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Aquaculture in Pakistan: Challenges and opportunities

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Abstract
The capture fisheries production is declining due to due to overexploiting natural resources. Therefore, the interest of aquaculture species is increasing to fulfil the aquatic protein demand of the pubic in the market. On the other hand, global environmental change, degradation of habitat, change in temperature, aquatic feed and original natural brood stock are the major challenge in aquaculture industry. In the present review, the challenges and opportunities in fisheries sector of Pakistan are discussed. The data and information were collected from the various sources including Fisheries Department of Pakistan, FAO and published literature. Pakistan is basically an agricultural country and is endowed with huge natural water resources, both freshwater and marine water as well as brackish water. Pakistan has an inland water area of about 79,200km^2. It is rich in a coastal of with an about of 1120 km long coastal belt with an Economical Exclusive Zone of 350 nautical miles, that covers an about 290,270km^2. Fisheries sector provide direct employment to about 400,000 fishermen and 600,000 people in ancillary industries. Estimated annual fisheries production is about 0.6 mmt including 63% marine and 37% inland. Pakistan has about 193 freshwater fish species, and 800 marine species. Only 31 fresh water fish species are considered as commercially important those are cultured. While, 120 marine species are commercially important but none of marine species yet practiced for being cultured. The domestic consumption of fish is about 1.9 kg per capita is the lowest in the world. However, unlimited resources are evidence that fisheries play an important role in human diet and economic development of country. Fisheries production is of top 10 export commodities that share 1.0% of the country's total GDP. However, in recent year fisheries sector facing with numerous challenges including natural and anthropogenic such as natural disasters, climate change, industrialization, environmental pollution and overfishing. These factors collectively have great threat to food security and income of the community. Therefore, immediate actions are required by the government and policymakers.

Keywords: aquaculture, challenges, natural resources, opportunities, Pakistan, production

1. Introduction
Pakistan is basically agricultural country and rich with natural water resources. Freshwater and marine water are the major resource for aquaculture. There are about 8,563,820km^2 area is in the form of Rivers, Lakes, Ponds and water lodging areas [1]. There are considered as suitable to aquaculture and provide the basis for aquaculture development. While there is a great potential of coastal fisheries with an about 1120 km coast line. In further, an open sea area, Exclusive Economic Zone, of about 350 nautical miles in the control of Pakistan government. Despite of these huge resources for aquaculture potential there is no any significant progress in fisheries sector. The main reason is the aquaculture practice. Only in the freshwater extensive and semi intensive aquaculture system have been adopted. On the other hand, coastal sources and deep water marine sources are still not utilized for aquaculture purposes. Hence, from the marine aspects, we are dependent totally on the natural availability. Hence aquaculture farming system production is estimated about 179,900 metric tons and 600,000 metric tons from the natural catch [2]. Aquaculture contributes 1% to Gross Domestic Product (GDP) [3]. Due to limited culture, majority of contribution is from capture fisheries. Fisheries contributes significantly to employment, income, food production and considered as important for the national economy of Pakistan. The price of fish is increasing, due to limited output, in proportion with increasing levels of poverty and population. The government import the fishes from China, Myanmar, Viet Nam, Singapore, Thailand and Burma [4]. In general, aquaculture is practiced at small-scale in the areas where the land is not suitable for the agricultural purpose. Recently, the government has paid a serious attention on aquaculture development through the Department of Fisheries and Donor funded projects.

This initiative was taken to improve nutrition and food security for the poor. At the same time, Fisheries Development Board is also established to promote aquaculture and fisheries in Pakistan. The major purpose of the present review is to identify the problems and associated opportunities with aquaculture development in Pakistan. Hence, proposed recommendations for relevant remedial measures and interventions will promote the aquaculture sector.

2. Aquatic sources

(a) Marine resources

In 1976, 200 nautical miles was declared as Exclusive Economic Zone (EEZ), providing the country with a fishing area of approximately 196,600km^2 [5]. In further, EEZ extended 150 nautical miles more in 2015. The entire coastline, bordering the Arabian Sea, is about 1,120 km, that spread from the coasts of Sindh, and Makran in Balochistan. The Makran coast is steep, rough and very narrow, about 12-32 km wide. On the other hand, the Sindh coast has extended about 40-120 km shelf area that is mostly flat and forms good trawlable ground. There are a few islands along the coast of Pakistan. Because, the coast protrudes into the sea in the form of capes and peninsulas. Hence, only a few sites, cut off into several small and large bays. The River Indus constitutes a large estuarine delta that provides best breeding grounds, shelter and good nurseries for shrimps, fishes and many other other marine life.

(b) Inland sources

Pakistan has a wide range of irrigation network including lakes, rivers and canal system. Approximately 109,780 hectares have been covered by the natural lakes [5]. Saif-ul-Mulook in the North West Frontier (NWFP) and Satpara in the Gilgit-Baltistan and Hanna in Balochistan province are high-altitude lakes suitable for cold water fisheries. While Sindh province has several warm water lakes, Manchar and Kalri are big and popular lakes. Thatta, Larkana and Sanghar districts of Sindh has many small lakes. The Indus River and its tributaries are the major sources of freshwater fisheries of the country. Generally, the Indus River flows from the Northern Areas through the NWFP and the Punjab passing through Sindh and finally draining into the Arabian Sea. Indus River representing one of the world's largest canal systems that has a number of dams and reservoirs, supplying water to an extensive irrigation network in the Punjab and Sindh province. This running and stagnant water over about an area of 4.57 million hectares. While, waterlogging covers an area of about 2.225 million hectares [6]. On the other hand, Mangla, Tarbela, Chashma, Hab, Khanpur and Warsak are the big reservoirs of Pakistan and play an important role in freshwater fisheries, those cover about 80,613 hectares [6]. Along with these, more than hundred small dams said as barani dams (rain-fed), mostly in Potwar Plateau, has a great aquaculture potential. All of these resources are not being properly utilized to raise fish.

As in the Pakistan aquaculture is fairly new activity and private sector has constructed dug-out fish farms. It is estimated about 3300 fish farms with an area of approximately 0.06 m.hectares [7]. Unfortunately, aquaculture is characterized by low production per unit area due to low input.

3. Production system

Semi-intensive type of aquaculture system is commonly practiced in Pakistan. The fish farming based on mostly *Labeo rohita*, *Cirrhinus mrigala*, *Catla catla*, *Cyprinus carpio*, *Hypophthalmichthys molitrix*, *Ctenopharyngodon idellus*, and *Hypophthalmichthys nobilis* species. Due to consumer preferences, some of these species such as *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* enjoy premium prices in the market. While, the farming of Catfishes, Snakeheads and tilapia are still in progress stage. In recent year 2014, Fisheries Development Board has good initiative to introduce tilapia and trained the farms for developing tilapia culture and improve its quality. On the other hand, cold water fisheries also in progress after a long period. In the cold water fish species comprising rainbow trout (*Salmo trutta* and *Oncorhynchus mykiss*). Now, breeding and culture of trout is gaining popularity in Gilgit-Baldistan. But still, the production is not on a large scale to supply throughout the country or even insufficient to export. Most interesting that tor tor, snow trout, *Tenualosa ilisha*, *Lates calcalifer*, *Mystus seenghala* and *Rita rita*, possesses special significance for aquaculture, can be cultured in Pakistan. Aquaculture has not attained a significant level of diversity ranging from from multi-species to mono species culture and extensive to intensive practices. Currently the government is encouraging semi-intensive and intensive aquaculture practices as well as communal water bodies culture practices, for strengthening food security. Fish stocking in reservoirs, lakes, earthen ponds, tanks, and a little cemented or fiber glass tanks are practiced for aquaculture production. While, a little effort has been made to introduce the cage culture in Pakistan. While, cage culture, pen culture, recirculatory aquaculture, intensive culture and integrated aquaculture systems are needed to be introduced to local fish farmers. Hence, to increase the aquaculture production per unit area and improve the socio-economic condition of fish farmers, such type of aquaculture should be developed on priority.

4. Aquaculture development

The progress in inland fishery and aquaculture was began in 1970s in Pakistan [5]. As earlier mentioned that most of development seen in today is achieved recently. During the last decade, inland fisheries have received substantial government assistance. On the other hand, the Asian Development Bank (ADB) also had started project in late 1979 for 5-year duration, with and investment of about 22.1 million dollars for aquaculture development. The priority area of the projects was upgradation of existing facilities, technical knowledge, improvement of fish hatcheries, nurseries, provision of consultancy, foreign training, procurement of nursery equipment, establishment of a pilot project, commercial trout farming, fellowships for foreign training, lake fishery development and cage culture pilot project. Hence, the base line was provided those aquaculture industries required. In result, the fish seed capabilities had been increased to encourage the fish farmers. Still adaptation and introduction of modern aquaculture technology is far away to reach on fisheries development. A limnological and fisheries study was commissioned by FAO, under 18-month pilot programme, and several approaches were made to improve fish stocks in the reservoirs.

5. Aquaculture production

In 1986 a National Commission on Agriculture (NCA) was constituted by the government of Pakistan. Hence, NCA proposed a broad strategy for the years 1988-2000. The major

objective of commission was to maintain self-sufficiency to improve the productivity of livestock, forestry, fishery and crops. Hence, followed by the commission fishing techniques, in landing, in boat and storage facilities were improved. While, the fish production was increased up to 419,000 tons in 1986-87 as compared to 343,000 tons in 1982-83 [5]. The increased production was mostly contributed by the capture fisheries. An appropriate management of Rivers and reservoirs, strong conservation programme, effective exploitation of the EEZ and an increase in the aquaculture area will enable to maximize the fish production.

There are about 13,000 fish farmers with 60,230 ha, fish ponds and lakes covering 127,109 hectares. Those are producing about 179.9 mt per ha per year. Mostly these farmers belong to Punjab and Sindh province [1]. While, 50,000 fish farmers are engaged in marine and coastal fisheries for their livelihood [8].

6. Role of fish in diet

Fish is considered as secondary animal protein source in Pakistan. In general, fishes are major aquatic protein, with 7% of total protein supplies, providing 80% of the animal protein intake. The fish consumption pattern is different among families and area. Most of families avoid fish dishes in their house when little babies are in family, due to small spine hectic. In the Pakistan, per capita annual fish consumption is about 1.9 kg [8], which is smallest as compared to developed countries i.e. 20kg [9].

7. Major challenges for fisheries sector in Pakistan

Aquaculture sector is developing in the Pakistan, but the development does not appropriate with the potential.

Numerous factors restrain the aquaculture development such as:

- Lack of coordination among institutions including Government, Non-governmental organizations, Research, institutes and Universities.
- Shortage of national and International research projects as well as experts, especially in the areas of production system, Fish nutrition, fish diseases and fish genetics.
- Lack of technical services to fish farmers such as training packages and materials including with inadequate capacity.
- Limited budget for basic research and development projects.
- Insufficient scientific awareness to design aquaculture research and development projects.
- Improper fishery policy and guidelines for the developing aquaculture.
- Expensive commercially produced seed and lack of quality fish seed.
- Less interest of private sector.
- Highest per unit cost due to improper management of production units.
- Poor assess to market and extension services.
- Little priority given to aquaculture development in national development programs;

8. Aquaculture development opportunities

Pakistan has a great potential of aquaculture for economic development that offers numerous opportunities including livelihood to local communities, contribution in food production, training and management staff, conservators, researchers, ecologist and business and other jobs through offering different types of aquaculture system such as integrated aquaculture, cage culture, bait culture, ornamental fish culture, export and import of fisheries product, integrated aquaculture, intensive aquaculture and culture-based fisheries.

9. Significance of Aquaculture Development

In order to meet challenges, associated with national nutrition and food security, the trend to aquaculture is growing very fast. In this regard, following area need utmost attention for promotion of aquaculture.

1. Aquaculture production

There is a bottomless market demand for fish, especially major carps, in Pakistan. Mostly, fish is imported from Burma, Iran and China. Such circumstances forces to articulate appropriate aquaculture technology which will enhance fish production and productivity. Hence, cage culture should be promoted for commercial and out-grower scheme.

2. Institutional cooperation

There are appropriate fisheries institutions, from provincial to federal level, but due to lack of coordination the aquaculture policies are not implemented properly. Therefore, it is essential to collaborate and support government as well as private sector to ensure the aquaculture development.

3. Evaluation and Monitoring

Most of the statistical data reported by the institutes are often contradictory. Therefore, comprehensive information gathering tool should be developed to generate the baseline data on aquaculture. Hence, functional monitoring and evaluation domain must be developed.

4. Proper policy and legal framework

Sound policies are considered to be the base line for development of any sector. Government should make a proper policy to attract the business man for profitable aquaculture. Although government already have aquaculture strategic plan that need to be implemented for best aquaculture management practices by extending collaboration with the stakeholders.

10. Conclusion

Pakistan is enriched with numerous aquaculture potential. Declining capture fisheries emphasizes to take serious efforts to revitalize the aquaculture sector. The present article highlights an overview of the fisheries sector in Pakistan as well as its challenges and opportunities. Keeping in view the sustainability and farmers need we have to change the routine direction of aquaculture towards the comprehensive research in development approaches. The performance of fisheries sector is crucial from the perspective of nutrition security and national macroeconomic. In further, to articulate relevant aquaculture technologies meeting the nutritional, economical and food security needs, researchers and extension agents will be required. Therefore a more efficient and sustainable management of the aquatic resources is proposed that will contribute greatly to health and economy of the country. The quality feed and seed are the major critical input in aquaculture. Therefore, it is urgent need for aquaculture development to formulate the cost-effective fish feed and quality fish seed targeting especially the resource poor fish farmers. Along with these efforts, the community-based aquaculture projects must be encouraged and supported in a sustainable manner. In addition the Inland Fisheries and

Marine Fisheries Department would be required to expend considerable resources on on-farm research by using indigenous fish species and recommend species which would adapt on farm feed resources.

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