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Assessment of livelihood assets and profitability of pond fish farmers in Khyber Pakhtunkhwa of Pakistan

Abdul Hassan[1*], Arshad Farooq[1], Muhammad Ishaq[2], Ghulam Sadiq[2]

[1]*PARC Social Sciences Research Institute, Tarnab-Peshawar, Pakistan*

[2]*Social Sciences Division, Pakistan Agricultural Research Council, Islamabad, Pakistan*

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Abstract

This study was conducted to assess the livelihood assets and profitability of pond fish farming in district Peshawar, Khyber Pakhtunkhwa of Pakistan. The results showed that pond fish farmers are quite young and educated. The farmers raised pond fish farming mainly for income generation. The government supports are in the form of financing, training and information provision. Pond fish farming is favorable for investment and encouragement in the area. There is a need for improving pond fish farming in order to increase the livelihood assets of the rural people. Strengthening of Fishery Department and encouragement by both public and private institutes (GOs and NGOs) are needed to invest in pond fish farming through subsidy and /or direct financing the pond farmers.

* **Corresponding Author:** Abdul Hassan ✉ ahassan7796@gmail.com

Introduction

Fish is an important part of people's diet in many parts of the world for centuries. It is a vital source of quality animal protein provider (Eer *et al.*, 2004) vitamins and other nutrients that are essential for human health. This sector faced similar challenges being a primary sector that is experienced by the agricultural sector (Rehman *et al.*, 2019). It is said that fish spring both food and income to numerous individuals in developing countries (Okpeke *et al.*, 2015).

Khyber Pakhtunkhwa province of Pakistan has the advantage of having water resources suitable for cold water, semi-cold water and warm water fisheries. The Government is striving for fishery development in the province "*to conserve, promote and develop fisheries resources in the province for the provision of proteineous food, income, sports, recreation, health, to improve the livelihood and socio-economic condition of people*".

The Fisheries Department of Khyber Pakhtunkhwa is striving through the utilization of all available water resources to play its role in making the province self-sufficient in the production of white meat (fish). The Department successfully introduced various species of cold water, semi-cold water and warm water in the area (*fisheries.kp.gov.pk*).

Pond fish farming is the fish raising in naturally controlled ponds (Carballo *et al.*, 2008). The growth of fish in ponds can be controlled and usually close to hand. Fish species raised are selected by the farmer (Eer *et al.*, 2004). Fishy ponds are in shapes like square, rectangle (Carballo *et al.*, 2008), U-shaped and triangle depending upon the availability of land. Polyculture type (more than one fish species production in the same pond) of pond fish farming is carried out by the farmers in district Peshawar.

Fish farming has an important role in the livelihood of small scale fish farmers. The inferences of fish farming were important in increasing income, food production, employment opportunities (Mondal *et al.*, 2012), financing children's education, ensured emergency cash flow in terms of urgent medical expenses and supporting household economy in times of maintaining social and family occasions (Moni and Khan, 2014). Poor resources, high production costs, lack of (quality) supply of fish fry, poor technical assistance, high levels of debt, poor institutional support, weak transforming structures and processes, vulnerability context, and lack of extension services, lack of aquaculture friendly credit support (Ahmed *et al.*, 2008; Mondal *et al.*, 2012) are constraints to the sustainability of fish farming.

Proper planning and analysis are required for small scale fish farming to be profitable (Engle and Stone, 2002) and in improving their livelihood. Evaluation of the essential conditions like land suitability and tenure security, water and input availability, access to fish seed, ability to know-how, expected returns from the available resources and its reasonability with other uses of the same resources, expected marketing facilities for the fish produced to sell the fish and sustainability were needed for successful [pond] fish farming (for detail Samudra, 1996). Keeping in view the importance of fish farming, this study was designed to assess the livelihood assets and profitability of pond fish farming in district Peshawar, Khyber Pakhtunkhwa of Pakistan.

Material and methods

Study area and data collection methods

This study was conducted in district Peshawar. It is a warm water fisheries area. The Fisheries Department of Khyber Pakhtunkhwa has established fish ponds at farmer's farms on average land ranging from 1 acre to 2 acres through its Annual Development Programmers. A list of pond fish farmers was obtained from the fisheries department developed by both Fisheries Department and the farmers" themselves. The list contained a total of 39 pond fish farmers. Initially, the farmers having no contact were deselected from the list.

The rest of the farmers were contacted either through their contact (Landline and mobile) numbers and or

visiting their sites. The majority of the pond fish farmers had already left pond fish production due to poaching, water accessibility and quality, water snack, monitor lizard and birds attacking fingerlings, pond destruction due to flood, non-availability of fingerlings, high input cost, no experience, discontinuing government support, the entrance of wild fish species from canal water, etc. Additionally, those farmers that produce fish from the pond for their consumption were also removed from data collection. Overall nine pond fish farmers that produce fish and sold them were selected for data collection. Of the nine pond fish farmers, seven farmers were interviewed for this study during February 2020.

The present study is based on primary and secondary data. Primary data was directly obtained from sampled respondents through a well-structured pretested questionnaire, while secondary data was amassed from various published and unpublished sources. The questionnaire was consulted with the personnel of the Fisheries Department of Peshawar, Khyber Pakhtunkhwa. At the beginning of the interview, the aims and objectives of the study were explained to the pond fish farmers that helped in developing a rapport with them for obtaining accurate information.

Data analysis

The data collected for this study were analyzed using MS Excel and SPSS to calculate averages/means, percentages and cross-tabulation. Moreover, partial budgeting techniques were also used to arrive at the benefits and cost of fish farming.

The situation of each pond fish is different, hence the budget given in the study are the average values. The net value of the product and the cost involved was estimated. Total cost is composed of the fixed and variable cost of inputs utilized. Variable cost includes labour, fertilizer, feed, fingerlings, water, harvesting and marketing charges. For the estimation of gross income, the value of production during the year was taken into account.

Gross margin is the gross farm income minus the total variable cost and the net farm income is the overall level of profitability obtained by subtracting the total costs (both fixed and variable costs) from the total revenue of an enterprise.

$$\text{Gross Margin} = \text{Total Revenue} - \text{Total Variable Cost}$$

Adeosun *et al.* (2019)

$$\text{Net Farm Income} = \text{Totale Revenue} - \text{Total Cost}$$

Olukosi and Erhabor (1988)

Return on Investment (ROI) indicated the returns performance as profit or loss of the invested amount in a particular action. It might be positive or negative. The negative value of ROI indicates an unprofitable project (Zamfir *et al.*, 2016).

$$\text{Return On Investment} = \frac{\text{Revenue after Investment} - \text{Amount Invested}}{\text{Amount Invested}} \times 100$$

(Zamfir *et al.*, 2016).

Internal rate of return (IRR), Benefit-Cost Ratio (BCR), Net Present Value (NPV) and Payback period were carried out for determining the feasibility and long term profitability of pond fish farming.

The economic life of pond fish farming was considered after asking the sampled respondents in the study area.

Result and discussion

Source of Fry and Species raised

Peshawar Carp Fish Hatchery and Training Center, Sherabad is one of the hatcheries of Khyber Pakhtunkhwa in district Peshawar, that produces fry or fingerlings in the study area. The hatchery produces millions of fry/ fingerlings every year.

The Hatchery stocked millions of fish seed in natural water bodies like rivers, dams and reservoirs. It not only provides fish seed to the farmers of Peshawar district but also to the farmers of other districts. This Hatchery & Training Center stocked fish seed of major carps (3000–6000) in fish farm free of cost for promoting fisheries in the area.

Table 1. Household Information.

Particulars	Unit	Mean	Std. Deviation
Age	Years	35.62	11.14
Schooling	Years	14.29	2.13809
Wage rate	PKR / day	546	210.371
Family Size	Number	9.83	1.835
Household Earners	Number	1.67	0.816
Farming Experience	Years	17	15.8745
Fish farming Experience	Years	4.08	2.49833
Households members in fish production/marketing	Number	1.67	0.816
Households with Chronic Illness	Percent	33	—
Total Land	Acre	8.32	5.56536
Waterlogged land	Acre	3.39	2.61748
Lease rate of fish land	PKR/year	21657	6073.675
Pond Area	Acres	1.82	(min 0.5 max 7.50)
Controlled water supply	Percent	71	—
Tested water quality	Percent	43	—
Credit facility not availed	Percent	71	—
Gas connection	Percent	43	—
Drinking water	Percent	86	—
Living space	marla	18.29	9.3401
Fishery office	Kilometers	10.92	5.5784
Fishery input market	Kilometers	16.08	6.4762
Fishery output Market	Kilometers	12.2	4.2071
Household received Govern Support in cash	Percent	57	—
Households faced Poaching	Percent	72	—
Households probable of Poisoning	Percent	72	—
Formal Training received	Percent	29	—

Note: 1 U.S. Dollar = 154.2188 PKR. February 28, 2020, https://www.sbp.org.pk/ecodata/CRates/2020/Feb/28-Feb-20.pdf. Source: Survey data 2020.

The sampled respondents obtained fish seed from the Punjab province of Pakistan. One of the reasons for obtaining fish seed from another province might be that the fish seed is available in the early season (March, April) in Punjab province while fish seed with Peshawar Carp Fish Hatchery and Training Center, Sherabad are available during June and July of the season. The pond fish farmers in the study area acquire fish seed in the early season for stocking their ponds.

Table 2. Fixed Cost and percent in total cost for fish pond production.

Item	Total Cost (PKR)	Economic Life (Years)	Depreciation Cost (PKR)	Percent of Total Cost
Land rent	5733	–	5733	5.19
Construction	235020	10	23502	21.27
Store/Workshop	3643	2	1821	1.65
Net etc.	5671	1.5	3780	3.42
Other (Boat, Dress, etc)	5043	1.375	3668	3.32
Annual Depreciation	–	–	38504	34.85

Source: Survey data 2020.

The study results revealed that the sampled pond fish farmers put 31 percent Grass Carp, followed by 23 percent Silver Carp, 22 percent Rohu Carp, 15 percent Mori Carp and nine percent China Carp in the pond (Fig. 1).

Livelihood assets of fish farmers

A sustainable livelihood approach was used in this study that draws upon the poverty reduction approach. The working definition of sustainable livelihood by Chambers and Conway (1991) is *a livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living*. The approach seeks "to identify what the poor have rather than what they do not have" and "[to] strengthen people's inventive solutions, rather than a substitute for, block or undermine them" (Moser CON, 1998). The approach centers on the links between an individual or household assets, the activities in which households can engage with a given asset profile, and the mediating processes (institutions, regulations, etc.) that govern access to assets and alternative activities (Allison and Ellis, 2001).

Table 3. Variable cost and percent in total cost for fish pond production.

Variable	Total PKR	Percent of Total Cost
Fertilizer	17047	15.43
Supplementary Feed	17960	16.26
Fodder	11901	10.77
Other Feed	6588	5.96
Fingerlings	6641	6.01
Wage	3963	3.59
Water (Tubewell)	864	0.78
Other Cost	7014	6.35
Total Variable Cost (TVC)	71978	65.15

Source: Survey data 2020.

Livelihood assets are the people's strengths in the livelihood framework. People need a range of assets for achieving different livelihood outcomes while no single asset category is sufficient for yielding varied livelihood outcomes that people seek. The poor people had limited access to any given category assets that need to combine the available assets for ensuring survival (DFID, 1999). Capital assets permit livelihood strategies to be constructed by individuals or households (Allisona and Horemans, 2006). Five core capital of assets were identified that made the building blocks of livelihood framework. More assets' ownership provides more options and abilities to switch between multiple strategies for securing their livelihoods (DFID, 1999).

Human capital

Human capital is the amount and quality of labour at the household level that is required for using any of the four types of assets. It represents the knowledge, skills, ability to labour and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives (DFID, 1999).

The study results revealed that majority of the surveyed pond fish farmers were quite young and educated. The estimated age of the pond fish farmers was 35.62 years with 14.29 average schooling years. The average family size of surveyed pond fish farmers was estimated at 10 members (half male and half female family members). The earners per family of the surveyed pond fish farmers were 17 percent (1.67 family members) and also involved in fish production and marketing. Among the surveyed group of pond fish farmers, the reported farming experience was 17 years and pond fishing experience was 4.08 years. More than three-fifth (67 percent) of the sampled pond fish farm households had no member with

chronic illness. In pond fish farming, the majority (71 percent) of the sampled fish farmers showed indigenous fish production technology having their knowledge while 29 percent had developed their skills of fish farming through obtaining formal training from the Fishery Department of Khyber Pakhtunkhwa (Table 1).

Natural capital

Natural capitals are the natural resource stocks from which resource flows and services that are useful for livelihoods derivation. It is very important mainly for those who derive all or part of their livelihood from resource-based activities like farming, fishing, gathering in forests, mineral extraction, etc., (DFID, 1999). Water, wild fry, land and wider environmental good of natural capital are vital for fish farmer's production (Ahmed, 2009).The average waterlogged land of sampled pond fish farmers in the study area had 3.39 acres (41 percent of own land) that were suitable for pond fish farming as perceived by sampled respondents having a lease rate of about PKR 22 thousand per acre per year. The average pond area was 1.82 acres with an earthen structure. Apart from rainfall, the main source for a vast majority of pond fish farmers was the groundwater seeped to the ponds followed by river canals, irrigation channels and pumping of underground water through the machine. Water supply to the pond was in control by majority (71 percent) of the sampled respondents that had no drainage system from the pond. More than half (57 percent) of the sampled respondents had not tested the water quality used for fishing in pond (Table 1).

Table 4. Profitability for fish pond production.

Variables	Value
Total Fixed Cost (TFC)	38504
Total Variable Cost (TVC)	71978
Total Cost (TC)	110482
- Production (Kgs)	597
- Price (Rs./Kgs)	270
Total Revenue (Rs.) (TR)	161336
Gross Margin (Rs.)=TR – TVC	89358
Net Farm Income (Rs.)=TR – TC	56587
Benefit Cost Ratio=Gross Revenue / Total Cost	1.46
Return on Investment (ROI)=((TR-TC)/TC)	0.46
Return on Variable Cost	1.24
NPV for 10 years	1262451
IRR	0.62

Source: Survey data 2020.

Financial capital

Financial capitals are the financial resources that people use for achieving their livelihood objectives. It is the cash availability or equivalent which enables people for adopting different livelihood strategies. The two main sources are the available stocks and regular inflows of money (DFID, 1999). Fish culture has the potential to produce a substantial amount of financial capital (Ahmed, 2009; Mondal *et al.*, 2012). Income in cash form is important for purchasing planting material or fish seed and farm inputs (Samudra, 1996). The study results revealed that the share of income from fish production in the total household income was PKR 806 thousand per year (PKR 805833, St. Dev 576423.60) was 29 percent (Fig. 2). A credit facility for the majority (71 percent) of the sampled pond fish farmers was not available in the study. Moreover, the rest 29 percent of the fish farmers obtained the loan from the landlord and input dealers. All the farmers received a fish feed

from input dealers on credit basis in the study area (Table 1).

Physical capital

Physical capital includes the basic infrastructure and producer goods that are needed to support livelihoods. Its development must be demand-driven from the intended users, otherwise, the service is likely to become unsustainable. Physical capital consists of affordable transport, secure shelter and buildings, adequate water supply and sanitation, clean, affordable energy and access to information (DFID, 1999). The study results revealed that all the sampled pond fish farmers had electricity supply at their homes but load shedding was the main issue they were facing. Moreover, 43 percent of the pond fish farmers had gas connection while majority 86 percent had drinking water facility at their home.

The fish farm households had an area of 18.29 marlas (1 marla= 0.00625 acres) of their houses while all the fish farm households were satisfied with their housing conditions. All the sampled respondents stated that there was no need for taking any approval from the government to start pond fish farming in the area (Table 1).

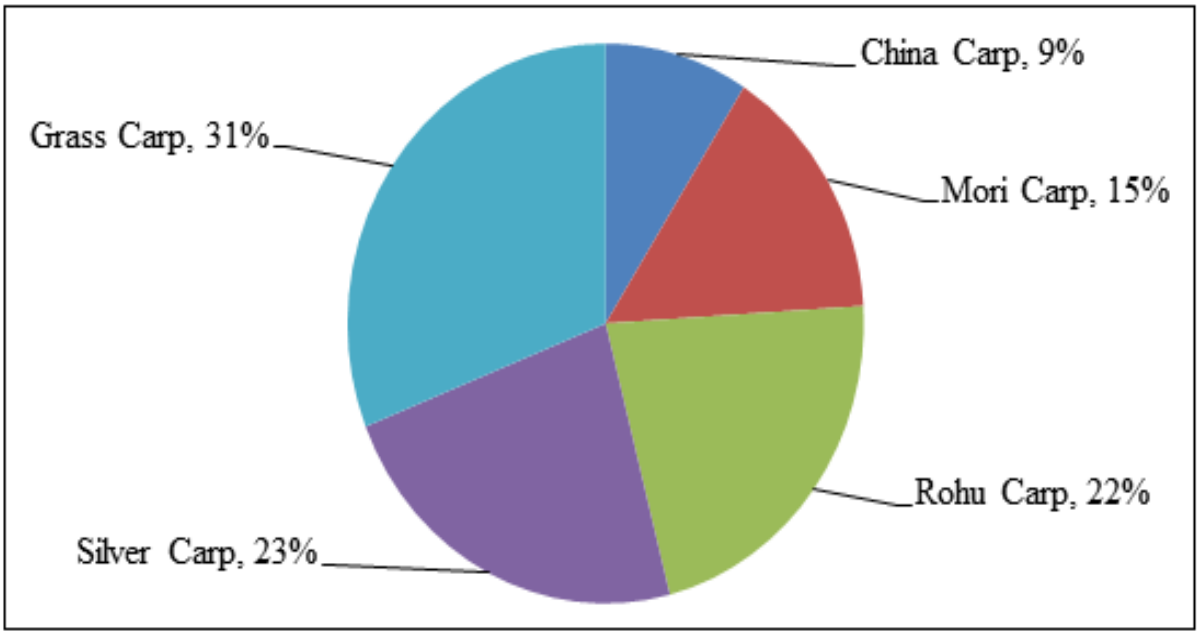

Fig. 1. Fish Species raised by proportion.

Easy access to social amenities like education, health, agricultural and fishery services, banks and markets enhanced the quality of rural livelihood. The facilities related to fish farming like fishery offices, fishery input market and fishery output market had located at a distance on average of more than 10 km (Table 1).

Social capital

Social capitals are the social resources upon which people draw in pursuit of their livelihood objectives. It is developed through (1) networks and connectedness, (2) membership of more formalized groups and (3) relationships of trust, reciprocity and exchanges (DFID, 1999). The lack of social capital has effects on the livelihood of farmers (Ali *et al.*, 2008; Ahmed, 2009; Mondal *et al.*, 2012). During the survey, it was observed that the sampled pond fish farmers were disadvantaged in social capital.

More than half (57 percent) of the sampled pond fish farmers were supported by the government in fish farming in the form of finance, training and information provision. In pond fish farming, majority (71 percent) of the sampled fish farmers showed indigenous fish production technology having their knowledge while 29 percent had developed their skills of fish farming through obtaining formal training from the Fishery Department of Khyber Pakhtunkhwa

(Table 1). The majority (43 percent) of the sampled pond fish farmers obtained technology to use information/ technical assistance from the fellow farmers followed by 29 percent that was using their own experience. The rest 14 percent of each of the sampled pond fish farmers received technology to use information/ technical assistance from Fishery Department and using the internet (Fig. 3). Moreover, about three quarter (72 percent) of the sampled pond fish farmers viewed that they had not faced any poisoning in fish ponds while worried regarding the poisoning of fish ponds in the future. Similarly, majority 72 percent of the sampled fish farmers stated that they had faced the poaching of their fish from ponds. The results indicated that the sampled fish pond fish farmers are disadvantaged in social capital that needs to be developed for developing the pond fish farming in the study area.

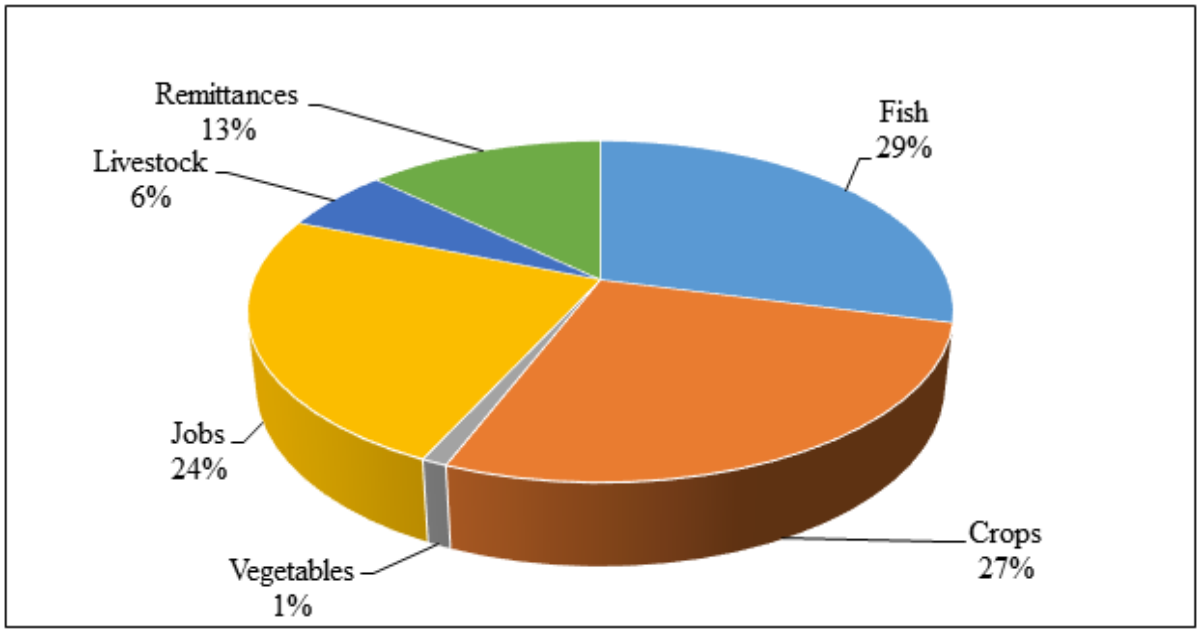

Fig. 2. Share of income by Source in total household income.

Benefit-cost analysis in fish pond production

The study in hand examined the profitability of pond fish production in district Peshawar. To determine the profit level of pond fish farming, attempts were made to estimate the cost and return analysis, the data was obtained from pond fish farmers on cost of input, yield, and output. Initial costs that are required for starting pond fish production.

The initial cost is also termed as a fixed cost that would not change in the course of production, however, it could be changed in long run. In the per year pond fish production, fixed cost is handled through depreciation. Variable costs in the study include fertilizer cost, supplementary feed, other feed, fingerlings/seed, labor, water, another cost like medicines, etc. The revenue of the pond fish production was obtained through the sale of mature or adult-sized fish. The different sizes and weights of fish were sold by the fish farmers. The size and weight of fish varied from 0.67 kg to a maximum of 2.48 kg with a majority weighted at 1.5 kgs.

The pond fish produce was sold either (1) at their pond through the provision of frying services, (2) at their farm through selling fresh fish by visiting restaurant owners (3) at their farm by visiting consumers, or (4) taking their produce to fish market.

Fixed cost

Fixed costs are not changes in the course of production, however, in the long run, can be changed. These include the cost of depreciation of fish ponds and equipment (Adeosun *et al.*, 2019). Same as Adeosun *et al.* (2019) depreciation of equipment was calculated through the straight line method.

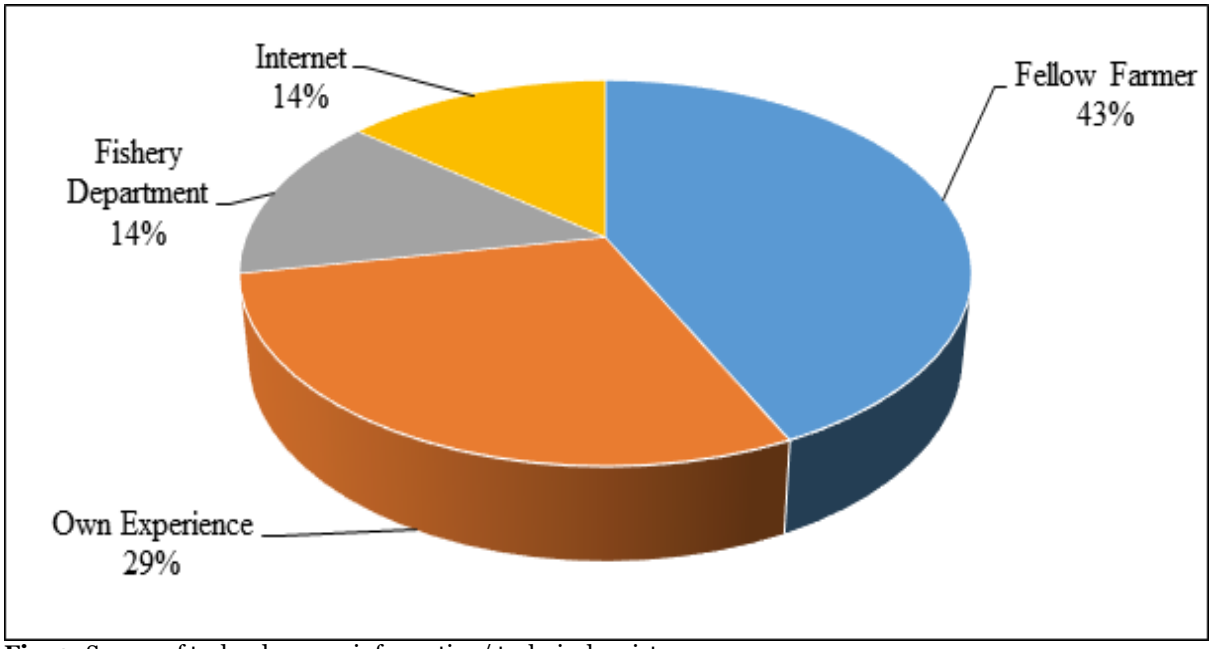

Fig. 3. Source of technology use information/ technical assistance.

The study results revealed that the fixed cost accounts for 35 percent of the total cost per acre of pond fish production per season. Pond construction (21 percent) was the major fixed cost of pond fish production in the study area (Table 2).

Variable cost

The results revealed that the variable cost accounted for more than three-fifth (65 percent) per acre of pond fish farming in the study area. Supplement feed, fertilizers and fodder were the major cost components of variable cost. Combine together, other cost components like fingerlings, other costs, other feed, wage and water accounts for around 23 percent of the total cost (Table 3).

Profitability

The study results revealed that a total cost of PKR 110, 482 was incurred on one-acre pond per season while the total revenue obtained was PKR 161, 336. The gross margin was PKR 89, 358 and a net farm income of PKR 56, 587 was obtained indicating that pond fish farming in the study area was profitable. The Benefit-Cost Ratio was 1.46 that is greater than 1 indicating that according to the rule of thumb (a project with a cost ratio greater than one, equal to one or less than one indicates a profit, break-even, or less respectively) is believed to be profitable. The return on the total cost and variable cost were 0.46 and 1.24 respectively. The NPV and IRR for 10 years were estimated as 1, 262, 451 and 0.62 respectively (Table 4). Moreover, based on the estimated annual costs and returns, all the financial viability criteria (BCR, NPV and IRR) were found viable and favorable for investment in pond fish farming and encouraging. The results is according to (Adewuyi *et al.*, 2010; Olaoye *et al.*, 2014**;** Omobepade *et al.*, 2015**;** Adeosun *et al.*, 2019).

Problems

The problems in pond fish farming in the study area was the high rates of expert laborers either having their expertise or having formal training organized by Fisheries Department followed by non-availability of quality fry on time in the area, non-availability of feed, water scarcity for those using canal water, high input prices, financial status (poverty prevailed in the area), social problems like watch and ward and quality of water, birds and marketing.

Conclusion

Present study shows that the pond fish farmers are quite young, educated with experience in pond fishing of 4.08 years and 29 percent has developed their skills of fish farming through obtaining formal training from the Fishery Department of Khyber

Pakhtunkhwa. Fingerlings / fry is not easily available in the area on the time of its demand in the study area. The government support in the study area as perceived are in the form of financing, training and information provision. Economic indicators are found favorable for investment for pond fish farming and encouraging in the area. Immediate actions must be taken to improve the pond fish farming for increasing their livelihood assets.

The study suggests for provision of demand driven training and modification in pond fish farming within the existing local knowledge and according to farmers' capacity. Moreover, Khyber Pakhtunkhwa's Fishery Department should be strengthened in respect of manpower for listening farmers and giving suggestions on the spot of fish ponds. The government need to intervene in the cost of production to minimize the cost through research based different interventions in pond fish farming.

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