

TCP/PAK/3301 – TCP FACILITY

**POTENTIAL FOR DEVELOPMENT OF INLAND
AQUACULTURE IN BALOCHISTAN AND GILGIT
BALTISTAN**

Analysis report

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1. INTRODUCTION

The government of Balochistan and Gilgit Biltistan (GB) requested FAO to assist in the development of inland aquaculture sector in their provinces. The FAO under the framework of ‘TCP/PAK/3301-TCP Facility’ fielded a mission to a) assess the status of fisheries and aquaculture sector of Pakistan, especially in the Balochistan and GB areas, b) consult relevant stakeholders to evaluate potential and issues in the sector and get their prioritized recommended for development of the sector and c) prepare a report on the potential for development of inland aquaculture in Balochistan and Gilgit Biltistan and recommend a strategy for FAO intervention for development of the inland aquaculture sector in two provinces. FAO would plan to intervene through an appropriate mechanism for development of the sector in Balochistan and GB.

The mission conducted two consultative meetings with the stakeholders’ one at Karachi and other at Islamabad in which stakeholder including representatives of provincial governments of Balochistan, Gilgit Biltistan, Punjab and Sindh and representative of PARC, Fisheries Development Board, Islamabad Capital Territory, private sector fish farmers, and civil society organizations were present. The lists of participants are annexed.

2. NATURAL CONDITION:

A. Climate (temperature change pattern, rainfall amount and distribution)

Pakistan is a South Asian country and is located northern hemisphere; it extends from 24°N to 37°N latitudes and 51°E to 76°E longitude. Pakistan is bordered on the north and northwest by Afghanistan, on the northeast by China, on the east and southeast by India, on the south by the Arabian Sea, and on the west by Iran. Its area is 796,095 square kilometers (307,374 square miles).

Pakistan lies in the hot and dry region with great extremes of elevation and temperature. Its location and topography is shown in figure below. Topography of Pakistan is such that its land is partly divided by the Indus River, which enters the country in the northeast and flows south into the Arabian Sea. The Indus forms the demarcation line between the two main landforms of the country, namely the Indus valley, which extends principally along the east side of the river, and Baluchistan, which lies to the west.

It is a land of varied landscapes ranging from perpetually snow capped peaks of Himalayan Range like the Karakoram, K-2 elevation 28,265 ft. (8,615 m) to lush green canal irrigated areas and the hot dry deserts of Sindh and Baluchistan where summer temperatures can exceed 120 F (49 C). Physiographically the country can be divided into three regions:

- A. Mountainous north and north-west 241,647 Km²;
- B. Table lands of Balochistan 242,683 Km² and
- C. Vast alluvial plain of the Indus River and tributaries 319,605 Km².

B. Natural resources availability: land, water (pond and river/lakes/reservoir, others)

a) Land Resources

From the total land area of 197 million acres (79.61 million ha) about 79 million acres (31.9 million ha) or 40 percent is cultivable but only 21.59 million ha or 27 per cent is cultivated. Annual cropped area is 56.64 million acres (22.93 million ha) or 29 per cent due to limitations of water supply. Out of these two-thirds is irrigated and one third depends on rain (called Barani). The canal irrigated system covers 81 per cent of the irrigated area while the rest depends on tube wells, open wells and flood irrigation called Sailaba. Quality of land for agricultural purposes is classified as in Table 1.

Table-1: Agricultural land capability

Sr. no.	Category of land	Area per cent
1.	Very good agricultural land	30.7
2.	Good agricultural land	42.9
3.	Moderate agricultural land	5.7
4.	Poor agricultural land	3.5
5.	Agricultural non-productive land	15.5
6.	Miscellaneous	1.7
	Total	100

b) Climate

Pakistan is located entirely in the temperate zone and within the monsoon belt the position of high mountain ranges in the north keeps her climate generally as arid and semi-arid, tropical and sub-tropical. There are four distinct climatic seasons:

- a. Cold, moderate widespread rainfall December to March.
- b. Extremely hot and dry, April to June.
- c. Hot and humid, scattered rainfall, July to September.
- d. Cool and dry, October and November.

Normal periods for the two major crops grown are "Rabi" (meaning "spring") from October to March and "Kharif" (meaning "fall") from April to September. The crops are named by the harvesting season.

Temperatures in the plains and most other cultivable areas allow for year round cropping, rarely dropping to freezing point. The summers are very hot with average maximum temperatures of 38C and 40C from May to July over greater part of the Indus Plain. Temperatures of the order of 49C are not rare. The highest maximum temperature of 53EC recorded at Jacobabad in Upper Sindh ranks amongst the world' highest. In the mountains of the north, summers are generally cool, the temperature varying appreciably with differences in elevation, exposure, etc. The plains experience frequent dust storms which are usually followed by thunder showers. The winters can be fairly cool with average maximum day temperature of 20°C during December and January and minimum temperatures generally between 2.2C to 5C (36F to 41F) but occasionally approaching freezing point. The lowest minimum temperature of -26°C was recorded at Misgar on 9 February 1949. The climate along the coast is not so hot in the summer and is mild in the winter due to the moderating effect of the sea.

The total annual pan evaporation in the Indus Plains ranges from around 50 inches (1,270 mm) in North-east Punjab to 110 inches (2,800) in Sindh. Evaporation is generally highest in May and lowest in January with 65 to 75 per cent occurring in April-September months.

c) Water Resources

i. Rain fall

Rainfall in Pakistan is markedly variable in magnitude, time of occurrence and its aerial distribution. However, almost two-thirds of the rainfall is concentrated in the three summer months of July - September. The mean annual precipitation ranges from less than 100 mm in parts of the Lower Indus Plain to over 750 mm near the foothills in the Upper Indus Plain.

There are two major sources of rainfall in Pakistan: the Monsoons and the Western Disturbances. The relative contribution of rainfall in most of the canal commands is low when compared with the two other sources of irrigation water i.e., canal water and groundwater. More than 60% of the kharif season rainfall is concentrated in the month of July for almost all of the canal commands.

The Monsoons originate in the Bay of Bengal and usually reach Pakistan, after passing over India, in early July. They continue till September. The Indus Plains receive most of their rainfall from the Monsoons. There are two periods of thunderstorms in Pakistan: (1) April-June (2) October-November. These periods are the driest parts of the year, particularly October and November. During this time, thunderstorms caused by convection bring sporadic and localized rainfall.

Pakistan lies in an arid and semi-arid climate zone. The entire Indus Plains (canal command areas) receive an average seasonal rainfall of 212 mm (95% confidence interval ± 28) and 53 mm (95% confidence interval ± 8) in the kharif and rabi seasons, respectively.

The rainfall varies as we move from the north and northeast to the south of the country. It is only the canal command areas in the North-West Frontier Province (NWFP) and the northern-most canal commands of the Punjab Province that receives some appreciable amount of rainfall during the summer as well as the winter season. The canal commands upstream of the rim stations (i.e., in the NWFP) receive almost 55% of their annual rainfall during the kharif season. The canal commands in the Upper and Lower Indus Plains receive 75% and 85- 90% of the annual rainfall respectively, during the kharif season. The annual variability of rainfall increases as one moves south. The canal command areas of Guddu and Sukkur Barrages fall in an area where variability is the highest.

ii. Glacier

The catchment area of the Indus Basin contains some of the largest glaciers in the world, outside the Polar Regions. The glacial area of the upper Indus catchment is about 2,250 km² and accounts for most of the river runoff in summer.

The Kabul River, which is mainly snow-fed, originates from the Unai Pass of the Southern Hindukush at an elevation of 3,000 m above sea level (masl). It drains eastern Afghanistan and then enters Pakistan just north of the Khyber Pass.

The Jhelum River rises in Kashmir at a much lower elevation than the source of the Indus River. It falls much less rapidly than the Indus River after entering Pakistani territory. The Chenab River originates in the Himachal Pardesh in India, at an elevation of over 4,900 masl. It flows through Jammu in Indian-held

Kashmir and enters Pakistani territory upstream of the Marala Barrage.

The snow and ice melt from the glacial area of the Upper Indus catchment supply approximately 80% of the total flow of the Indus River in the summer season. The annual flows in the Kabul River are less than one-third of that in the Indus River. However, the Kabul River starts to rise approximately a month earlier than the main stem of the Indus. Its flows are of significance for fulfilling the late-rabi early-kharif (March to May) irrigation requirements of the canals.

Snowmelt accounts for more than 50% of the flow in the Jhelum River. However, the Jhelum is much more dependent than the Indus on the variable monsoon runoff. Both, the Jhelum and Chenab River catchments can simultaneously be influenced by the Monsoons. Since the Chenab River rises at higher altitudes, snowmelt accounts for a considerable proportion of its runoff.

iii. Rivers and Dams

The embryonic Indus river system, which is the main source of surface water in Pakistan, most likely was created some fifty million years ago, when the Indian Plate (Gondwanaland) first collided with Eurasia (Angaraland). Between the two plates was the Tethys Sea, which was shallow and sandy and up-folded to form the great Himalayan Mountains in the Mesozoic era. These mountains, their unbroken snow cover, have become the primary source of water to the Indus system.

The average annual flow-rates of major rivers has been calculated between 1922-61 to indicate water flows before the Indus Water Treaty, 1985-1995 to indicate the post-treaty flows and the 2001-02 flows to present the current situation of drought conditions. These are presented in the table-2 below.

Table-2

River	Average Annual Flow (1922-61) MAF	Average Annual Flow (1985-95) MAF	Average Annual Flow (2001-02) MAF
Indus	93	62.7	48
Jhelum	23	26.6	11.85
Chenab	26	27.5	12.38
Ravi	7	5.0	1.47
Sutlej	14	3.6	0.02
Kabul	26	23.4	18.9
Total	189	148.8	92.62

The history of dam construction in Pakistan is relatively short. The perennial River Indus fulfilled the irrigation needs and the drinking water supply was served by tapping the vast underground water reservoir. Before independence, there were only three dams in Pakistan, and none on the major rivers. Two of the dams were in the water scarce area of Balochistan i.e. the Khushdil Khan Dam – 1890 and the Spin Karaiz – 1945. The Namal Dam, 1913 was located in the Mianwali district of the Punjab.

The construction of dams in Pakistan was initiated in 1955, when the country was facing an acute power shortage. Work on the Warsak Dam on Kabul River near Peshawar was undertaken.

Later, when India stopped water supplies to the network of canals in Pakistan, it became imperative to build large storages and link canals to restore water to the affected canal system. This resulted in the construction of two gigantic dams, Mangla with a gross storage capacity of 5.88 MAF and Tarbela with 11.62 MAF, as a part of the Indus Basin Replacement Works. Apart from replacement works, a number of relatively smaller schemes of irrigation and water supply dams were also undertaken.

iv. SURFACE WATERS

The accounting of surface water resources in the Indus System is based on river inflows measured at Rim Stations. A rim station, in the context of the Indus Basin Irrigation System, is defined as a control structure (reservoir, barrage, etc.) on the river just when the river enters into Pakistani territory or upstream of the canal-irrigated Indus Plains of Punjab and Sindh Provinces.

The rim stations for the Indus System rivers are the Kalabagh Barrage (or sometimes Tarbela Reservoir) for the main Indus River, Mangla Reservoir for the Jhelum River, Marala Barrage for the Chenab River and Balloki and Sulemanki Barrages for the Ravi and Sutlej Rivers.

The Indus River and its tributaries, on an average, bring 154 MAF of water annually. This includes 144.91 MAF from the three Western rivers and 9.14 MAF from the Eastern rivers. Most of this, about 104.73 MAF, is diverted for irrigation. 39.4 MAF flows to the sea and about 9.9 MAF is consumed by the system losses which include evaporation, seepage and spills during floods.

The flows of the Indus and its tributaries vary widely from year to year and within the year. As is the case with the water availability, there is significant variation in annual flows to the sea.

The waters of the Indus Basin Rivers are diverted through reservoirs/barrages into canals, classified as Main Canals. These main canals then distribute the irrigation water into their command areas through a network of branch canals.

The Indus Basin Irrigation System comprises of three major reservoirs, 16 barrages, 2 head-works, 2 siphons across major rivers, 12 inter river link canals, 44 canal systems (23 in Punjab, 14 in Sindh, 5 in NWFP and 2 in Balochistan) and more than 107,000 water courses. The aggregate length of the canals is about 56,073 km. In addition, the watercourses, farm channels and field ditches cover another 1.6 million km. The system utilizes over 41.6 MAF of groundwater, pumped through more than 500,000 tube wells, in addition to the canal supplies.

Outside the Indus Basin, there are smaller river basins. One on the Mekran coast of Balochistan drains directly in to the sea and a closed basin (Kharan). These in total amount to an inflow of less than 4 MAF annually.

v. Ground water, historic development

Before the introduction of widespread irrigation, the groundwater table in the Indus Basin varied from about 40 feet in depth in Sindh and Bahawalpur areas to about 100 feet in Rechna Doab (the area between Ravi and Chenab Rivers). After the introduction of weir-controlled irrigation, the groundwater table started rising due to poor irrigation management, lack of drainage facilities and the resulting additional recharge from the canals, distributaries, minors, water courses and irrigation fields. At some locations, the water table rose to the ground surface or very close to the surface causing water logging and soil salinity, reducing productivity.

In the late 1950s, the Government embarked upon a programme of Salinity Control and Reclamation Projects (SCARPS) wherein large deep tube wells were installed to control the groundwater table. Over a period of about 30 years, some 13,500 tubewells were installed by the Government to lower the groundwater table. Of these, about 9,800 tube wells were in the Punjab.

The projects initially proved to be quite effective in lowering the water table but with time, the performance of the SCARP tube wells deteriorated. The development of deep public tube wells under the SCARPS was soon followed by private investment in shallow tube wells. Particularly in the eighties, the development of private tube wells received a boost, when locally manufactured inexpensive diesel engines became available. Most of these shallow tube wells were individually owned.

Now more than 500,000 tube wells supply about 41.6 MAF of supplemental irrigation water every year, mostly in periods of low surface water availability. These tube wells compensated the loss of pumping capacity of the SCARP tube wells and helped in lowering the water table.

3. AQUACULTURE SECTOR

Sindh and Punjab provinces of Pakistan are the region where fish farming is being practiced at large areas. However, fish farming exists in other provinces too. A brief overview of the fisheries sector in various provinces is given below.

A. Sindh

Province Sindh has vast potentials for freshwater, brackish water and marine aquaculture. The freshwater aquaculture is the mainstay of the province with carp species as predominant species, while attempts have been made in the recent past to initiate brackish water and marine aquaculture with no success. A total area under fish production in the province is 49000 ha consisting of 2139 farms with production of 66300 ton fish annually. About 32 fish hatcheries are in operation out of which 27 hatcheries are in the private sector. Fourteen district of Sindh provinces has reported fish farming, but the bulk of fish production comes from four districts viz. Badin, Thatta, Jacobabad and Shikarpur.

B. Punjab

Province Punjab is endowed with plenty of water resources including the tributaries of the Indus River and the vast network of irrigation canals which make many areas much suitable for fish farming. The province is much ahead of other provinces due to its staff strength and infrastructure. The facilities of the provincial departments includes the six hatcheries, eight nurseries, 34 seed collection centers, one research station, two training centers and five water and soil testing and fish disease diagnostic laboratories, apart from the 74 private sector fish hatcheries. Total area under fish farming is 13600 ha. Predominant fish species under farming system are carp species.

C. Balochistan

Province Balochistan has a long coast line and much of the interest of fisheries department lies in the marine capture fisheries. The inland fisheries and aquaculture resources are limited and concentrated in the Nasirabad division. The reported data on fish farming indicate 105 fish farms with total area about 1600 ha. Other water resources include some dams, four saline lakes, and hub river reservoir. Three government fish hatcheries at DM Jamali, Turbat and Quetta are established. Three dams have been stocked with fish seed from hatcheries viz Mirani, Subakzai and Hub dams. Predominant fish species under farming system are carp species.

D. Khyber Pakhtunkhwa

Province KPK has diverse water resources including the warm water, cold water and cool water resources. Trout fish is being cultured in some parts of the Province while carp culture is the mainstay. The fisheries department is operating 07 trout fish hatcheries, and about 7 trout farms,

while about 45 trout farms are in operation in private sector. In the other parts of the province including Peshawar, Mardan and DIKhan area have many carp farms and hatcheries in Public and private sector.

E. Gilgit Baltistan

Province GB is established very recently. The Gilgit-Baltistan has been gifted with great potential of natural fisheries resources. Apart from water resources these includes the numerous indigenous and exotic fish species.

The history of trout culture in Gilgit-Balistan dates back to the time of A.F Bruee a British political Agent, who for the first time introduced eyed ova via Sri Nagar on pony backs in 1908. The number of hatcheries in public sector is 10 out of which 6 have been damaged during the recent floods. The number of farms in public sector is 4 while in private sector are 14.

4. FISH FARMER PROFILE

A. Educational/aquaculture related training background

Fish farming in Pakistan is not a traditional business. The fish farmers in Pakistan are mainly the part time agricultural farmers who have spare land and a regular supply of suitable water. However, there are plenty of full time fish farmers in the main fish farming cluster areas of Sindh and Punjab namely the Thatha and Baddin in Sindh and Gujranwala and Muzzafargarh in Punjab. At the first instance the agricultural farmers who have some entrepreneur skills ventured into the fish farming business. The majority of these fish farmers have at least basic education of high school level. The other category of fish farmers is the agriculture farmers who observed the ongoing business of entrepreneur fish farmers and started on the same lines by following the same practices, these farmers are mostly uneducated and acquire basic training of fish farming as learning by doing. The farmers can therefore be said to be literate since only small proportion of them had no formal education.

B. Gender, age, family size

The fish farming business in Pakistan is predominantly a male dominated business where participation of female is negligible because it is not a traditional business and women are mainly involved in the traditional businesses in agriculture sector. However, fish farmers use their younger children in feeding, netting and marketing of fish. The average household size of Pakistani fish farmers is 5-6. The fish farmers whose age fell between 41 – 50 years constituted the majority; however, the range of fish farmers falls between economically active groups of 15 – 60years.

C. Social structure (village/community structure, land/water tenure types etc.)

The Land Administration System in Pakistan is organized on the traditional system of land registers and maps. The Board of Revenue (BOR) at provincial level is mandated with all matters connected with administration of the land, collection of land revenue, preparation of land records and other matters. The BOR is also the highest court of appeal and revision in revenue cases within the Province.

The distribution of land holding at province level indicates that about 85% households own no land in Sindh (landless plus non agriculture), followed by 78% in Baluchistan and 74% in Punjab. The unequal land ownership pattern is clearly reflected by the fact that a very small portion of all households holds large farm size in all provinces. The average ownership of farmers is 8.2 in Punjab, 12.4 in Sindh, 3.5 in KPK and 13.4 in Balochistan.

5. CURRENTLY AQUACULTURE PRACTICES

A. Species cultured presently

Aquaculture in Pakistan is pre-dominantly carp based. Three indigenous species of major Indian carps viz Thaila, Rahu, Mirgal, and three exotic species of Chinese carps viz Grass Carp, *Common carp* and Silver Carp are cultivated in ponds. A combination of five to six species is reared under poly culture system. However, some attempts have been made to introduce high value fish species like Tilapia, Pangasius and American channel cat fish with varying success. While on coastal aquaculture side various shrimp species have been experimented with variable success.

B. Seed production (hatchery/nursery): facilities, brood stock, management practices, distribution (hatchlings and fingerlings)

Aquaculture practices in Pakistan started with seed collected from rivers, but now it is almost entirely replaced by hatchery-produced seed. Artificial fish breeding techniques and low cost hatchery designs have been successfully adapted to Pakistani conditions since 1980. Breeding techniques for the major carps (rohu, catla and mrigal) and Chinese carp were introduced by the department of fisheries Punjab and adopted by other provinces through trainings and trial methods etc. a large number of infrastructure of aquaculture sector specially fish hatcheries in various provinces was established under two major development projects, viz. Aquaculture-1 and Aquaculture-2 during 90s. Both projects were funded by Asian Development Bank.

Parent fish or Brood fish is considered as the most important aspect of the hatchery management and the quality brood stock is the key of success in the sector development. Success of induced breeding depends on availability of sufficient number of brood fish. Most of the government's hatcheries have own brood stock. Similarly most of the private hatcheries have their own stock and maintain them more or less scientifically but very few of them do not have the required number of broods. During breeding season they instantly buy broods from others and produce fry from them to fulfill their target. Besides this, most of the private hatcheries make new brood recruitment from the subsequent generations of few pairs of original parents that result in inbreeding. Fingerling marketing is generally done by middlemen since very few fish farmers buy directly from nursery farms. About 80 percent of fingerlings are supplied to farmers by middleman (fish seed traders) and some 20 percent of fingerlings are directly collected by farmers from the nursery operators and this is very much evident in Sindh where most of the seed is supplied from Punjab through middlemen. In addition to this, when spawn are reared to fingerling at the hatchery cum nursery, fingerlings also reach farmers through the same channel. At present there is no established and formal fish seed market for selling and buying seed.

In Punjab 74 fish hatcheries are working in private sector while 14 hatcheries and nurseries are operating in the public sector. There are five hatcheries in Sindh located at Chilya (Thatha), Mirpur Sakhro and Sukkar and various fish farms. In Balochistan there are only three hatcheries. Eight (08) warm water fish hatcheries and about 30 trout farms cum hatcheries are in operation in the

KPK. Provincial Fisheries Departments are providing technical guidance, seed on subsidize rate to farmers and other extension services, which has resulted in establishment of a number trout hatcheries/farms in private sector. Government has successfully transferred the Provincial technology to private sector as result numbers of farms are increasing

C. Grow out production

System and facilities, water supply

In the grow out system of Pakistani aquaculture can be divided into two parts

a) Pond culture system

Fish farming in ponds is very common model in Pakistan and predominantly used for culture of carp species. The ponds are made usually non drainable earthen ponds, rectangular in shape for easy harvesting is made. In most parts of Punjab province, the ground water is suitable for carp culture. Canal water is good for farming but usually contain eggs and larvae of fish species especially of *Tilapia mozambica*. In Sindh suitable ground water is available in limited upper areas therefore, canal water is widely used for fish farming. In Balochistan the fish farming is confined to Nasirabad division where underground water is suitable for carp culture. In KPK and GB the ground water is most suitable for carp and trout farming.

b) Race ways culture system

The trout culture is being practices in raceways in KPK, GB and at one place in Punjab. The raceways of various sizes viz. 10 x 10 to 20 x 100 can be seen at various trout farms. Swat in KPK, Gilgit, Skardu, Ghizer, Ghanche , Astore , Diamer in GB and Muree in Punjab are the popular places of trout farming in Pakistan, however, one trout hatchery cum farm was established in Balochistan, which is currently non functional.

c) Stocking models (species combination, size, density)

The stocking models vary in different parts of Pakistan, per acre stocking density in KPK is 2500, in Punjab 800 to 1000 and in Sindh and Balochistan 600 to 1000 fish babies of one inch size are stocked in poly culture system. The species combination is not clearly defined in any part of Pakistan. People have their own choices, more percentage of rohu is popular in Muzafargarh area in Punjab, more silver in Gujranwala and potohar region, and no silver in Sindh province.

d) Feeding and fertilization

Fertilization of fish pond for carp culture is popular practice throughout Pakistan. Progressive fish farmers use farm made supplementary feeds and the use of provisional feeding for carp is non existence in Pakistan. The use of provincial farm made trout feed is common in trout farming system of Pakistan.

e) Water management

For carp culture practices, pond is usually filled with water at the beginning of the growth season and replenishment is made to maintain the water level. Most of the farmers' do not dry fish pond every year due to heavy cost of pumping and stock new fish seeds in the same water, however, in the areas where water seepage or evaporation rate is high, ponds are filling with freshwater every year. For trout farming, running water raceways are designed which use new water from a nearby river or spring.

f) Harvesting & post-harvesting

In Pakistan the fish harvesting from the ponds is done by the traditional methods using nets and sometime boats with nets if the ponds are larger. Fish farmers of small water bodies make their pond harvest themselves with nets with the help of laborers. But for relatively larger water bodies, harvesting are organized by contracted fishers and fish farmers who by dragging the net manually from one end to the other end of the water body. Boats and nets are used for harvesting in the further bigger water bodies.

Post harvest losses are huge in Pakistan, as efforts are made to maintain cool chain from the production to consumption. Farmers after harvesting their fish from ponds pack into plastic sacks and put some ice around them and transport it to city fish markets. The middleman at the fish markets dump the fish on ground and put some ice around it. The venders and other fish traders buy fish from markets and transport to their business places for further disposal to consumers.

Most of the local people do not eat fish only due to bad handling of fish during the market channel. There is a great need for establishment of modern fish markets and maintenance of cool chain across the supply line.

g) Production efficiency (yield, economic)

To evaluate the profitability of fish farming practices in Pakistan, basic data was collected from average fish farmers in cluster area of fish farming near Alipur, District Gujranwala, Punjab. The calculation reveals that against the total expenditure of Rs. 103,000/- a net income of Rs. 137,000/- is achieved. The detail data is given at Annexure-1.

6. INPUTS SUPPLY

A. Feed supply (including feed ingredients);

Feed is not a regular input in the current carp aquaculture practice of Pakistan. However, progressive fish farmers (about 10%) use supplementary fish feed in addition to pond fertilization. This feed is usually farm made by using locally available feed ingredients. The list of feed ingredients being used by the fish farmers is given below:

List of feed ingredients normally used in Pakistan

1. Fish Meal
2. Soya Bean Meal
3. Sun Flower meal
4. Canola seed meal
5. Rice Polish
6. Maiz Gluten (30%)
7. Maiz Gluten (60%)
8. Wheat bran
9. Vitamin mineral premixes
10. Soybean oil
11. Di-Calcium Phosphate (DCP)
12. Corboxy Methyl cellulose (CMC)

B. Seed supply

In Pakistan the main fish seed production and supply resources are hatcheries operated by public and private sector. Three types of fish hatcheries exists in Pakistan i.e. carp hatcheries, trout hatcheries, Mahaseer hatcheries, etc. Presently, the estimated number of hatcheries are 30 carp hatcheries in the government sector whereas 150 hatcheries in private sector. With regard to cold water fish culture, there are 17 trout hatcheries. One Mahseer hatchery exists in the semi-cold water area of Malakand in KPK, another in District Attock, in Punjab.

Carp seed is easily available throughout the country from government or private fish hatcheries or middlemen. Trout seed is available through selected fish hatcheries in Public and private sector, while *Tilapia nilotica* seed is being made available to interested fish farmers every year by Fisheries Development Board after importing it from Thailand.

C. Other inputs supply

The availability of various kinds of fishing nets, hatchery implements and supplies, fishing boats, water quality instruments etc are easily available in local markets.

7. MARKETING OF AQUACULTURE PRODUCTS

A. Market price in comparison with other animal food items

Fish price fluctuations are highly problematic. When the farmers harvest their ponds in the winter and the market becomes flooded with pond fish and the price drops. When there is no fish in the market and the rates become high. This situation is exacerbated by poor post-harvest facilities such as non availability of cold storage etc. Currently middlemen and market mole-holders' commissions are high and it is suggested that to counter this government should fix the price of fish as it does for other commodities. Furthermore, fish farmers selling their fish through the mole-holder do not receive payments for fish immediately.

Fish prices varies in species wise, size wise and on the basis of demand and supply situation, the rohu is the most valued fish, followed by thaila, grass carp, mori, and silver carp. The prices for these species at whole sale markets in Pakistan ranges from Rs. 130/kg to 200/kg.

B. Marketing channel;

Pakistan has an open market system where fish marketing is totally in the hands of private sector and operates through a complex channel, it includes direct purchase of fish from farmer to fish retailer, farmer to middleman who further sell it in fish market, direct sale by fish farmer in the whole sale market, some time farmers has their own retail shops, etc. the wholesale market operates through commission agents (mole holders or Arthias) who effectively control the whole system. Some time these Arthias provide advances to fish farmers in the form of cash or kind who in turn are required to bring fish to them for sale. The Arthias charge 2% to 8% commission and take one kg for every 40 kg fish sold. There is evidence of widespread exploitation of fishermen and fish farmers and the extraction of rent by traders and leaseholders.

C. Market location;

Village markets are popular in Alipur chatha area of district Gujranwala which is one of the main fish farming cluster in Punjab, the fish markets are also available in each major cities, the popular fish markets exists in Lahore, Multan, Sukkur, Thatha, and Karachi. The fish market of Lahore is most popular fish market which receives fish from all over Pakistan. Fish from this market is used for local consumption in Lahore and other areas especially KPK.

The operational efficiency of the fish marketing system of Pakistan is characterised by:

- i) Inadequate and unhygienic infrastructure including landing, auctioning, and parking facilities in the wholesale and retail market,
- ii) Inadequate cold storage and insulated transport facilities,
- iii) Limited supply of ice near the fish landing centres,
- iv) Improper grading and packaging of fish,
- v) Limited market information, and

- vi) Apparently high marketing margins which vary between 30% to 50% of the retail price for different fish species.

There is a need to improve fish marketing system of Pakistan for which new standardized fish markets need to be established in major cities like Lahore, Rawalpindi, Multan, Hyderabad and Sukkur.

D. Market facility

The whole sale fish market facilities vary from one market to other, usually the *Arthai* have an office with a platform to place the fish for auction. The platform is a cemented place on the ground of 10 x 10 or 10 x 20 feet size or more different. The graded fish is placed in heaps on the ground for auction some ice is also placed on or around the heap. Ices and water are available around the markets. On the time of auction the *Arthai*, asks buyers to quote rates above the base price announced by the *Arthai*, the buyer offer rates in open auction system.

The retail market consists of several models, from open air push cart to shops having freezer facilities. While hyper star stores have all modern facilities found anywhere in the world. The spaces in these markets are generally inadequate for handling highly perishable commodities like fish.

Transportation is the most important element in the fish marketing system but no specialized fish transportation system exists in Pakistan. Fish farmer or middlemen have to arrange their own transport, which is some time pickup vehicles, trucks or tractor trolley depending on the distance of market form the farm and that too is completely managed by private entities.

Jut bags or plastic sacs or used to transport fish from farm to market. Sometime fish is transported in open vehicles. For short distances, ice is not used but for longer distances ice is placed in the bags. Use of fish crates, baskets or boxes is not in practice in inland fish markets.

8. DEMAND ANALYSIS

A. Current fish supply (aquaculture and capture-trend)

Total fish production of Pakistan is 952,735 M. ton which includes 660,141 M. tons from Marine capture fisheries and 292,594 m tons from inland capture and culture practices. The total export quantity is 210,000 m. tons resulting in export earnings of US\$ 300 million per annum. The share of aquaculture share in inland production is just about 45 %.

B. Current fish consumption

Pakistan fish consumption is among the lowest at 1.8 to 2.1 kg per capita (varies in various studies) compared to its neighboring countries.

C. Current animal protein food consumption

Animal protein supply to Pakistani population is about 22.9 g/person/ day, which is below the 27 g/person / day recommendation as per WHO.

D. Trend of peoples diet preference (fish vs. other animal protein food)

As regard to animal protein the Pakistani people are mostly chicken eater. Fish is not a regular diet component of general masses. The rate of fish consumption varies from one place to other, like eating fish is more common in coastal areas of Pakistan in Sindh and Balochistan but very rare in GB, KPK and upper part of Punjab. Further, people consider eating fish as a luxury food habit, not because of its prices but due to unawareness and non availability of hygienic fish products in common markets. Vary recently due to growing middle class and opening of hyper star markets in big cities of Pakistan, the fish consumption is increasing. During the year 2010-11 about 4000 ton of Pangasius fillets were imported in Pakistan, it is expected that the import will cross mark of 12000 tones at the end of year 2011-12.

E. Population

According to demographic survey of Pakistan 2007, the estimated population of Pakistan was about 149.8 million. The area wise distribution of population is, Punjab: 86.44 million, Sindh: 33.46 million, KPK: 21.29 million, Balochistan: 8.65 million. The total population increased by over fourfold during 1950-2011. In the past, the country's population had a relatively high growth rate that has changed by moderate birth rates. The population growth rate now stands at 1.6%.

9. PUBLIC SUPPORT TO THE SECTOR

A. Technical extension service

In the wake of overall globalization process, the government of Pakistan implemented its “Devolution Plan” on August 14, 2001. The plan has decentralized various functions of provincial governments to district governments including the agricultural and fisheries extension services. This decentralization has yet not shown any considerable change in the efficiency of extension service. The extension still remains top-down and autocratic in decision-making. After the devolution process, the assistant director fisheries is re-designated as District Officer Fisheries and reports to Executive District officer (EDO), agriculture, the EDO then reports to “District coordination officer” (DCO) who reports to District Nazim. The system once again is under change process but still working as mentioned above.

B. Financial and credit service;

In view of the importance and un-tapped potential of the non-farm sector (includes fisheries/aquaculture), in August 2005 State Bank of Pakistan (SBP) established a Committee of Experts which recommended for financing livestock and fisheries sectors.

As per guidelines of SBP the loans can be extended to individuals, fishermen, fish farmers, corporate firms, cooperative societies/self help groups, fish catching/ processing /packing companies and fish exporters having sufficient knowledge and relevant experience. However, agriculture financing shall not include loans to traders and intermediaries engaged in trading/processing of agriculture commodities. Such lending would be covered under Prudential Regulations for Corporate/ Commercial Banking or SME Financing. However, agricultural financing can be extended to entities (including corporate farms, partnerships and individuals) engaged in farming activity as well as processing, packaging and marketing of mainly their own agricultural produce, provided 75% of the agriculture produce being processed, packaged and marketed should be produced by the above-mentioned entities themselves.

C. Land and water access for aquaculture development

Province Balochistan is the only province of Pakistan which possesses an approved land lease policy for fisheries and aquaculture sector. The province Sindh is in process of approval of the land lease policy. The rest of the provinces include fisheries and aquaculture in the agriculture land lease policy.

D. Regulations and management system

There are no direct laws applicable for regulation of aquaculture industry of Pakistan. It may be worthwhile to note that “aquaculture” or fish farming specifically has not been expressly defined in these laws which appear to have been regulatory laws up until now. This comes as no surprise keeping in mind the chronology of fisheries laws. Fisheries laws were first enacted during the

times of the British in the form of the Punjab Fisheries Act, 1914, Bahawalpur State Fisheries Act 1951 and the Fisheries Act, 1897. Post independence, fisheries laws were promulgated through the West Pakistan Fisheries Ordinance 1961 and Rules of 1965; despite amendments/additions to these laws subsequently, all 4 provinces and Northern Areas continue to retain most features of the 1961 and 1965 laws.

Currently, aquaculture and fish farming is regulated under a wide range of general legislation, including fisheries laws, forest laws, wildlife laws, environmental protection laws, land use laws and policies, agricultural laws, water use laws, food, safety, chemicals, pesticides, quarantine and quality control laws, which if read in conjunction can provide a true picture of the legal and regulatory framework existent in Pakistan. . The general system of ownership of land and land holding is both private and public. There is no specific program for making funds available for aquaculture or land available (except as specified in the Land Use Policies)

Investors in fish and shrimp farming, fish processing or fish capture would naturally expect their investments to be protected by adequate rules and regulations; which do not specifically exist, or if they do are spread over other legislation covering associated areas. Currently the Balochistan fisheries laws, apart from the Shrimp Policy, do not cover aquaculture. Areas not covered include pollution, introduction of new species, use of antibiotics, pesticides and other drugs in feeds, residue levels in harvested products, harvesting of wild post larvae or brood stock, registration of farmers and farms, organic waste management, protection of navigation, quarantine and fish health, notification of diseases, quality of feeds etc.

Profitability of one acre fish farming for Carp fish species in Pakistan

Sr. no.	Item	Quantity																					
1.	Area	One acre																					
2.	Source of fish seed	Local																					
3.	Number of seed per acre	1000																					
4.	Price of fish seed	Rs. 15000																					
5.	Stocking <ul style="list-style-type: none">▪ Rohu▪ Mori▪ Thaila▪ Silver▪ Grass	400 200 100 200 100																					
6.	Stocking date	15 March																					
7.	Stocking size	5-7 inch																					
8.	Fertilization	Organic manure Cattle dung Poultry waste grasses Urea Rs. 43000																					
9.	Feed used	No feed in ordinary farming practices																					
10.	Other expenditure	Electricity cost, Lease of land, Labor and Miscellaneous expenditure Rs. 45000																					
11.	Fish Harvested (data is collected from fish farmers in Alipur area district Gujranwala, Punjab)	Gross production <table border="1"><thead><tr><th>Fish</th><th>Kg</th><th>Rs.</th></tr></thead><tbody><tr><td>Rohu</td><td>500</td><td>75000</td></tr><tr><td>Mori</td><td>300</td><td>45000</td></tr><tr><td>Thaila</td><td>200</td><td>34000</td></tr><tr><td>Silver</td><td>400</td><td>52000</td></tr><tr><td>Grass carp</td><td>200</td><td>34000</td></tr><tr><td>Total</td><td>1600</td><td>240,000</td></tr></tbody></table>	Fish	Kg	Rs.	Rohu	500	75000	Mori	300	45000	Thaila	200	34000	Silver	400	52000	Grass carp	200	34000	Total	1600	240,000
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Total	1600	240,000																					
12.	Gross profit at the minimum price	240,000/-																					
13.	Total expenditure	103,000/-																					
14.	Net income	137,000																					
15.	Remarks	Profitable business																					

List of Participants Karachi

List of participants for consultative meeting held in Karachi on 31st May, 2007

Sr. No.	Name	Profession
1.	Muhammad Alam	fish farmer
2.	RSN Janua	Representative, American Soybean Association
3.	Mr. kalim khan	Fish farmer
4.	Aamir Dhedhi	Fish farmer
5.	Mr. Faisal Iftikhar	CEO, Fisheries Development Board
6.	Ali Sulman	SAF group of companies
7.	Mir Maqsood	Fish processor
8.	Muhammad Noor	Director General Fisheries, Balochistan
9.	Khawar Pervez Awan	Director Fisheries, Sindh
10.	M. Javaid Boloch	Assistant Director, inland, Balochistan
11.	Asad Shah	Businessmen
12.	Ghulam Muhammad Mahar	Director General, Sindh Fisheries Department
13.	Mr. Ziaudin A Junejo	Fish farmer
14.	Muhammad Junaid Wattoo	National Consultant
15.	Mr. Miao Weimin	Aquaculture Officer, FAO

List of Participants Islamabad