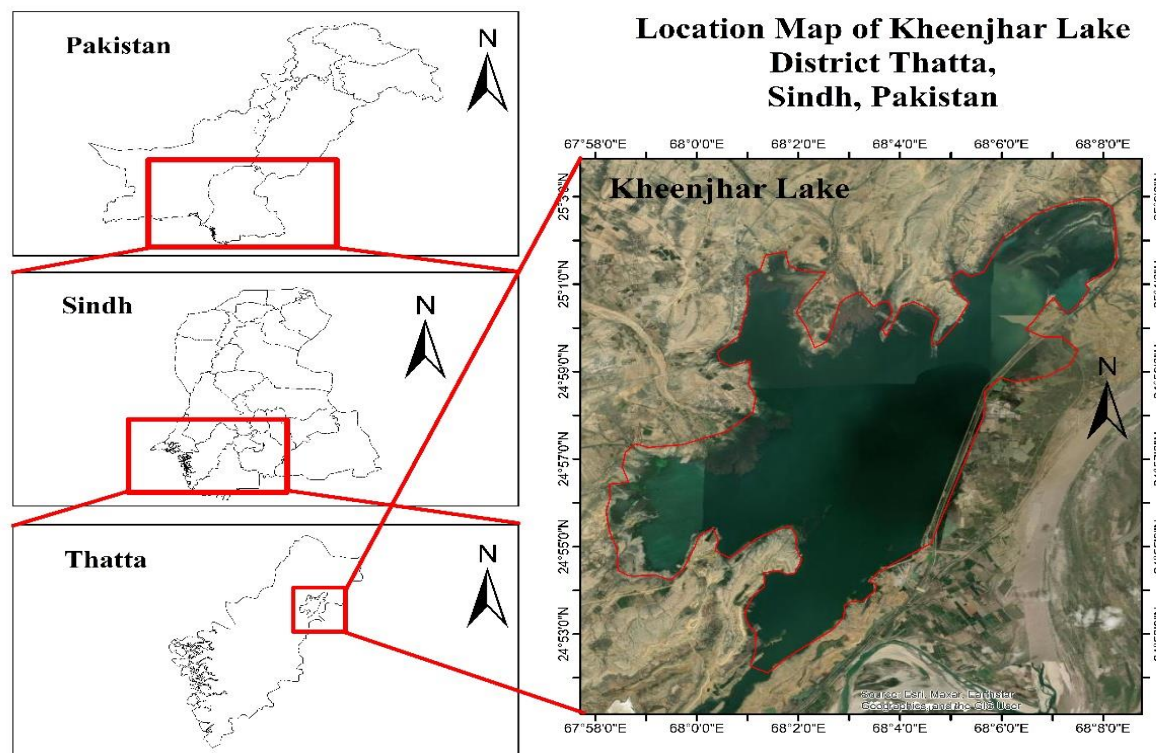


Fig. 1. Map of Keenjhar lake showing the study area

Materials and Methods

The data was collection through focus group discussions (FGDs) and key informant interviews (KII). In this connection, eight significant villages of Keenjhar lake namely; Jhimpir village, Nabi Bux Palari village, Chul site village, Sonheri village, Adam Gandro village, Bhambra village, Hilaya village and Lal Bux Manchari were visited to have an open discussion about the NRM plan for fisheries with local farmers, fishermen, stakeholders, and

working women who share jobs with men as well.

On second round of studies, field trips were organized for survey of the lake through boats to evaluate the eco-biological and fish potential status. The collection of water samples, plankton, macrophytes, and fish were done. ten stations were visited throughout the lake: St. 1 Hillaya, St. 2 Sonehri, St. 3 Amir Pir, St. 4 Bachal Shah, St. 5 Lal Bux Manchary, St. 6 Maldev, St. 7 Open Water Central Region, St. 8 Noori tomb, St. 9 Dolatpur, St. 10 Khumbho,

and Abdullah Gandro village. The collection took place between 12.56 am and 6.15 pm. Water samples were collected in sterile plastic bottles to analyze their chemical properties. The transparency and light penetration were measured by lowering the Secchi disk in water and observing its appearance and disappearance. Additionally, wooden bamboo was used to gauge the water's depth. Temperature, salinity, conductivity, and total dissolved solids (TDS) were measured using the WTW 330i/Set conductivity meter. The pH and dissolved oxygen were measured using the WTW. Meter and pH/Oxi340i/Set digital meter. Alkalinity and hardness were measured by titrating standard HCl 0.01N with methyl orange and phenolphthalein as indicators, ethylenediamine tetra acetic acid with indicator buffer solution, and Eriochrome black-T. Total nitrogen was measured using mercuric oxide red as a catalyst. Orthophosphate was measured by converting phosphomolybdic acid, which was made using ascorbic acid, to molybdenum blue using a Hitachi 880 model A spectrophotometer. Aquatic microbiological samples such as zooplankton, phytoplankton and other microorganism samples were collected using a 55µ plankton net mesh. The samples were put in sterile plastic bottles containing 5% formalin right away. Using DCM 35 (350 pixels USB0.1), phytoplankton and zooplankton species were recognized at magnifications of x100 and x400 under a binocular microscope (Swift M.3300D). Various types of aquatic plants such as emergent, free floating, attached floating, and submerged in water were collected through a plant-gripner and hand net using. A huge variety of fish species samples from Keenjhar lake were collected from landing centers and various fish specimens were collected using gillnets, cost nets, and hook lines. In such away local fishing techniques were utilized in the lake.

Results and Discussions

Keenjhar Lake is 2nd largest freshwater lake in Thatta Sindh Pakistan. About 60% of native communities are involved in fishing occupation. The water quality parameters of the lake were

collected and analyzed. The overall results of water quality parameters were found satisfactory for drinking and other domestic uses. Fish catching is being practiced throughout year even in closing season (June-August). While 40% of community people by profession are involved in agriculture, cattle farming, stone extraction, mat making using of reeds *Typha*, *phragmites* and other aquatic plants, the observations are confirmed (Cook, 1996), and other professions as source of income for livelihood. Major fish species caught from Keenjhar Lake are *Labeo rohita*, *Cirrhinus mrigala*, *Giblian catla*, *Channa marulius*, *Channa striata*, *Oreochromus mossambicus*, *Oreochromus niloticus*, *Mastacembelus armatus*, *Notoperus notopterus*, and *Notopetrus chitala*, *Aorichthys aor*. The Keenjhar lake fishing communities expressed that lot of small-size fish species are decreased and disappeared from the lake due to over lapping introduction of exotic fish species pollution, over exploitation, freshwater scarcity and climate change actions (Mahar, 2016). The primary cause of Keenjhar Lake's issues is anthropogenic activity, such as overuse of natural resources. The primary threats to this body of water were the growth of cattle and poultry farms, fish farms on the lake's eastern bank, unplanned tourism, pollution, habitat degradation, animal grazing, and the introduction of exotic fish and plant species. Eutrophication problems have also been observed in several parts of the lake. Keenjhar Lake was declared a Wildlife Sanctuary in 1977 in compliance with the Sindh Wildlife Protection Ordinance of 1972. The sanctuary is surrounded by a five-kilometer buffer zone. It was also designated as a Ramsar site in 1976 (Rabani et al., 2008). The lake is home to several submerged, floating, and emergent aquatic plants, including *Potamogeton* sp., *Najas minor*, *Nelumbo nucifera*, *Nymphaea* sp., *Cyperus* sp., *Phragmites* sp., and *Typha* sp. These provide food and shelter for wildlife species. Numerous birds call the dense growth of *Typha* and *Phragmites* home. The Keenjhar Lake's fish productivity has significantly decreased over the past 20 years due to a variety of circumstances, as has the

number of fisherman and fishing boats. The lack of fish productivity in the lake because of the ongoing water deficit in Kotri downstream is the reason for this massive migration of fishing villages from the lake. Industrial pollution from KB feeder contamination and unanticipated poisonous grassless fish growth were examples of mismanagement causes that significantly reduced fish production. As a result, fishing villages moved to other locations to support themselves. The ground around the lake is home to a diverse range of semi-aquatic to dry land plant species. Keenjhar Lake has a wide variety of fish. Among them are *Labeo rohita*, *Cirrhinus mrigala*, *Giblian catla*, *Channa marulia*, *Channa striata*, *Oreochromus mossambicus*, *Oreochromus niloticus*, *Mastacembelus armatus*, *Notopetrus notopterus*, *Notopetrus chitala*, *Aorichthys aor*. The local inhabitants rely on these resources as their main source of income (Ali, 1999). The present observations are closely related to the studies (Boyd and Tucker, 1998). Keenjhar Lake is an essential breeding, wintering, and staging site for numerous terrestrial and migratory bird species. Ducks come from more than 65 different species. Yearly waterfowl census at Keenjhar Lake was also observed with presence of Night-heron, Cotton Teal, Pheasant-tailed Jacana, and Purple Moorhen are among the breeding birds, along with several passerines. The cology and appearance of birds confirmed with findings of one of the studies (Roberts, 1991). The cotton teal has disappeared in recent years and hasn't been seen in the lake for a few years. Mammals include mongooses, porcupines, jackals, foxes, and small rodents. Pangolins have also been reported. Among reptiles, snakes such as cobras and saw-scaled vipers are common. Spiny-tailed lizards and monitor lizards can also be found in this area. The communities at Keenjhar Lake often adhere to the same cultural customs, and Sindhi is the most widely spoken language in the region. The herdsmen are Palari Jakhra; farmers are Hillaya, Dars, Autha, and Katiar; fishermen are Gandhra, Mirbahar, Manchri, and Machhi casts. The communities reside in various villages and hamlets. 18,792 people live in 38 villages with 2,610 homes and an average

household size of 7.2 within a two-kilometer radius. The housing infrastructure surrounding the lake is quite inadequate; 73.3% of the homes are Kacha houses, which are made of thatch and have one or two rooms. Sindhi is the most spoken language in the area, and the people at Keenjhar Lake frequently follow similar cultural traditions. Hillaya, Dars, Autha, and Katiar are farmers; Gandhra, Mirbahar, Manchri, and Machhi casts are fisherman; and Palari Jakhra. The first consultative meeting was held regarding the Key Informative Interviews and Focus Group Discussion in Jhimpir with a CBO called Keenjhar Youth Welfare Development Organization. Meeting started with general discussion about specific fisheries related issues. It was reported that previously lake area had great assets of natural resources, now assets vanished due to pollution, over exploitation, freshwater scarcity and climate change actions. The pattern was adapted with study of Review of Sindh Coastal Act 1991. (Mahar and Solangi 2017) Birds are going shorter in numbers though Keenjhar Lake, a Ramsar wetland, serves as a breeding, staging, and wintering ground for migratory and resident waterbirds. Local community is ready to take ownership of their natural resources, but they are demanding that resources provide us the alternative options against their dependency. Community demanded that fisheries department facilitate the community in terms of setting up fish hatcheries around Keenjhar Lake. This will raise the stock in the lake. There is lot of mats of *Typha* plants are available by which a variety of handmade marketable items are being made. This local industry needs immediate attention in terms of creating market linkages in local and in international perspective. Community members raised their voice that capacity should be built to manage their natural resources. Trainings should be organized at their villages not in air-conditioned halls. There is need for close coordination with communities and government, NGOs as well as private companies regarding the sustainable development, conservation and restoration of assets. Keenjhar Lake is attractive site for rock excavation for

construction and other purpose. Different contractors are doing their excavation in different sensitive areas of lake and creating a lot of problems i.e. habitat destruction. Government should ban this activity in area of Keenjhar though it is a Ramsar Site.

Second round of meetings was organized at Jhimpir village. This area has great importance due to availability of Date Palm trees (Baluchistan Palm). Date palms are a great source of livelihood for local community dwellers. Nowadays due to water scarcity Date Palm is making their survival hard. Government must take this in notice and introduce drought-tolerant varieties with the support of local communities. Community as whole was demanding that Pen and Cage fish culture should be introduced to support livelihood. Government should provide facilities of ice factory at local level otherwise villagers have to travel far away. Jhimpir town has a railway station. Community suggested that there should be fish market equipped with all latest facilities. This market will provide us with an opportunity to market our fish to different parts of Sindh, Punjab up to NWFP through train services. This market will broaden the scope of fish market apart from Karachi.

Consultative team visited the village Nabi Bux Pallari for third FGD and KII round meetings. In result, local villagers said that 60% of the population are dependent on fishing. They further shown viewpoints that government should take firm steps to preserve fish resources of the lake said a fisherman. We are using small boats for fishing that cannot go deep into the lake, that's why we are unable to catch small number of fish. Government should provide us with big boats on soft loans. There are powerful people in the village who are catching immature fish seed and sell them to market illegally that drastically reduce fish stock. Government should take serious steps to eliminate this problem. There is illegal practice of catching Channa fish in breeding season because in that season this fish species gives handsome amount to fishermen. This practice should be immediately checked and strictly monitored.

There is a lot of growth of weeds in the lake water that causes great damage to fish and other aquatic life. Government should hold regular cleaning campaign through different technological advances. This site is being declared as Ramsar Site-a wetland of international importance but due to ignorance of law enforcement lake is facing different environmental problems. Lake can be better managed if all the environmental stipulations are strictly enforced.

Fourth round of meetings related to FGDs and KII were organized at village Chul Site. Community people shared their concerns regarding fisheries related issues, challenges and present opportunities with demands of solutions. Community demanded that lake water should come straight away there should be no diversion someone else sites. Due to rain fall decline lake also suffered. A lot of industrial waste is coming from Nooriabad an industrial estate near to Keenjhar. These industrial effluents damaged a lot of lake biodiversity. Sindh EPA should take immediate steps to control water pollution. Government should build here a small water reservoir to harvest rainwater. Health care facilities are also not available here.

Fifth round of meeting was held at Village Lal Muhammad Manchhary and village Sonheri with CBO Keenjhar Development Organization. When discussion started community raised the concern that we should be given the small projects of fisheries extension. Pen and Cage fish culture should be introduced here, and zero size nets must be installed at canal gates so that fish can now be escaped back. They also demanded that we really need capacity building trainings on fisheries and NRM. NRM consultative meetings were held in four villages i.e. Jhimpir town, village Nabi Bux Pallari, village Chul Site and village Sonheri. The main concerns were raised over exploitation, industrial pollution, non-availability of fish seeds, practice of illegal nets to catch small-sized fish seed, solid waste generated by tourists and unsustainable fishing practices i.e. use of toxic material as food.

The Keenjhar Lake used to get water from the main Indus River via the K B feeder canal. It was filling the lake with muddy Indus water. To prevent this turbidity from mingling with the lake during the monsoon season, a connecting canal was constructed to transfer water straight to the canal serving Karachi, avoiding the Keenjhar Lake. The main Indus River is used for commercial fishing during the monsoon season. The K. B. Canal was used as a seed bank for the commercial fish in Keenjhar Lake. The KB feeder supplies millions of fingerlings and fries of the fish that spawned in the main Indus River, and each year it replenishes the lake with fresh fish seed stocks to compensate for the fish populations that the lake's fishing operations were depleting. Because of the Link Canal's construction, Keenjhar Lake no longer has access to this natural fish seed, which has a major detrimental effect on the lake's fish production. The lake requires 2,500,000 mixed fish seeds annually to meet the present fishing pressure (PDMA, 2012). The lake has an open outlet in the form of a canal supplying water to the city of Karachi. Most of the fish seeds that are put in the lake by the fisheries department are escaped from the lake through this canal. The licensing or auction systems are a point of contention between the local fishermen and the fisheries administration. The fisheries department is failing to contribute the required quantity of fish seeds to the lake, which is urgently needed, due to the loss of the fish stock and the lack of natural recruitment through the K. B. branch. Where will the fish join the lake because it isn't being organically recruited and a large percentage of the seed that the fisheries department stocks has also escaped? This will surely result in the current situation that the fisherman of Keenjhar Lake.

The five government departments that currently perform different jobs in the lake are the Sindh tourism department, the irrigation department, the wildlife department, the fisheries department, and the local government. While the tourism department encourages tourism-related activities, the irrigation department maintains the lake's water supply, connecting

canals, and embankments. While the wildlife department deals with wildlife, the fisheries department manages fishing operations. The local government has an impact on the selling of fishing rights in the lake. Each of these department's functions independently, without consulting one another or considering the interests of other departments. The activities of one sector often led to problems for the other; for example, tourism might lead to problems for wildlife and fishing. A Keenjhar Lake Development Authority must be established, and this structure must be reevaluated for all operations to be carried out correctly (PDMA, 2017). The policies now in effect for the management of natural resources are governed by the rules and regulations of the pertinent government ministries. Community involvement in the planning and management of these resources is not addressed by current laws and regulations. The "top down" approach is how natural resources are managed. Today, the primary management approach is command and control systems. The local community is not involved at all in planning, management, or benefit sharing. The appropriate departments also don't work closely together. The management-related departments are all understaffed and unable to develop and manage resources in a scientific way, as well as adopt new technology. These shortcomings in the existing management procedures have negatively impacted the natural resources at the Keenjhar Lake site. Situation analysis and baseline surveys of the Keenjhar site have shown that several social, economic, and environmental variables are actively degrading the lake's ecology. The current management systems and policies must be urgently changed from command and control to participation due to the major risks mentioned in this chapter. The work on the NRM plan of Sindh coastal region designed in the studies (Shams ul Haq Memon and Ghulam Qadir Shah, 2016). Planning, management, and benefit-sharing methods must involve all stakeholders, including local communities. The creation of a Participatory Natural Resource

Management Plan is crucial to achieving these goals.

project. Therefore, WWF-Pakistan is highly acknowledged for supporting this study.

Acknowledgement: This work is part of a study which was carried out in connection with a

Proposed Participatory NRM Plan for Keenjhar Lake Thatta Sindh Pakistan

No.	Proposed Activity	Timeline	Funding	Responsibility	Targets/ Indicators	Comments
1	Support Literacy, Vocational Training and other Educational Programmes in Fishing Communities	1-5 Years	Provincial and Federal Govts, Donner Agencies and NGOs.	Sindh Fisheries Department, WWF Pak	Literacy, Vocational Training Programmes	Some activities should be related to income generation for women.
2	Reactivate the Training Programme at Fisheries Training Centre in Chilya	1-2 Years	Federal Govt., Govt. of Sindh, HEC and Donner Agencies	Sindh Fisheries Department		Training Programmes may include courses on hatchery development, sustainable fish catching, preservation and quality control.
3	Develop Training Modules for Sustainable Fisheries Practices for building capacities and skills for sustainable management of ecosystems at all levels.	1-3 Years	Federal and Provincial, Fisheries and Education Dept, HEC, Donner Agencies, IUCN, WWF	Sindh Fisheries Department, WWF Pak and IUCN	Ecosystem and Biodiversity friendly fisheries and Aquaculture degree, diploma course certificate programme	Training Programme developed should target both Govt. and Fishermen.
4	Ensure that Training Course on Culture of Ornamental Species and Improved	1-2Years	Federal, Provincial and District Govt. FAO, Ministry of Education	Sindh Fisheries Department, WWF Pak and IUCN	A significant target must of set to train women for each year.	Such training courses may be delivered through mobile extension and

	Fishing Methods, included Net Making are designed and targeted at women					training units.
5	Raise Awareness among fishermen and Fish Farmers about Conservation and Sustainable Management Principles	1-5 Years	Federal and Provincial Govts, IUCN and WWF	Sindh Fisheries Department, WWF Pak and IUCN	Awareness Programmes must be launched to fishing communities of rural areas	
6	Educate and Train Fish Traders on the use of improved fish transportation methods	1-3 Years	Federal and Provincial Govts, IUCN and WWF	Sindh Fisheries Department, WWF Pak	Fish traders and middlemen are included in such trainings.	Such training Programmes are linked with post harvest losses
7	Lobby for ban on use of polythene bags	1-5 Years	Sindh-EPA, WWF and IUCN	Sindh-EPA and WWF	Impacts of polythene bags on inland fisheries are reduced.	Raise awareness on the problem they cause when disposed in water ways and water bodies. Only biodegradable bags should be used.
8	Conduct resource survey and species stock assessments	3-5 Years	Sindh Fisheries Department, District Govt. PARC, Universities	Sindh Fisheries Department, WWF Pak and IUCN	Data base of fisheries resources must set	
9	Monitor the spread and impacts of introduced plants and fish	2-5 Years	IUCN, WWF, Sindh Fisheries Department,	Sindh Fisheries Department and WWF Pak	Impacts of exotic species must be studied before	<i>Silvinia molesta</i> problem in Keenjhar

	species such Tilapia etc.		Universities and FAO		release into waters	
10	Restock Freshwater bodies with seeds/fingerlings of commercially important carp species.	1-5 Years	Federal, Provincial and district government	Sindh Fisheries Department	Infrastructure of seed production and stocking must be initiated	Ensure that scientific protocols of free stocking are followed to restore or enhance biodiversity
11	Declare zones as a reserved areas for fish breeding and survivor	1-3 Years	Provincial Govt., fish contractors and NGOs	Sindh Fisheries Department and CBOs	Fish production will be increased	
12	Establish a registration systems for all fisherfolks	1-2 Years	Provincial and District Govts	Sindh Fisheries Department	Directory of registered fishermen will be available	
13	Ensure that all hatcheries should enhance biodiversity to the fish seed	3-5 Years	Provincial, PARC, Universities, Donor Agencies	Sindh Fisheries Department	Fish seed will be available	Involvement of private sector should be promoted and will be possible as fish seed becomes available for culture of these species
14	Install quality ice making plants and cold storage facilities at all major fish landing points	1-3 Years	Banks and other investing agencies	Sindh Fisheries Department and WWF	Plants should be installed based on capacity of landing point	
15	Establishment of pen and cage culture	1-3 Years	Sindh Fisheries Department, WWF, UNDP	Sindh Fisheries Department, NGOs/CBOs	Pen and cage culture should be set up through active participation of local community to get desirable size for release in the lake.	

16	Set of fish market at Jhimpir Railway Station	1-2 Year	Sindh Fisheries Department	Sindh Fisheries Department	Fish market should be set up at Jhimpir railway station must be equipped with latest infrastructure availability to broaden the scope of fish marketing.	
17	Establish fish nurseries on the bank of lake and set up of fish hatcheries around lake	1-3 Years	NGOs, Sindh Fisheries Department WWF Pak	NGOs/CBOs Sindh Fisheries Department.	Fish nurseries and hatcheries should be set up through active participation of local community and maximum quantity of fish seed must be released annually.	
18	Eliminate water weeds	1-3 Years	Sindh Irrigation Department Sindh Fisheries Department	Sindh Irrigation Department Sindh Fisheries Department	Regular mechanical cleaning of the infested parts of lake and check introduction of any other invasive species.	
19	Prevent lake from industrial waste	1-5 Years	Sindh-EPA	Sindh-EPA	Monitor level of waste generation of industries surrounded the lake and enforce to set up waste treatment plant at the source to	

					minimize the toxicity of waste	
20	Installation of iron nets at the outlets of lake	1 Year	Sindh Fisheries Department	Sindh Fisheries Department NGOs/CBOs	Iron nets should be installed at outlets of the lake to prevent fish escape into canal	
21	Strict enforcement of environmental especially fisheries acts.	1-5 Years	Sindh Fisheries Department Sindh-EPA	Sindh Fisheries Department Sindh-EPA CBOs	Regular monitoring over harmful fish catching practices around lake and responsible persons should strictly be dealt with prosecution.	
22	Provision of Alternate Livelihood	1-2 Year	NGOs, Sindh Fisheries Department WWF Pak	WWF Pak, National and International NGOs.	Strengthen the local industry of Mat and other marketable items from Typha and build linkage to major markets. Encourage the potential fish by-products i.e. fish oil rich source of vitamin A and D.	
23	Elimination of Hurdles from Inlet for direct flow of canal into lake.	1-2 Years	Sindh Fisheries Department and Sindh Irrigation Department	Sindh Fisheries Department and Sindh Irrigation Department	Regular monitoring of concerned department to check smooth flow of canna into lake.	

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