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Economic Analysis of Fish Farming in Punjab, Pakistan

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ABSTRACT

Fish consumption is very less in Pakistan as compared to the world. The study was designed to conduct the economic analysis of the fish farming. Two districts were selected with the highest number of fish farms, i.e. Muzaffargarh and Khanewal. A total of 50 fish farms from both study areas were selected randomly for the study. Economic analysis was carried out from the collected data to estimate the profitability of fish farming. In order to make a comparison of profitability of fish farming with crop cultivation on per acre basis, data from 50 farmers from crop sector were also collected. The results revealed that fish farming was more profitable as compared to crop farming in the study area. Net income per acre was estimated at Rs. 252426 from fish farming as compared to net income per acre of Rs. 58612 from wheat-cotton, Rs. 72662 from cotton-rice and Rs. 53290 from sugarcane cultivation. The benefit cost ratio (BCR) of fish farming was calculated 1:1.52 and 1: 1.74 with and without land rent respectively. It illustrates that the enterprise yields 1.52 rupees and 1.74 rupees for every rupee invested. On the basis of results, it is suggested that fish farming should be promoted, especially in the areas of saline soils to enhance food security and uplifting the socioeconomic conditions of small farmers.

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1. Introduction

In Pakistan, the majority of the population takes maximum calories form staple food i.e. wheat

and rice. Fifty-two percent of women having age between 15-49 years were anaemic and this percentage was higher than the world average of about 33% (FAO, 2019). Brown (2017) stated that animal proteins are better and contain a good balance of all the amino acids that we need. Wasim (2007) also explored that fish is an outstanding source of animal protein. FAO and WHO in a study highlighted that animal protein intake should not fall below one gram per Kg body weight for adults. While, per capita availability of protein is far below the minimum daily requirement in Pakistan.

The coastline of Pakistan is approximately 990 km long which comprises of 270 km and 720 km of Sindh Coast and Makran Coast respectively. The Exclusive Economic Zone (EEZ) of Pakistan covers an area of about 240,000 sq. km (MFF Pakistan, 2016). The contribution of fisheries sector is vital to Pakistan's economy in terms of livelihood for the population of Pakistan especially population of coastal areas. Pakistan has a diverse sources of water comprises of sea, rivers, dams, lakes, ponds etc., where fish can be produced (GoP, 2019).

Aquaculture is being done in almost all the provinces of Pakistan. Total area of fish ponds in Pakistan is about 60.47 thousand hectares. The province wise distribution of the area is 49.17, 10.5, 0.560 and 0.240 thousand hectares in Sindh, Punjab, KPK and other provinces (Balochistan, Azad Jammun Kashmir, Northern Areas) respectively. The highest potential of aquaculture exists in the province of Sindh and Punjab. The total number of fish farms is approximately 13000 in all parts of the country. The farms are of different sizes, however, average farm size ranges between 5-10 hectares. Although no exact estimates are available about employment in the sector, however, the estimates show that about 50000 peoples are employed in the sector either directly or indirectly (FAO, 2020).

Although, the fish has been considered as an important source of protein, yet in Pakistan, due to high price and limited availability, fish consumption could not gain mass acceptance in the major urban and rural areas. However, fish trade has remained one of the promising area for fish producers as Pakistan is already exporting around 19 percent of its total production. However, more than 70 percent of the total fish production comes from the marine sites while the rest comes from inland fish farming (Haq, 2015).

Since, the last few years there has been an increasing trend of fish farming (GOP, 2015). Literature shows that fish productivity in Pakistan is low as compared to other countries of the world due to several reasons, including the socioeconomic characteristics of fish farmers, which include education, land holdings, age, ownership of capital, old technologies (Meena et al., 2002).

2. Review of Literature

One of the problems of agriculture sector is soil salinity in Pakistan. According to an estimate, more than 6 million hectares soils are affected by salinity in Pakistan. Moreover, more than 70 percent tube wells are pumping brackish water for irrigating soils. The problem is immense in the province of Sindh and Punjab, especially in Southern Punjab (NIAB, 2020). One of the advantages of aquaculture is that it can be adopted on the land which is not suitable for crop cultivation i.e. saline land. This problem can be turned into an opportunity by turning the area into fish cultivation without opportunity cost (Bashir et al.,2018).

Since the last few years there has been an increasing trend of fish farming (GOP, 2015). Literature shows that fish productivity in Pakistan is low as compared to other countries of the world due to several reasons including socioeconomic characteristics of fish farmers which include education, land holdings, age, ownership of capital, old technologies (Meena et al., 2002). Shah et al.(2017)

concluded that despite of gradually increase in growth of inland fish production and exports, it is low as compared to other developing countries. The study explained that aquaculture has developed as the potential way to meet fish demand, food security, livelihood, employment and national income. Moreover, they suggested that government should develop and expand this sector as it has the potential to offer various opportunities to support livelihood in Pakistan.

Qasim et al. (2004) studied the economics of fish production and marketing in saline areas of the central Punjab by taking sample of 33 farmers randomly. They calculated that per acre fish production was 1524 kgs. Sale price was Rs. 55 per kg. Total variable cost per hectare estimated was Rs. 45513 and total revenue was Rs. 127531 for those fish farmers who made their farms at non saline soils while total variable cost and total revenue per hectare of saline soils fish farms was Rs. 45513 and Rs. 73219 respectively. Profit (Rs. 40488 per hectare) of fish farms of non saline soils was high as compared to that of saline soil (Rs 30029). Bashir et al. (2018) also estimated the profitability of fish farming in Hafizabad district and concluded that per acre cost of production was Rs. 199310.70 on large farms as compared with medium and small farms. The net earnings per acre was calculated at Rs. 59298. The benefit cost ratio was estimated 1.0:1.3, indicating earning of Rs. 1.3 on every rupee spent in the enterprises.

Fish farming plays vital role in improving the socioeconomic conditions of rural people (Mazid, 2002). Fish farming creates miscellaneous income opportunities for a number of people, especially those who live below the poverty line (Ahmed et al., 2005). Pond fish farming was proved to be more profitable as compared to rice cultivation, therefore, in the rural areas so many farmers have changed their rice field into pond fish farming (Islam et al.,2002). Olawumi et al., (2010) found fish farming as a profitable enterprise. They concluded that fish seed stocked, labour, the size of the pond and waste feed of poultry were the dominant factors of the income which increased the small holding production of fish in Nigeria. Olaoye et al. (2013) assessed the socioeconomic analysis of pond farming in Nigeria and found that total cost, total revenue, gross margins, which were N 2, 883515, N 4873521 and N 2,376,616.36 respectively. The estimated benefit cost ratio was 1: 1.69 which shows that fish farming has the potential to alleviate poverty of farmers. Okpeke and Akarue (2015) appraised the profitability by calculating total cost, total revenue and net revenue. The total cost per farming season was estimated at N976, 622 while total revenue was N976, 622. The net farm income was estimated at N 384, 306 per farmer per annum, which reflects that fish farming is a profitable enterprise. Adewuyi et al. (2010) estimated average total cost of N394,380 per annum and gross revenue of N 715030. The estimated profit was 320650 Nigerian Naira. The estimated rate of return was 0.55 Nigerian Naira. The results of regression analysis showed that variables pond size, labour, cost of lime, cost of feeds and fingerlings have significant impact on output. The elasticity of pond size, labor, feeds, fertilizer, lime, fixed input and fingerlings was found 0.029%, 0.057%, 0.005%, 0.534%,0.007, 0.79% and 0.001% respectively. The study suggested the fish production as profitable business activity in the study area. Namonje-Kapembwa and Samboko (2020) estimated the profitability of small-scale aquaculture production in Zambia by employing primary data collected through individual interview and focus group discussion. They found that benefit-cost ratio was greater than one, implying that an investment in aquaculture was a profitable over the useful life of 10 years. They further estimated net present value(NPV), and internal rate of return and established that it was 17524 ZMW and 42.38 percent at 15 percent discount rate respectively. The positive NPV indicated that aquaculture business was a profitable business in Zambia. Irz and Mchenzie (2003) they evaluated the profitability and technical efficiency of aquaculture in Philippines by comparing the two production systems, i.e. intensive monoculture of tilapia in freshwater ponds and an extensive poly culture of shrimps in brackish water ponds and concluded that aquaculture in both systems was very profitable. However, higher profitability was achieved in

brackish water ponds. As for technical efficiency is concerned, it was concluded that technical efficiency was higher in freshwater aquaculture as compared to brackish water aquaculture. Olagunju et at. (2007) they estimated gross margin and profitability ratio of catfish in Ibadan metropolis, Oyo State, Nigeria and found that the average total cost per kg of fish was N 204 and average total revenue per kg of fish was N 308. The estimated gross margin was N 194.60 per kg of fish produced. They also found a significant relationship between total revenue and cost of feed, years of farming experience, size of pond and labor.

3. Research Methodology

To estimate the economics of fish farming, primary data were collected from 50 fish farms through random sampling technique from top 2 farm fish producing districts i.e. Mazaffargarh and Khanewal in Punjab. Similarly, data from 50 non fish farmers was also collected from the same vicinity to compare the profitability of fish farming. Detailed data on cost of production of fish farming and crop farming was taken through well designed questionnaire. In addition to that benefit cost ratio (BCR) was also calculated for calculating the profitability of fish farming per rupee invested.

3.1 Economic Analysis

3.1.1 Budgetary Techniques

In this technique, cost and return were estimated to estimate the economic analysis of fish farming. Following formula for estimation of cost, revenue, economic profit, business profit, gross margins and benefit cost ratio were employed and are given as:

Total revenue (TR) = Total fish produced * Average price of fish.
Gross margin (GM) =TR- Total Variable cost (TVC) for producing fish
Economic profit = TR – [explicit cost + implicit cost]
Business profit = TR – [explicit cost]
Benefit cost ratio (BCR) = Business profit/TVC (When imputed cost is not taken)

3.2 Results and Discussion

Education status of fish farmers is given in table 1. The table shows that 78% farmers have their education upto martirc and 22% fall under the range of intermediate to master level education.

Table 1: Education Status of Fish Farmers

Schooling Years	Frequency	Percent
1-10	39	78.0
12-18	11	22.0
Total	50	100.0

Classification of fish farmers with respect to age illustrated that 30% farmers were having age between 18 to 30 years and 44% were below the range of 31-40% and limited number of 26% were those who were above 40 years of age. It explains that the majority of the farmers are young and energetic. Studies such as (Khatun et al. 2013; Peter and Susan, 2014) also concluded that the majority of the fish farmers were young. Table 3 displays the information of experience of fish farming. It was found that 40% had experienced between 1 to 5 years while 60% were doing since last 6 to 10 years. Since this enterprise was not popular among the farmers, however the demonstration impact of profitability had attracted the other farmers especially small farmers to adopt the enterprise.

Table 2 : Classification of Fish Farmers With Respect to Age

Age range	Frequency	Percent
18-30	15	30.0
31-40	22	44.0
Above 40	13	26.0
Total	50	100.0

Table 3: Experience of Fish Farming

Years	Frequency	Percent
1.00-5.00	20	40.0
6.00-10.0	30	60.0
Total	50	100.0

Table 4 demonstrates that only 4% farmers had taken loan while 96% had not taken loan for fish farming. One of the inhabiting factors was the complexity involved in the procedure of loan taking. Studies like Bashir and Azeem (2008) indicated a lot of problems for getting formal loan.

Table 4: Loan Taken by Fish Farmers

Farmers	Frequency	Percentage
Loan taken	2	4
Loan not taken	48	96
Total	50	100

The marketing of a product is one of the important areas of any enterprise. Table 5 displays that the majority of the farmers sold their produce to big cities (i.e. 40%) while 30% sold at local markets and 30% took their produce both at local and big cities markets. The main reason for selling in big markets was to fetch high income from the sale of their produce. As for the distance of the market from their farm is concerned, table 6 depicted that the maximum distance of big markets was 300 to 400 km and the minimum distance of market ranged from 9 to 20 km.

Table 5: Sale of Fish With Respect to Market

Sale of Fish	Frequency	Percent
Local	15	30.0
Big City	20	40.0
Both	15	30.0
Total	50	100.0

Table 6: Distance From Market Where They Sell Their Produce

Distance	Frequency	Percentage
9 to 20 km	15	30
35 to 100 km	15	30
300 to 400 km	20	40
Total	50	100

Use of feed is an important ingredient for better production. The results given in table 7 show that the majority of farmers used the formulated fish feed while 24% were using self-prepared feed. Those who were found using both type of feed were 32%. Formulated feed was popular among the fish farmers, however, there is still enough room to increase the production of fish feed. Moreover, the quality standards are also required to be monitored. As regards the number of fingerlings put in the fish farm of one acre size, table 8 discloses that 90% farmers put 600 to 800 fingerlings in one acre farm and only 10% release 800 to 900 fingerlings in one acre pond.

Table.7: Source of Fish Feed

Source of Fish Feed	Frequency	Percent
Formulated	22	44.0
Self-Prepared	12	24.0
Both	16	32.0
Total	50	100.0

Table 8: Number of Fingerlings Per Acre

No. of fingerlings per acre	Frequency	Percent
600-800	45	90.0
800-900	5	10.0
Total	50	100.0

The ownership status of fish farms indicates that 46% fish farmers were owner, 42% were found tenants while 12% were owner cum tenants. It means that most of the farmers had their own farms (table 9). The classification of farmers discloses that 36% farmers were small, 34% were found medium while 30% were estimated to be owner cum tenants as shown in table 10.

Table 9: Land Ownership Status

Ownership status	Frequency	Percentage
Owners	23	46
Tenants	21	42
Owner cum Tenants	6	12
Total	50	100

Table 10: Classification of Farmers Categories

Farm type	Frequency	Percentage
Samll Farms (1-7 acres)	18	36.0
Medium Farms (8-25 acres)	17	34.0
Large Farmers (> 25 acres)	15	30.0
Total	50	100

Note: categories based on discussion with fisheries officer

Table 12: Types of Fish Cultured

Type of fish	Frequency
Rahu	50
Thaila	48
Grass Carp	15
Mori	5
Malli	4
Singhari	4
Tilapia	1
Gulfam	1
Silver Carp	1

3.3 Analysis of Non Fish Farmers

Table 12: Types of Fish Cultured

	N	Minimu	Maximu	Mean	Std.
Education	50	0	16	4.90	5.148
Age	50	17	75	42.60	16.284
Experience	50	2	50	21.72	14.995
Farm distance from main road (Km)	50	1	7	3.01	2.057
Family Size	50	2	26	8.42	4.682
D_Market	50	1.00	300.00	15.2600	41.84986
Valid N (listwise)	50				

The experience of non-fish farmers discloses that they had experience ranges from one year to more than 40 years. 34% farmers had experience ranging from 1TO 10 years, followed by 30% farmers had 11 to 20 years of experience. 36% farmers were those having experience ranging from 21 to more than 40 years as presented in table 13.

Age classification of the farmers reveals that 32% farmers were those having age between 18 to 30 years and 22% were comprised of the farmers having age between 31 to 40 years as shown in table 14. While the rest 46% have experienced more than 40 years. One thing which is clear from the comparison of age between fish farms and non-fish farmers is that fish farmers are relatively more younger as compared to non-fish farmers (farmers growing crops).

Table 13: Farming Experience

Years	Frequency	Percentage
1_10	17.0	34
11_20	15.0	30
21_30	6.0	12
31_40	6.0	12
>40	6.0	12
Total	50.0	

Table 14: Age Distribution of Crop Farmers

Age	Frequency	Percentage
18_30	16	32
31-40	11	22
41-50	10	20
>50	13	26
Total	50	

The distribution of non-fish farmers with respect to education illustrates that a big proportion of farmers were illiterate (i.e. 40%) and the second significant segment of the classification comprises of holding primary education. Twenty percent farmers were having education upto Matriculation, followed by 6% Bachelor and another 6% got Mater degree (Table 15).

Table 15: Educational Status of non-Fish Farmers

S.No.	Education	Frequency (n=50)	Percentage
1	Illiterate	20	40
2	Primary	14	28
3	Matriculation	10	20
4	Bachelor	3	6
5	Master	3	6
	Total:	50	

One of the main objectives of the study was to compare the profitability of fish farming and crop cultivation in the study area. Table 16 demonstrates per acre cost of production of fish farming. Average gross cost per acre was estimated at Rs. 96624 and average gross income per acre was estimated at Rs. 349050. The calculated net income per acre was Rs. 252426. The Benefit cost ratio had been estimated at 1: 3.61 which illustrates that the enterprise yields 3.61 rupees for every rupee invested. The results of our study also find support from the studies of (Bashir et al., 2018; Qasim et al., 2004).

Table 16: Per Acre Cost of Production of Pond Fish

S.No.	Income and Cost items	Rupees.
1	Average fertilizer cost/ Acre	2656
2	Average feed cost per acre	158760
1	Average disease cure cost per acre	678
2	Average electricity and fuel cost per acre	21298
3	Average labour cost per acre	17340
4	Average cost of fingerling per acre	449
5	Average rent of farm per acre	27828
6	Average gross cost per acre	229009

7	Average gross Income per acre	349050
	Average Net income	120041
	BCR	1.52

The profitability estimates of crop cultivation in the study area discloses that per acre cost of production (with land rent) for wheat, rice, cotton, s/cane and fodder cultivation was Rs. 41079, Rs. 50825, Rs. 64158, Rs. 79513 and Rs. 426465 respectively. Similarly, per acre cost of production (without land rent) for wheat, rice, cotton, s/cane and fodder cultivation was calculated at Rs. 22443, Rs. 32189, Rs. 45522, Rs.60877 and Rs.24010 respectively. The net income with land rent for the same crops was estimated at Rs.11756, 25806, 9584, 34654 and Rs. 437 respectively, while the estimates of net income without land rent was estimated at Rs.30392, 44442, 28220, 53290 and Rs. 19073 respectively, for the same crop. The estimated BCR shows that all crops have BCR above 1, however, it is highest for Rice crop followed by S/cane and wheat. The BCR for cotton crop is the lowest due to the high cost of production and effect of climatic change. Moreover, prices of cotton were not encouraging, therefore, the farmers were found reluctant to grow the crop (Table 17).

Table 17: Per Acre Cost of Production of Crops

Crops	Wheat	Rice	Cotton	S/Cane	Fodder
Land Preparation cost	2606	4814	4833	7500	2073
Seed Bed Prep. Cost	2301	2527	2000	3500	1980
Seed Cost	2125	1503	3138	9000	6400
Fertilizer cost	7835	7765	11168	7200	6500
Plant Protection cost	1222	4326	13706	3667	2100
Irrigation cost	1970	7462	6210	8135	2100
Harvesting cost	3317	2725	3400	12500	2357
Land Rent (6 months)	18636	18636	18636	18636	18636
Labor cost	1067	1067	1067	1500	500
Marketing cost	0	0	0	7875	0
Production cost (with land rent)	41079	50825	64158	79513	42646
Production cost (without land	22443	32189	45522	60877	24010
Gross income per acre	52835	76631	73742	114167	43083
Net income (with land rent)	11756	25806	9584	34654	437
Net income (without land rent)	30392	44442	28220	53290	19073
BCR	1.29	1.51	1.15	1.44	1.01

Since fish farming takes a year to harvest, therefore, comparison of both the enterprises is required to be made on the basis of net income received annually. Table 18 explains per acre per year net income earned from crop cultivation with and without land rent.

Net income from a wheat-cotton combination was estimated at Rs. 21340 with land rent and Rs. 58612 had been calculated without land rent. The cotton- rice combination reveals that net income obtained by the farmers was calculated at Rs. 35390 with land rent and Rs. 72662 without land rent. The net income earned by sugarcane farmers was estimated at Rs. 34654 including land rent while it was Rs. 53290 excluding land rent (Table 18). Table 19 reveals that net income from fish farming is Rs. 120041 and Rs. 147869 with land rent and without land rent respectively. The comparison of the estimates of income earned per acre from crop sector and income earned per acre from fish farming concludes that fish farming is a more profitable enterprise as compared to crop cultivation. The results of Gachucha et al. (2014) also showed that fish farming was a profitable business compared to maize crop farming in Kenya.

Table 18: Per Year Per Acre Net Income from Different Combinations of Crop Cultivation

Net income from crop cultivation	Per Year Net income (with land rent) (Rs.)	Per Year Net income (without land rent) (Rs.)
Wheat-Cotton	21340	58612
Cotton-Rice	35390	72662
S/Cane	34654	53290

Table 19: Per Year Per Acre Net Income from Fish Farming

Income from fish farming	Per Year Net income (with land rent) (Rs.)	Per Year Net income (without land rent) (Rs.)
Fish Farming	120041	147869

4. Conclusions

The study has been designed to conduct the economic analysis of the fish farming in the study area. Two districts were selected with the highest number of fish farms, i.e. Muzaffargarh and Khanewal. A total of 100 farms, (50 fish farms and 50 non fish farms) from both study areas was selected randomly for the study. Economic analysis was carried out from the collected data to estimate the profitability of fish farming. Moreover, for comparison purpose, data from 50 crop growing farmers were also collected. The results revealed that fish farming was more profitable as compared to crop farming in the study area. Net income per acre was estimated at Rs. 252426 from fish farming as compared to net income per acre of Rs. 58612 from wheat-cotton combination of crops, Rs. 72662 from cotton-rice combination of crops and Rs. 53290 from sugarcane cultivation. The benefit cost ratio (BCR) of fish farming was calculated 1:3.61 which illustrates that the enterprise yields 3.61 rupees for every rupee invested.

5. Recommendations

On the basis of results, it is suggested that fish farming is a profitable business and it could help to the farmers especially small land holders to adopt the fish farming, which will not only improve their socioeconomic conditions, but also shall be helpful for combating the issue of food security at the household, community and at national level. At the same time it could earn foreign exchange for the country also. It is more suitable for those who have severe issues of salinity as crops are difficult to grow well in saline soils.

Fish farming instead of traditional agriculture has been seen as a way to increase agricultural profits from saline affected land

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