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The Prospects and Problems of Rural Household Based Aquaculture: A Study of Selected Fish Farming Households in Kerala, India

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ABSTRACT

Rural household-based micro fish farming serves a twin purpose: augmenting the marketable supply of fish products and helping to alleviate rural poverty. This study made an attempt to dwell on the performance of some of the selected fish farming households in Kerala, India. Responses from 124 fish farmers were collected from Ernakulam, Kollam, and Alappuzha Districts. The study revealed that biofloc fish farming is a female dominant one, while pond fish farming is a male dominant one. The mean age of fish farmers in the category of biofloc fish farming turns out to be 37 years; whereas in the case of cage and pond fish farming, it is 44 years. Excess rain causes many hardships to the farmers. In the case of cage fish farmers, only 7 percent do not seek any credit. Among those who source credit from money lenders, pond fish farmers stand out with 60 percent. Among the fish farmers, 24.19 percent opine that they receive a profit set above the normal profit. 39 percent consider labor cost as the most volatile. Being more labor-intensive and eco-system-based, pond fishing can accelerate both fish production and livelihood avenues for poor and disadvantaged rural households.

INTRODUCTION

The demand for fish has been growing on account of the significant changes in the diet pattern of many societies in the world **(Tschirley *et al.*, 2015)**. This, coupled with the dwindling availability of wild fish catch due to climate change and associated issues, has made a mismatch between the demand for fish products and its supply, driving the necessity of finding other avenues of fish production **(Tran *et al.*, 2019)**. This trend has ended up in devising newer methods in freshwater and inland fish farming in different parts of the world. Rural household-based micro fish farming has been recognized as one of the promising avenues of such endeavors to augment the supply of nutrient-based and cost-effective fish products **(Day *et al.*, 2008)**. It is interesting to note that rural household-based fish farming serves a twin purpose in this regard: It not only augments the marketable supply of fish products but also helps in ameliorating the intensity of poverty existing among rural households **(Isaacs, 2016)**. Similarly, for some households

whose principal source of income happens to be highly volatile, the earnings from the fish farming activity may help in smoothing such income shocks emanating from varied reasons, including job loss and climate change **(FAO, 2020)**. Nevertheless, the rural fish farmers lack adequate and desirable access to five different forms of capital, viz. natural, human, physical, financial, and social, and the acute paucity of fish ponds and the like places pushes the fish farm households to utter irony under certain difficult circumstances **(ADB, 2005)**. This apparent paucity of indispensable assets that serve the process of determining the likely success of a business creates a number of impediments that make our fisheries sector more vulnerable to climate change-induced problems. Small-scale household-based fish farmers being poor and asset-less are likely to confront the problems of credit constraints and lack of timely and reasonable institutional support. This, in fact, impoverishes the innate enthusiasm for augmenting the supply of fish products while finding sustainable and reliable avenues of livelihood and supplementary sources of income generation. Given this background, the current study attempted to fathom the commercial feasibility of rural-based fish farming households with special reference to selected fish farming households from different parts of the state of Kerala.

OBJECTIVES OF THE STUDY

The role of fish in ensuring food security has well been acknowledged **(Thompson & Amoroso, 2011)**. It is obvious that fish farming households accelerate the supply of fish products to compensate for the dwindling trend in wild fish catch observed across leading fish producer nations in the world; while at the micro level, it adds to the income and livelihood of the poor and economically weaker people, thereby helping to resolve the issue of poverty to a greater extent. Since poor and economically disadvantaged households engage in the field of fish farming, their entrepreneurial initiatives in this regard may not be sufficiently met by the existing institutional system including the market for factors, raw materials, the market for products and credit. This lacuna in properly accessing the existing institutional facilities impedes the operational viability of fish farming households, and, if it remains unaddressed, this may thwart the attempts to enhance fish production to match the skyrocketing demand for fish products. Hence, it is imperative that small-scale fish farming households should be encouraged to continue in the field so as to motivate the entry of more households and small-scale village-based Self Help Groups in the field of fish farming **(Singh *et al.*, 2008)**. In this context, this study made an attempt to dwell on the socio-economic and performance of some of the selected fish farming households to understand how far these fish farming households have succeeded in addressing the issues that might have come in the way of their business. The specific objectives of the present study can be summarized as:

- To understand the socio-economic characteristics of small-scale household-based fish farmers.

- To examine the enabling conditions and associated possession of capital assets by fish farmers.
- To analyze the performance of fish farming units and institutional support that the fish farming households receive.

CONCEPTUAL FRAMEWORK

Fish Farming: Fish farming is a form of aquaculture and it connotes producing fish commercially in ponds or specially designed tanks or cages built in rivers and lakes.

Aquaculture: Aquaculture has gained wide currency in the world, especially in the context of depleting the wild fish population and growing demand for fish products over the years due to its nutritional quality, being protein and fat-rich. Aquaculture itself is categorized into: Indoor Aquaculture and Outdoor Aquaculture.

Brackish Aquaculture or Coastal Aquaculture: In this kind of aquaculture, fish are artificially fed and grown in salty water although not as salty as the seawater **(Primavera, 2006)**. On the contrary, in the freshwater aquaculture culture, fish are fed and grown in zero salty water.

METHODS OF FISH FARMING

Since the present investigation obtained information from various types of fish farming, it was imperative to have a glimpse of ideas about various methods of fish farming existing in the study area.

Cage Fish Farming: as the name indicates, it is a system of fish farming by making cages in open ponds, lakes, or seashore parts of the ocean. Sometimes, this is also called off-shore fish cultivation **(Martin, 2021)**. In this method, fish seeds are allowed to grow in the cage structure and they are artificially fed. Since fish are grown in the natural environment, they are unlikely to be affected by diseases. However, in most unfortunate times, fish may escape into the wilderness of the ocean, causing losses to the farmers.

Pond Fish Farming System: This is a fish farming system done in ponds that hold water sufficiently for the fish to grow. Although fish are artificially fed in this system, they are prone to diseases as in the case of the cage fish farming systems. However, for a real farmer who is engaged in other cultivation activities, the waste of fish can be used as fertilizer **(Popp *et al*., 2019)**.

Composite Fish Culture: This is also a pond fish farming system where the local species of fish are grown along with imported species of fish while ensuring that their coexistence does not lead to competition for food **(Panda, 2016)**.

Biofloc Fish Farming: It is a high-density fish farming method requiring some inbuilt waste management infrastructure **(Hargreaves, 2013)**. This has been gaining wide

popularity in Kerala under the specially designed programme called Subiksha Kerala Scheme. Biofloc fish farming is a solution to twin problems that we face today: Growing demand for fish which can be hardly met properly by the existing alternative methods and the declining space or land available for fish farming. It was first developed and practiced in Israel. In biofloc fish farming floc, a composition of bacteria and flora and fauna are also grown along with the fish. This floc naturally purifies the water by making the ammonia content zero in the water. Besides being a natural water purifier, floc can be good fodder for fish. This twin advantage makes biofloc fish farming a preferred one among the farmers. In Kerala, the State government 60 percent subsidy for the starting of a biofloc fish farming system.

Aquaponics: This is an intensive fish farming system using tanks **(Kyaw & Ng, 2017)**. The importance of aquaponics lies in the fact that the quantity of fish produced in 50 percent of the natural pond can be produced in one cent of land using this intensive fish farming method. In this method, water is purified using a filter system built externally. Using pumps, water is taken to the purifier and the recycled water is flown back to the tank.

FISH VARIETIES FOR HOUSEHOLD-BASED FISH FARMING

In Kerala, different fish varieties are used for fish farming. Some of these varieties are listed here:

1. **Tilapia**: this is the most common variety found in Kerala aquaculture. Four species of tilapia are used in aquaculture: red tilapia, mono sex tilapia, gift tilapia, and the Nile tilapia. Gift tilapia is a high-yield species.
2. **Redbelly Natter**: These are carnivorous species that can grow up to the size of 15 to 30cm. This variety is also called piranha. The period of cultivation of this variety ranges from six months to one year.
3. **Rohu:** commonly known as Rui, it will group up to the size ranging from 15 cm to 70 cm. it is a freshwater variety. The duration of its cultivation is one to two years.
4. **Catla:** Also called major carp, catla can grow up to the size of 100 to 180cm in freshwater. The duration of cultivation ranges from one to two years.
5. **Anabas:** These are carnivorous varieties, and they will grow up to the size of 15 to 30cm in length. Its duration of cultivation ranges from six months to one year. It can survive without water for up to 8 hours.
6. **Crab Farming**: Crab is the brackish fish variety found in many parts of Kerala. It is of two varieties: mud crab or green crab and red crab.
7. **Vannamei shrimp**: This is a much sought-after variety of shrimp. These are cultivated in coastal areas as it requires saline water. Biofloc farmers generally tend to use this variety of shrimp for farming.

MATERIALS AND METHODS USED IN THE STUDY

The present study uses both quantitative and qualitative methods. Largely, it makes use of a well-structured interview schedule to obtain information from respondents. In addition to this, informant interaction and focus group discussion (FGD) was also used to get in-depth information from the selected respondents. As the fish farmers are poor and ignorant about baseline accounting principles, recorded evidence and information are not immediately available for any quantification and subsequent analysis. Hence, the study has mainly relied on the recall method, and often information obtained from the recall method was cross-checked with secondary evidence. Since reliable recorded data could not be collected, the study mainly attempted to seek opinions from the fish farmers regarding the performance of units in terms of profit generated, costs involved, and different performance ratio variables. Because of this kind of approach, instead of scale variables, the study mainly relied on nominal variables. Statistical tools applicable to nominal variables have been used in the analysis of the performance and evaluation. We attempted to contact more than 200 persons over the phone and personally wherever possible for the collection of data. Given the social distancing and other Covid-19 protocols, quite often direct face-to-face interviews could not be conducted. Therefore, we were constrained to use limited face-to-face interaction keeping the Covid-19 protocol in mind. Apart from this method, the telephonic interview was also extensively used to collect information from respondents. Responses from 124 fish farmers were collected from Ernakulam, Kollam, and Alappuzha Districts.

RESULTS AND DISCUSSION

Several aspects of the socio-economic conditions of fishing farmers were considered in the study. Among different types of fish farming, viz. cage fish farming, pond fish farming, biofloc fish farming, Pond fish farming being more labor-intensive and nature bound has been more popular among the fish farmers in the study area. Among the fishing farmers, 61 percent were doing pond fish farming whereas 22.58 and 19.35 and 8.87 percent were adopting Cage fish farming, Biofloc fish farmer, and other fish farming methods respectively (Table 1). It is curious to note that despite the coming up of different labor-saving methods of aqua farming like Biofloc fish farming, people tend to be still relying more on Pond fish farming as it is quite natural and eco-friendly. Cage fish farming is the second most popular fish farming method in the study area although its presence is nowhere near pond fish farming. One reason for pond fish farming gaining momentum is the availability of paddy fields close to small river buds and streams, and the availability of water. ‘Pond fish farming is familiar to paddy cultivators, and therefore, in the off-season, paddy cultivators plunge into pond fish farming’, remarked Sreekumar, a pond fish farmer turned paddy cultivator from Paravur, Kollam. Biofloc fish farming is a tank-based one that requires constant attention and scientific information

on the part of the fish farmer for successful harvesting. Moreover, pond fish fetches high prices compared to products from Biofloc fish farming.

Table 1 Type of Fish Farming (n=124)

Type of Fish Farming	Frequency	Percent
Cage Fish Farming	28	22.58
Pond Fish Farming	61	49.19
Biofloc Fish Farming	24	19.35
Others	11	8.87
Total	**124**	**100.00**

Education and Fish Farmers

As in any activity, education is a primary factor that prompts people to venture into a field and understand more about the field through experience backed by basic skills gained through general education. It is evident from the table that mean years spent on education do not show much variation among different categories of fish farmers (Table 2). Nevertheless, it is quite interesting to note that compared to pond fish farmers and cage fish farmers, farmers engaged in biofloc fish farming spent more years for education which points towards the fact that relatively educated farmers indulge in biofloc fish farming. On average, farmers engaged in biofloc fish farmers completed nearly 15 years of education whereas Pond fish farmers, on average, spent only 12 years of education (Table 2).

Overall, it could be observed that a little more than 36 percent of farmers completed 12 years of education, the largest among the categories whereas only 22.5 percent completed 15 years of education ().

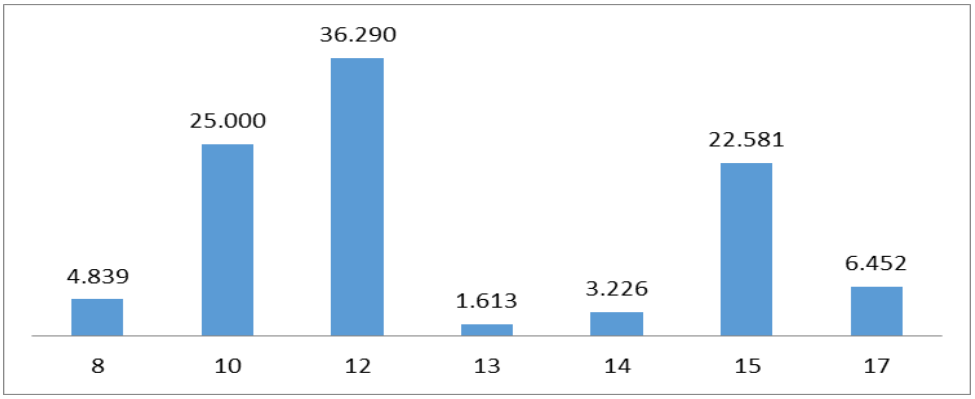

Figure 1 Average Years Spent on Education (n=124)

Table 2 Fish Farming Wise Statistics of Average Years spend on Education (n=124)

Type of Fish Farming		Statistic
Cage Fish Farming	Mean	12.00
	Std. Deviation	2.37
	Minimum	8.00
	Maximum	17.00
	Range	9.00
Pond Fish Farming	Mean	11.84
	Std. Deviation	2.15
	Minimum	8.00
	Maximum	17.00
	Range	9.00
Biofloc Fish Farming	Mean	14.79
	Std. Deviation	1.32
	Minimum	12.00
	Maximum	17.00
	Range	5.00
Others	Mean	11.18
	Std. Deviation	1.60
	Minimum	10.00
	Maximum	15.00
	Range	5.00

Gender Dimension and Fish Farmers

It is true that the agriculture sector does not discriminate much between males and females when it comes to most of the activities concerned with that sector. Data shows that 49 percent of the labor force engaged in global agriculture is women **(Raney *et al.*, 2011).** Although works requiring more physical labor tend to be taken up by the male, the female population also takes a central role in farming activities. In recent times, due to the transformation in the employment structure in the labor market, there is growing evidence that the farm sector has been subjected to what is often referred to as 'feminization' **(Pattnaik *et al.*, 2018).** Gender-wise distribution of the type of farming reveals that of the total female engaged in fish farming activities, 45.45 percent are in Biofloc fish farming while only about 12 percent are found in cage fish farming fields. In pond fishing also, women present are remarkably high at 30.30 percent (Table 3). On the other hand, of the total male farmers, 56.04 percent are in the pond fish farming sector while only 26.37 percent are in cage fish farming. In short, Biofloc fish farming is a female-dominated area and pond fish farming is a male-dominated one.

Table 3 Gender Wise Distribution of the Type of Farming (n=124)

Type of Farming	Male	Female	Total
Cage Fish Farming	26.37	12.10	22.58
Pond Fish Farming	56.04	30.30	49.19
Biofloc Fish Farming	9.89	45.45	19.35
Others	7.69	12.14	8.87
Total	100	100	100

Years of Experience in Fish Farming

Turning to the experience of farmers in the field, we find that the mean years of experience in the case of pond fish farming was found to be 5.7 years while the same in the case of cage fish farming is 5.4 years. As Biofloc fish farming is a relatively new venture, the mean years of experience in this category have been found to be just around 2.4 years (Table 4. Average Year of Experience).

Table 4. Average Year of Experience (n=124)

Type of Fish Farming		Statistic
Cage Fish Farming	Mean	5.4
	Std. Deviation	2.4976
	Minimum	2.0
	Maximum	10.0
	Range	8.0
Pond Fish Farming	Mean	5.7
	Std. Deviation	2.2636
	Minimum	2.0
	Maximum	10.0
Bio Floc Fish Farming	Mean	2.4
	Std. Deviation	0.8297
	Minimum	2.0
	Maximum	5.0
	Range	3.0
Others	Mean	3.7
	Std. Deviation	1.2721
	Minimum	2.0
	Maximum	5.0
	Range	3.0

Age-Wise Statistics of Fish Farmers

Looking at the statistics related to the age of the respondents, it is found that relatively younger people are found to be more engaged in the Biofloc fish farming method. The mean age of fish farmers in the category of Biofloc fish farming has been found to be 37 years whereas in the case of cage and pond fish farming it is 44 years (

Table 5 Age wise Statistics of fish Farmers).

Table 5 Age wise Statistics of fish Farmers (n=124)

Type of Fish Farming		Statistic
Cage Fish Farming	Mean	44
	Minimum	32
	Maximum	54
	Range	22
Pond Fish Farming	Mean	44
	Minimum	32
	Maximum	54
	Range	22
Bio Floc Fish Farming	Mean	37
	Minimum	31
	Maximum	52
	Range	21
Others	Mean	39
	Minimum	35
	Maximum	52
	Range	17

Crisis faced by Small Scale Fish Farmer Households

Small scale fish farmers face multiple crises, crises that generally affect the small-scale sector or industrial sector in general, and crises that are internal to such industrial units. General crises include morbidity associated with the fish, problems due to excess rain, flood, and sometimes theft of the fish at night, loss of employment other than fish farming, issues related to not getting adequate and reliable credit, lack of government support, and personal issues. In this study, it has been found that the main problem that the fish farmers face is the problems associated with excess rain (21.8 percent). Damage due to floods, which has now become a common thing in the weather landscape of the state of Kerala, also causes severe damage and becomes a potential source of crisis in the field of fish farming (21 percent). Lack of credit is another crisis that the fish farmer

households are faced with. 16.2 percent of farmers cite lack of credit as an important crisis that they confront with (Table 6). It is really interesting to note that only a negligible percentage of fish farmers face problems from their neighbors (4.8 percent).

Table 6. Crisis faced by Small Scale Fish Farmer Households (n=124)

Nature of Crisis	*Percentage of Households Experiencing Crisis*
Morbidity and Associated health expenses	11.3
Excess Rain	21.8
Flood Damage	21.00
Theft	08.1
Loss of Employment	03.2
Lack of Credit	16.1
Lack of Government Support	10.5
Problems from neighborhood	04.8
Personal debt	03.2
Total	100

Analysis of Gender Role in Small Scale Fish Farming

Analyzing gender roles in small-scale fish farming households may be of immense help to understand the gender issues in the fish farming sector. In the present study, it has been observed that females do take up a number of activities pertaining to fish farming. Most of them, nearly 32.3 percent in the present study, engage in feeding the fish while 17.7 percent engage in procuring fish seeds. And it is worthwhile to note that 29 percent of females are active in public information management including sending videos and messages and responding to the queries of customers using social media platforms. Many of the fish farmers who were interviewed opined that social media has helped them a lot in advertising their activities, and in this, the role of women has been very commendable. However, it must be reiterated that in activities like preparation of ponds and harvesting which require more physical labor, women were found less active (Table 7)

Table 7 Gender Roles in Household Based Small Scale Fish Farming (n=124)

Activity	*Percentage of Households*
Preparation of Ponds, Cages, Tanks	4.8
Feeding Fish	32.3
Harvesting Fish	3.2
Marketing Fish	12.9
Procuring Fish Seeds	17.7
Public Information Management	29

Other Sources of Income for the Small Scale Fish Farming Households

Fish farmers being poor and multiply disadvantaged barring some of those who run Biofloc fish farming for fantasy, it is obvious that they cannot entirely depend on only the fish farming activity for livelihood. It follows from the above discussion that Fish farming especially pond and cage fish farming is very uncertain, especially on account of the frequent changes in weather conditions causing excess rainfalls and sometimes heavy floods. This uncertainty in earnings from fish farming might have prompted farmers not to put their all eggs in one box. Many fish farmers have reported earnings from other sectors of activity can mitigate the income and employment shocks emanating from the uncertainty in fish farming. Fish farmers in the present study tend to participate in service sector employment, agriculture activities, and manufacturing. In the category of those who are engaged in the service sector, Biofloc fish farmers are more (40 percent) followed by Pond fish farmers (32.5 percent). Among those whose other source of income is agriculture, Pond fish farmers come first with 68.3 percent followed by cage fish farmers (17.5 percent). Among the manufacturing category as the other source of income, cage fish farmers are more in percentage terms (33.3 percent). It does mean that most of the Biofloc fish farmers have the service sector as the other source of income, pond fish farmers and cage fish farmers have agriculture and manufacturing as the other source of income respectively (Table 8).

Table 8 Source of Other Income and the Type of Fish Farming (n=124)

Type of Fish Farming	Source of Income		
	Service Sector Employment	Agriculture is the source of income	Manufacturing is the source of income
Cage Fish Farming	25.0	17.5	33.3
Pond Fish Farming	32.5	68.3	23.8
Biofloc Fish Farming	40.0	4.8	23.8
Others	2.5	9.5	19.0
Total	**100**	**100**	**100**

Forms of Capital Required in Fish Farming

It is evident that five forms of capital are required for starting any economic activity: Human Capital, Natural Capital, Physical Capital, Social Capital, and Financial Capital. Human capital encompasses education attainment and skill acquisition whereas natural capital incorporates ownership of land and other natural properties. Physical capital takes into account the possession of different kinds of constructed properties like houses, buildings, and machines. Access to necessary overhead capital viz. roads, drinking water, and airports are also reckoned as physical capital. Financial capital implies ownership and access to obtain different kinds of financial assets.

Social Capital

The role of social capital in household fish farming has been observed to be very important in determining the pace and success of the business **(ADB, 2005)**. Social capital mainly refers to social networks, farmer-to-farmer contacts, cooperation from neighboring households, and advice from experienced but retired people from the concerned field. Studies have shown that farmer-to-farmer contacts have played an indomitable role in household fish farming activity. It is apparent that access to reliable social capital increases the speed with which one could gather valuable information on how to proceed with each step in the farming process. Moreover, marketing the fish product requires a good social connection especially to inform the potential buyers about the quality of the product in terms of nutritional content. Important Social Capital sources are Fellow Farmers, Media, Friends and Relatives, Financiers, Seed Suppliers, Feed Suppliers, NGOs, and educational institutions, government departments. Farmers having a good reputation in social networks possess a high probability of getting access to financiers and thereby acquiring not only credit at a reasonable cost but also receiving information on how to do fish farming in the most effective way. The referrals made by social networks are also increasingly used by the indigenous financiers to get rid of the problem of moral hazards in the disbursement of credit. Apart from this, the success of fish farming also becomes important for the financier to avoid payment default.

In some instances, social capital may boomerang in some ways especially when conflicts in respect of the area of fishing. This particularly happens in the case of cage fish farming where the same pond or a part of the river may be used for building fish cages. Conflicts arise due to water pollution or some other reason with the other users of water in the same areas. Again in some societies, theft of fish from the pond, tank, and even the cage has created a lot of furor. The probability of theft increases when the fish farming is female-managed. Moreover, surveillance of the fish farming locations to avoid theft adds to the operational cost of the fish farming, eating into their net profits, and therefore female fish farmers often join together and forms their own committees to jointly guard their fishing properties on a rotational basis.

Thus it is obvious that social capital plays an important role in the success of an entrepreneurial initiative, be it small scale or large scale. In our present study, it has been found that fish farmers do not underestimate the significance of social capital in their activities. Over social platforms like WhatsApp and Facebook, they share their concerns and advice each other on different steps to be followed in fish farming. "We always value our friends' views and experiences in fish farming. They share it with us in our groups on social media. We consider this as more valuable as this advice come out of their practical experience", said Mohankumar, a pond fish farmer from Alappuzha. Not only do social media play an important role in this respect, but farmers also have their local groups, groups generally formed with the initiative and support of the local government or agriculture/fishery officials. These groups also advise farmers on many areas related to fish farming. Mainly farmers receive advice on areas ranging from fish pond preparation, Husbandry, Nutrition to Seed production, and the like. In the present study, it has been found 36.3 percent of fish farmers receive advice on seed production as seed production requires much expertise and knowledge (Table No.9)

Table 9 Areas on which advice from Social Capital received (n=124)

Social Capital Advice Areas	***Percentage of Fish Farming Households***
Fish Pond Preparation	16.1
Husbandry	30.6
Nutrition	16.9
Seed Production	36.3
Total	100

Natural Capital

When it comes to the natural capital, it is evident that access to land and water continues to be a prerequisite for household fish farming activities. It is observed that successful fish farmers have their own land to carry out their farm operations. However, in the case of very poor farmers devoid of land, although they can do the activity on the leased land, in the absence of a proper written agreement to use the land for a fairly long period, eviction from the land poses a serious problem. Interruptions in the farming activity being caused by the threat of the landlords may wash away the highly-priced capital that the fish farmers invest in the business. It is obvious that for sustainable aquaculture, the existence of sound and effective natural capital is a prerequisite **(Valenti, Kimpara, & Preto, 2011).**

Here we proxy land for natural capital in the analysis, and we proceed with the explanation of the ownership of land. Four categories of land ownership are considered here among which the last one namely 'I do fish farming on CPRs' needs some elaboration. Common Property Resources (CPRs) connote resources that are not privately owned, and unless and until privately owned they are considered common property. In the interior places of India, and even in such states like Kerala where the density of population is quite high, CPRs could be observed in many places surrounding agricultural and paddy lands. These lands may be used for fish farming. It is interesting to observe from this study that only 27 percent of fish farmers have their land for fish farming (Table No.10). The rest 63 percent either use partly their owned land or use rented land or CPRs. hence, it is obvious that with regard to the holding of natural capital especially land, the small-scale fish farmers are at a disadvantageous position.

Table 10 Land Ownership Pattern (n=124)

Ownership Pattern	No of Fish Farmers	Percentage
I do fish farming only on my land	27	21.77
I completely take land on rent	33	26.61
I use both my own land and rented land	31	25.00
I do fish farming on CPRs	32	25.81
Total	**123**	**99.19**

Role of Physical Capital

Physical capital mainly connotes the ownership of and access to houses, vehicles, communication facilities, transportation facilities, roads, reliable water supply, and the like. These things can be described as the enabling conditions for the successful running of the fish farming activity. Hence, as a proxy for physical capital, we now turn to the discussion of enabling conditions (Table No11). A glance at the following table reveals

that transportation and communication have become not a hurdle for the fish farmers thanks to the improvements made in the construction of roads especially rural roads and mobile communication networks. But in the case of medical facilities and the availability of water and electricity, fish farmers face a lot of issues. Hence it could be concluded that transportation and communication have become good enabling conditions for the small-scale rural-based fish farmers in the present study.

Table 11 Enabling Conditions for Fish Farming Activity by the Households (n=124)

The attribute of Enabling Conditions	Very Difficult	Difficult	Neither Difficult nor easy	Very easy
Transportation	8.1	50	37.1	4.8
Communication	3.2	25.8	29	41.9
Medical	25.8	37.1	30.6	6.5
Water Supply Electricity	12.9	40.3	41.9	4.8

Finance Capital

Finance capital is an indispensable one especially for the poor households to step into the fish farming activity. Finance capital may come in the form of own savings, chit funds, formal and informal credit sources, and guaranteed credit from the government. Access to finance is very important for the fish farmers, and the access to finance depends on a number of factors like the repayment capacity and history, income, prospects of the business, ability to offer securities, history of the business, and the like. Aquaculture being capital intensive compared to other modes of farming, credit assumes indomitable importance in augmenting the production and productivity in this sector. Studies show that for credit unconstrained fish farmers engaged in aquaculture, productivity is shown to be high relative to other modes of farming **(Mitra, Khan, and Nielsen 2019)**. Collateral-free micro-credit and joint liability-based credit have become popular in many countries, and these have had a promising impact on the prospect of fish farming activity too. It is observed that a financier-caretaker model has been in practice in many countries in the field of fish farming activity. The financier provides credit and the caretaker, probably the fish farmer, does the business on behalf of the financier. The fish farmer usually gets remuneration for looking after the cage or pond by feeding the fish. In this model, the financier takes away a large chunk of the profit from the business, but the bright side of this is that the fish farmer or the caretaker can get rid of all worries with regard to obtaining credit and the financier takes care of all credit needs. But, this can hardly be considered a sustainable model as the fish farmer just acts not as an entrepreneur but as an agent who acts on behalf of the financier. It is further interesting to note that fish farmers in the field of aquaculture appear to be using modern inputs for

their activities, but the financing of modern inputs deserves more attention. The common wisdom is that farmers might have adopted formal and informal sources to finance the use of modern inputs. Nonetheless, studies show that farmers 'primarily finance modern input purchases with cash from non-farm activities and crop sales'. It does mean that fish credit, formal or informal, does not seem to have been playing a significant role in financing the use of modern inputs in fish farming **(Adjognon, Liverpool-Tasie, and Reardon 2017)**. Access to credit becomes more precarious when it comes to the case of small especially household-based farmers. Generally, banks more particularly private sector banks tend not to lend to the small-scale sector based in rural areas, citing a number of reasons including high transaction costs, lack of sufficient and reasonable collateral, and risk in lending on account of high default rates **(Dorward, *et al.*, 2009)**.

Credit is said to be the lifeblood of an enterprise, be it small scale or large scale. It is often seen that as the size of enterprise increases, the avenues of credit rise whereas risks associated with credit normally declines. Therefore, in the case of small-scale businesses, credit involves many risks viz. risk in getting access to credit, and risk involved in servicing the credit once it is received. Owing to these risks, people planning to venture into small-scale businesses normally keep themselves away from seeking credit of high volume and high cost; rather they try their best to use their own hard-earned savings or capital sourced from relations (relational capital) for business. The same story holds goods in the case of small-scale fish farmers as well. In the present study, it has been found that 27 percent of the fish farmers did not seek any credit from any source. Moreover, none of the fish farmers sourced all of their capital from sources of credit. It is not surprising that 29 percent of the small scale fish farmers sought only 50 percent of their capital to be financed through credit from other sources while 44 percent sought 70 percent of their initial capital from other sources (Figure 2)

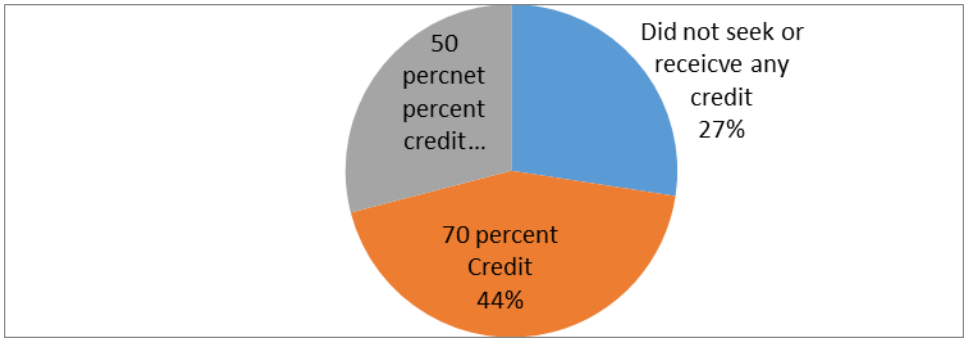

Figure 2. Credit Seeking by the Fish Farmers (n=124)

The propensity of not seeking credit increases as we move from the category of cage fish farmers to the 'other' category (Figure No.3). In the case of cage fish farmers only 7 percent did not seek any credit and the rest 93 percent sought credit of some form. Farmers not seeking credit increases to 25 percent in the case of pond fish farmers

category and 46 percent in the case of biofloc category, and further to 55 percent in the 'other category.

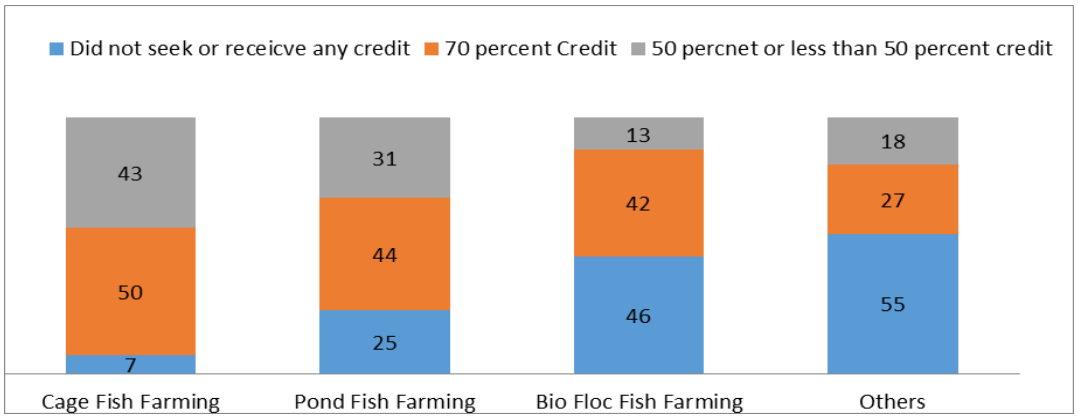

Figure 3 Credit Seeking and Type of Fish Farming (n=124)

Further, it is quite interesting to look into the sources of credit that the fish farmers usually rely on to seek credit. Here, five sources are considered viz. Banks, Cooperatives, Development Agencies, Money Lenders, and Relational Capital (including credit from neighbors and friends). Pond fish farmers received the highest share of credit from all the five sources compared to other categories of fish farmers. Among those who sourced credit from money lenders, Pond fish farmers stand out with 60 percent (Figure No.4). Biofloc farmers' largest source of credit is relational capital as compared to other sources. Their share in relational capital stands at 26.47 percent. In short, looking at the source of credit, it is evident that pond fish farmers are more financially vulnerable fish farming category.

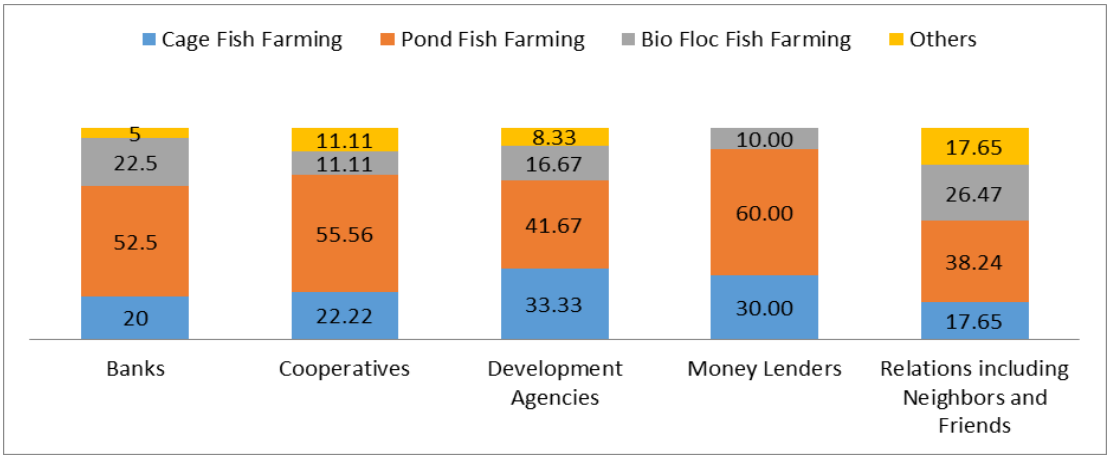

Figure 4. Source of Credit and Type of Fish Farming (n=124)

On the Question of Profitability

It is true that the ultimate aim and for that matter, the ultimate yardstick to evaluate the performance of a private concern is profit. Looking into the profitability of the small-scale fish farmers under the present study, it has been found that 51.61 percent are normally profitable in the sense that they cover the costs of production with a normal and remunerative profit. Among the fish farmers, 24.19 percent opine that they receive considerable profit that is profit set above the normal profit. 14.52 percent of fish farmers are just breakeven, neither making profit nor losses, and only a negligible percent that is less than 10 percent experience a non-profitable condition (Figure 5).

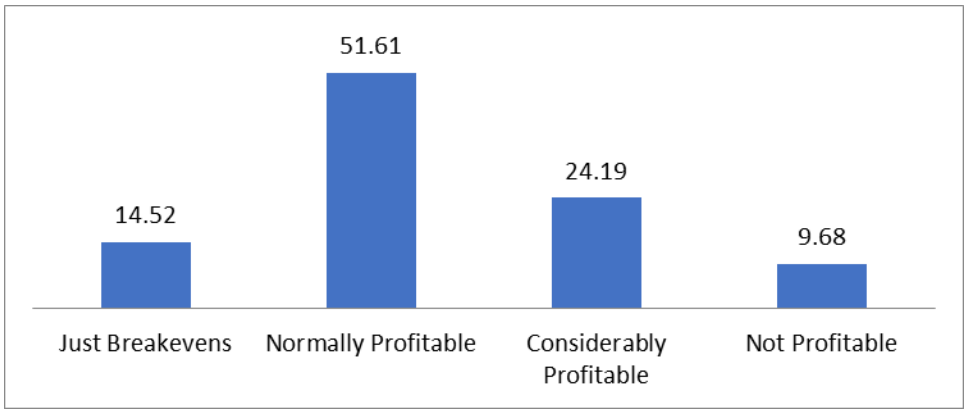

Figure 5. Profit from Fish Farming (n=124)

Now, we attempt to relate the profitability status to the type of fish farmers. Among the category of 'Normally Profitable', and 'Considerably Profitable', a relatively more percentage of pond fish farmers are included whereas, in the case of the 'Not Profitable' category, about half of the fish farmers are biofloc fish farmers (Table No.12). It boils down to the fact that pond fish farmers make a relatively better profit whereas the other forms of fish farming do not appear to be lucrative activities.

Table 12 Type of Fishing and the Profitability Status (n=124)

Profitability Status	Type of Fish Farming				Total
	Cage Fish Farming	Pond Fish Farming	Biofloc Fish Farming	Others	
Just Breakeven	11.11	38.89	27.78	22.22	100
Normally Profitable	28.13	50.00	14.06	7.81	100
Considerably Profitable	26.67	60.00	13.33		100
Not Profitable		33.33	50.00	16.67	100
Total	22.58	49.19	19.35	8.87	100

Breakeven Period

Another important finding associated with profitability and the performance of fish farmers is the time taken for breakeven. As is well known, the breakeven point is that where Total Cost (TC) matches with the Total Revenue (TR), making a condition of neither profit nor loss. For a firm, the time taken to reach the breakeven point is important, and it plays an important role in assessing the performance of a small-scale business. Although financial records are necessary to find out the breakeven points, in this study, as has been highlighted at the outset, owing to the lack of financial records, some kind of extrapolation has been used to arrive at the breakeven period for each fish farming household that comes under this study. It is evident from the analysis that 30.65 percent of fish farming households have a breakeven period of three years whereas the majority 43.55 percent reach the breakeven point within two years, and only 2.42 percent take a longer period of five years to reach the breakeven point (Figure No.6).

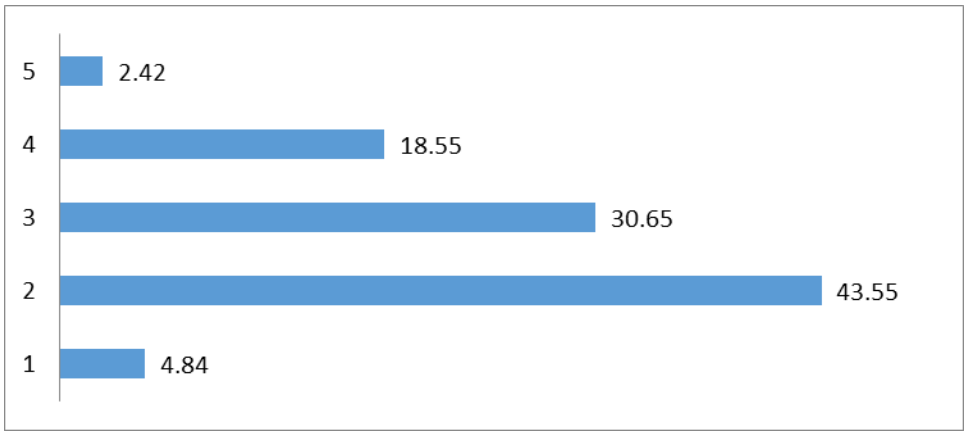

Figure 6. Breakeven Period (n=124)

Labor Cost and its Volatility

As is well known, the cost of a business is split into two: Fixed costs and Variable Costs. The former does remain constant as the output changes whereas the latter varies with the volume of output. Although both are important, as output changes the latter becomes more prominent in the total cost. Variable cost is again decomposed into many, of which the labor cost is the most important and the most volatile as well. But the intensity and frequency of volatility of labor cost vary from business to business, often depending upon the ratio with which capital is combined with labor. It is true that as the variable cost becomes more uncertain, the probability of loss increases, and business may turn out to be more unstable and uncertain. Hence, we need to look into the opinion of fish farmers with regard to the volatility of the labor cost. In the present study, 39 percent consider labor cost as the most volatile while only 2 percent consider it as not volatile. 32

percent opine that labor cost is only moderately volatile whereas 27 percent do not have any opinion (Figure 7).

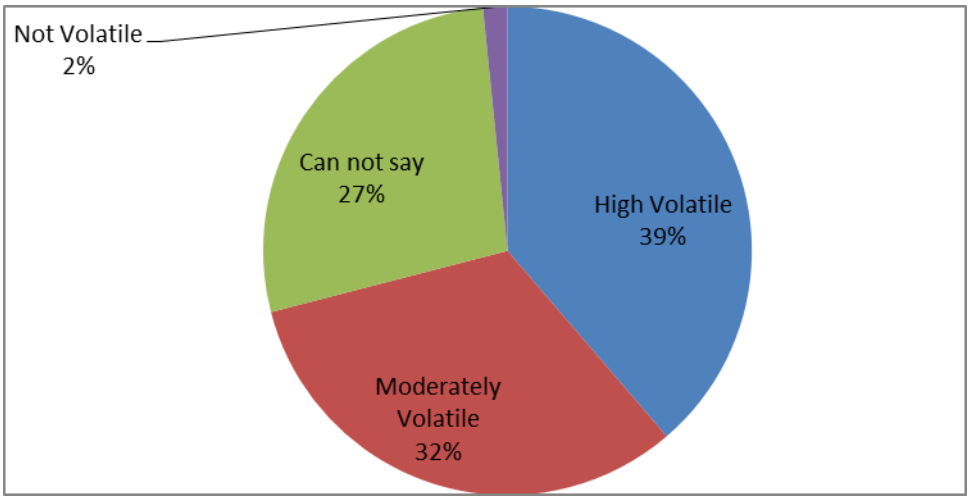

Figure 7. Volatility of Labor Cost (n=124)

How volatile is the Labor Cost?

Among those who regard labor cost as the most volatile, Pond fish farming households constitute the most with 60.66 percent while among the moderately volatile, Cage fish farmers form the highest 50 percent (Figure No. 8). Hence, it boils down to the fact that for the Pond fish farmers, labor cost is the most volatile. The main reason for this is that pond fish farming is the most labor-intensive method of aqua fish farming. Not only does the labor cost become most volatile for them, they too are facing the problem of systemic and seasonal shortage of skilled manpower. In some cases, hired migrant labor has been used instead of local skilled employees, leading to inefficiency and loss of profit in some cases.

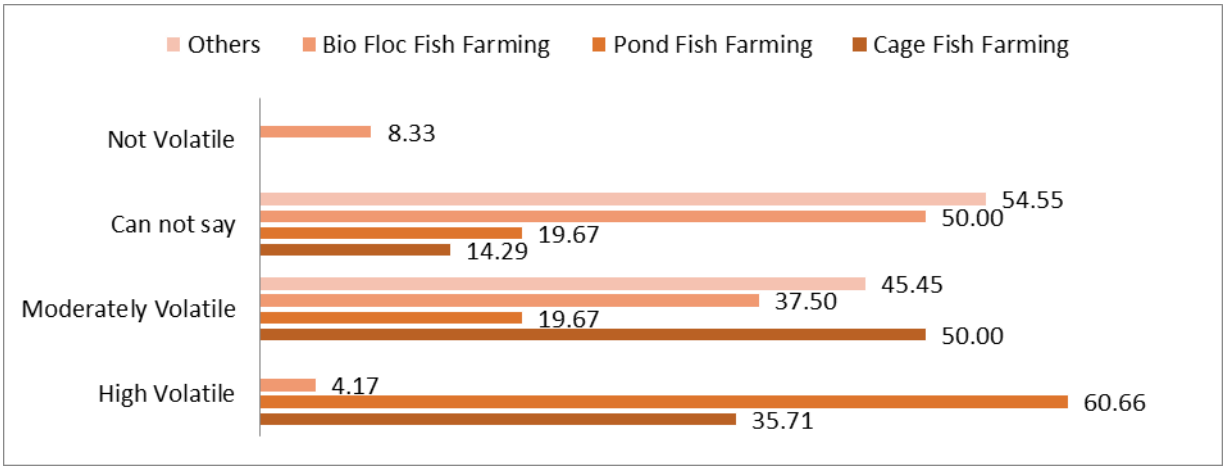

Figure 8. How Volatile is the Labor Cost? (n=124)

Institutional Support and Fish Farming Households

For any business to start and flourish, both external and internal factors are important. One of the most important external factors contributing to the growth of an enterprise is the institutional support available to them. Institutional support covers broad things including support from the government, non-profit organizations, legislative support, and the support from the general public. In the present study, we threw this question by clarifying that institutional support meant support from the government, and their responses turned out to be very interesting. Of the total fish farmers, a little more than 50 percent found not satisfaction with the institutional support offered to them from different corners primarily from the government side, and only 23.39 percent put their opinion as 'satisfied'. Again, it may not be surprising that among the category 'Not Satisfied', 60 percent are pond fish farmers followed by 'others' and 'cage farmers'. It is worth mentioning that Biofloc fish farmers are happy with the institutional support as among the category 'satisfied', they constitute 41.67 percent (Table No.13).

Table 13 Institutional Support and the Type of Fish Farming Households (n=124)

Type of Fish Farming	Are you satisfied with the Institutional Support?		
	Satisfied	Not Satisfied	No Opinion
Cage Fish Farming	35.71	46.43	17.86
Pond Fish Farming	13.11	59.02	27.87
Biofloc Fish Farming	41.67	33.33	25.00
Others	9.09	54.55	36.36
Total	**23.39**	**50.81**	**25.81**

CONCLUSION

To conclude, household-based small-scale fish farming is the need of the hour given the continuing pressure on the depleting marine fish wealth, growing demand for fish products, and the narrowing alternative livelihood avenues for the rural poor. But as a business, it can no longer be put on the wheels of grants and aid from the government and institutional arrangements. It appears that many plunge into enterprising activities including fish farming being attracted by the initial huge subsidies offered by the government in the expectation of giving a push to such initiatives. But, for the continuance of such initiatives, more practical and sustainable support not based on subsidies and freebies must be put in place to accelerate the pace of such initiatives.

This study reveals that almost 50 percent of the fish farmers engage in pond fishing, and they are the most dissatisfied category with the institutional support being offered by

many responsible agencies. With this scale of dissatisfaction and much dependence on money lenders for credit (among the category of money lending as the source of credit, pond fish farmers are the largest in percentage) and limited physical and natural capital, pond fish farmers continue to report that they are making normal and sometimes even considerable profit. It should be contrasted with the other method of fish farming like biofloc fish farming. What does it point out is that it is imperative to streamline the institutional support in such a way as to promote the interest of those enterprises which generate both output in big volumes and employment for people. Pond fish farming being more labor-intensive and eco-system-based, it can turn out to be a good way of accelerating both fish production and livelihood avenues for the poor and disadvantaged rural households.

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