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Socio-Economic Analysis of Brackishwater Cage Culture in Kerala

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ABSTRACT

Cage culture has been one of the most dependable fish production systems in the world. For wide adoption in countries like India, it needs to be technically feasible and socially acceptable. In the current study, the socio economic factors are taken into account for investigating the influence of these factors on the performance and productivity of the cage culture operations in central Kerala. An extensive survey was carried out among the cage farmers of the coastal districts of central Kerala to study the influence of socio-economic indicators in the overall production and performance. The study revealed that major socioeconomic features like age, occupation, level of education, experience in cage culture, technical skill, financial status and gender participation had significant effects on the cage culture productivity and economic returns.

Keywords: *Cage culture; socio-demographic; farmers; productivity; Kerala.*

INTRODUCTION

In recent years, brackishwater cage farming is being promoted more keenly by the Department of Fisheries, Government of Kerala and other agencies to improve fish production. The participation of registered farmers as beneficiaries to undertake cage culture is increasing. The coastal water area of Kerala state covers nine districts which have a high literacy rate. Various studies were carried out on the effect of social and economic aspects of cage culture by researchers like Narayanakumar (2009) (in Andhra Pradesh), Aswathy and Joseph (2018) and Kappen et al., (2019) (in Kerala).

Cage farming in Kerala exhibits vivid diversity in different locations with respect to the area covered, number of farmers, their feasibility and viability to produce. The profitability of cage farming largely depends on the culture area, technical knowhow of the stakeholders and the existing protocols in addition to the socio-demographic factors. The promising species used in cage culture of central Kerala, the study area, include the Asian seabass, *Lates calcarifer* (vernacular name: *Kalanji)*, Pearl spot, *Etroplus suratensis* (vn: *Karimeen*). Surveys were undertaken to study the farmers' participation in cage

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farming, their social status and knowledge in augmenting the cage culture production. The study will throw light on the promising culture species and its performance as well as on the common socio-demographic indicators influencing the productivity. It could be useful to enlighten the farming community on the shortfalls and for maximizing the profitability.

METHODOLOGY

The area under investigation; i.e. central Kerala is divided into three coastal districts; Ernakulam (9.98°N and 76.29°E), Alleppey (9.49°N and 76.49°E) and Trichur (10.52°N and 76.21°E) with a total coastline of 46, 82 and 54 km respectively and occupies 30.86% area of the total coastline of the State. In Kerala, more than 50% of coastal brackish water cage farming is undertaken in these districts.

Surveys were conducted in the selected coastal villages of the study area to study the socio-demographic characters and other independent variables in the overall production and income generation in cage farming. The research sample size was 62 percent of the population (i.e., 62 percent × 74 registered farmers = 46 farmers). Altogether 74 farmers were registered for brackish water cage culture practice from central Kerala during the year 2018-19 as beneficiaries of State sponsored scheme. Out of the total registered farmers in the study area, farmers were chosen randomly from widely distributed areas in these locations. Sample size percentage from Ernakulam District was 62%, from Trichur it was 69% and from Alleppey it was 57% which were 29, 9 and 8 sample farmers respectively.

Forty-six farmers culturing in 669 operational cages at different locations were brought under the study to understand the output performance. The required data were collected from the respondents using a comprehensive questionnaire. The collected data were analyzed for the difference within the groups and between locations and compared with the production quantities. Other than the details of the species cultured and protocols followed, the study included the basic indicators of socio-demographic factors influencing production and profitability of operation. Seven common socio-demographic variables mainly associated to the brackish water cage culture operations in central Kerala viz., farmer's age, occupation, level of education, experience in cage culture, technical skill, gender participation and financial status were considered in the evaluation which were directly influencing productivity. The income generation of farmers of different locations practicing cage culture was also assessed. The observations were recorded and tabulated. The economic analysis pattern was concerned mainly to the evaluation of varied income generation of farmers from different location and the possible influence of socio-demographic indicators in productivity. The evaluation of economic performance was done taking into account the infrastructural cost, operational cost, market price, culture period, harvest period and species cultured in cages and assessed the production and income generated from each location of the

study area. The study also evaluated the achievement of high productivity per unit area and the remunerative price for the cultured species which benefited the farmers in raising their income. The economic performance indicates a larger scope in cage farming and in decision making for investment at the micro level.

FINDINGS AND DISCUSSION

The survey revealed that there exist varied practices and knowledge among the farmers with respect to the protocols in brackish water cage culture in central Kerala. The study also revealed extensive diversity in farmers' productivity between locations in practicing cage culture. It was also observed that the variance in income generation was largely related to the consequence of certain socio-demographic factors of the farmer's and species selected. The basic dependent variable in a cage culture system is the species selection by farmers. As far as the species diversity in the brackish water cage culture is concerned, two families (*Latidae* and *Cichlidae*) contributed 95% of the total production, even though fishes belonging to other families were also cultured in 669 cages in the study area. Based on the market demand and availability of seed, species were chosen. Other variables like feed, harvest periods, water quality and environment conditions are also considered for species selection (Kailasam et al., 2014). The most abundantly cultured species were *Lates calcarifer* (Asian seabass) and *Etroplus suratensis* (Pearl spot) which were stocked in 122 and 511 cages, constituting 18% and 76% respectively. The remaining 36 cages were stocked with other species like the Red snapper, Trevally and Tilapia constituting 6% altogether.

The socio-demographic indicators like the age, occupation, level of education, technical knowhow, gender wise participation of the farmers are exogenous variables correlated to location specific enhanced productivity. The age of the farmers plays an important role for being active and is associated to their experience and long-term association in fish farming. Around 51% farmers were between 51-60 years of age with experience, knowledge of cage farming and with improved awareness on related aquaculture activities (62%). (Table 1).

The educational level and experience of farmers provide the basic knowledge for understanding the technical aspects and in improving the economic standards of the cage farmers. Majority of farmers have completed their high school level (57%). Most of the farmers of Ernakulam (64%) and Trichur (67%) districts were having the educational background of 10-12 standard. Interestingly, about 18% of the total respondents are graduates or post graduates in Ernakulam district. It was also observed that the educational background of farmers from Alleppey district were secondary school level (60%) which is lower than other Districts on educational standard. The annual income earned by the farmers in Ernakulam was highest (62%) compared to other farmers. The variations in income was largely due to adoption of bi-culture method of farming by farmers from Ernakulam district. Among the three districts under investigation, Ernakulam

Table 1.
Socio-Economic Characteristics of Respondents Adopting Brackish Water Cage Culture

Sl. No	Process	Indicators	Ernakulam (%)	Trichur (%)	Alleppey (%)	Mean Value
1.	Age	20-30	13.79	22.22	12.50	16.17
		31-50	27.59	33.33	37.50	32.81
		51-60	58.62	44.44	50.00	51.02
2.	Occupation	Only cage farming	17.39	11.11	25.00	17.83
		Other aquaculture activities	56.52	66.67	62.50	61.90
		Employed in other firms	15.22	11.11	0.00	8.78
		Other business	10.87	22.22	12.50	15.20
3.	Education	Primary School (class 1-5)	9.00	0.00	0.00	3.00
		Secondary School (6-9)	9.00	33.00	60.00	34.00
		High School (class 10-12)	64.00	67.00	40.00	57.00
		Graduate and above	18.00	0.00	0.00	6.00
4.	Technical skills obtained	Own experience	9.00	0.00	0.00	3.00
		Govt. Workshops	0.00	0.00	0.00	0.00
		Own experience & workshops	91.00	100.00	20.00	70.33
		Shared information from others	0.00	0.00	80.00	26.67
5.	Gender participation	Only Male	27.00	67.00	80.00	58.00
		Only Female	0.00	0.00	0.00	0.00
		Both	73.00	33.00	20.00	42.00
6.	Registered farmers	Male	69.00	70.00	71.00	70.00
		Female	31.00	30.00	29.00	30.00
7.	Annual income from fish sale	Rs 100000-Rs 500000	10.34	100.00	25.00	41.41
		Rs 500001-Rs 1000000	6.90	0.00	37.50	18.50
		Rs 100001-Rs 2000000	10.34	0.00	37.50	15.95
		Rs 200001-Rs 5000000	62.07	0.00	0.00	20.69
		> Rs 5000000	10.34	0.00	0.00	3.45

was the most progressive in terms of per capita income, literacy and social status.

Most of the farmers from the study area gained technical skills from their own experience and by attending the related workshops/training organized by reputed organizations (70%). The farmers acquired knowledge on the culture protocols and management practices by such workshops and trainings. Farmers also improved awareness and long term exposure to cage culture system due to interventions of Kerala University of Fisheries and Ocean Studies and Central Marine Research Institute and acquired technical skills. Interestingly, the maximum productivity could be observed in Ernakulam District with experienced farmers and improved technical skills. The high literacy rate which might also be contributing to the augmented technical skills.

Maximum productivity was observed by the involvement of both gender in cage culture system. The average percentage of male participants (58%) was higher than the female participants (42%). In Ernakulam District, the female participation along with their male partners was found to be the highest compared to other districts which constitute to the tune of 73% even though the registration had been done in their spouse's/ brother's/father's name.

A significant gender inequality was noticed among the cage farmers registered in central Kerala. Even though there were women-oriented schemes coming up, as high as 70% of registered farmers were males and 30% were female. In Ernakulam, though the registrations were done by the male member, significant participation of the female partner was observed. Recently, more women are getting registered to various Government sponsored schemes as groups.

Evaluation of economic performance of cage culture farmers was done collecting the details on the cost of production (both recurring including cost of feed, seed etc. and non-recurring including the cost of cage setting and erection), production figures, selling price of fish species, individual size/ weight, seasonality of production etc. The initial investment cost was the same though subsidies were provided to the registered farmers in accordance to the scheme. Additional investments were made by the farmers for poly culture of species for enhancing production. It was noted that the market price of a particular species varies from season to season; higher prices could be realized in festival seasons. The intent of farmers was to generate maximum income in minimum culture period. The market prices of the various species during the survey were Rs. 500-600, Rs. 400-500 and Rs 300-400 for Asian seabass, Pearl spot and for other species like the Red snapper and Trevally respectively.

The species-wise analysis of total production clearly indicated that the performance of Asian seabass was significantly higher (61%) than Pearl spot (29%) and other species (11%) amounting to 67, 32 and 11 tonnes respectively. Though the pearl spot was cultured in maximum number of cages, their production quantity was much lower than Asian seabass due to the less average

Table 2.
Economic Analysis of Brackishwater Cage Farming

Sl. No.	Items	Indicators	Ernakulam	Alleppey	Trichur
1	No. of farmers	46	29	8	9
2	No. of cages	669	500	92	77
3	No. of cages adopting bi-culture	100	83	0	17
4	Infrastructural cost (Rs/Lakh)	1.2	1.2	1.2	1.2
5	Operational cost (Rs/lakh)	1.8	1.8	1.8	1.8
6	Culture period	Months	10-Aug	10-Aug	10-Aug
7	Total production quantity (tonnes)	Asian Seabass (67)	51.01	0.7	15.54
		Pearl Spot (32)	23.48	4.44	4.03
		Others (11)	11.16	0	0
		Total	85.65	5.14	19.57
8	Production per cage (Lakh)	Asian Seabass	418.11	350	457.05
		Pearl Spot	55.77	50.44	62.96
		Others	310	0	0
9	Total Income (Lakh)	Asian Seabass	306.06	4.2	93.24
		Pearl Spot	117.4	22.7	20.15
		Others	33.48	0	0
10	Income /cage (Lakh)	Asian Seabass	2.51	2.1	2.74
		Pearl Spot	0.28	0.25	0.31
		Others	0.93	0	0
11	Market price (Rs.)	Asian Seabass	500-600	500-600	500-600
		Pearl Spot	400-500	400-500	400-500
		Others	300-400	300-400	300-400

body weight. The maximum production was achieved in Ernakulam district with 86 tonnes (78%) of the total production, followed by Trichur and Alleppey with 20 lakh tonnes (17%) and 5 tonnes (5%) respectively. Also, the maximum income generated was from Ernakulam district by culturing Asian seabass accounting to Rs 306 lakh (51%) of the total revenue generated followed by Trichur generating Rs 93 lakh (16%). But on computing the mean revenue per cage, it was observed that Trichur generated higher income per cage by culturing Asian seabass and generating an average of Rs 2.74 lakh per cage followed by Ernakulam with Rs 2.51 lakh and Alleppey Rs 2.10 lakh per cage. (Table 2). The average income generated from Ernakulam per cage was higher than other locations covered in the study demonstrates that the economic performance of farmers in Ernakulam was enhanced due to the right decision making and following best management practices.

The species suitable for maximizing production and profitability in central Kerala was found to be Asian seabass cultured along with pearl spot as secondary species in bi-culture method avoiding the cross predation by proper sizing the stocked individuals. The observation on the promising species suitable for brackish water cage culture in central Kerala correlates with the findings of earlier authors (Aswathy and Joseph, 2018) as a promising species.

Moreover, the average production per cage of Asian seabass is observed to be higher than other species cultured, thus fetching the farmers, higher revenue. Also, all the major indicators like site selection, grading, harvest period, culture duration, nutrition, feed conversion ratio (FCR), water quality parameters etc. are very important variables in cage culture like any other aquaculture operation. Cage culture system can contribute socially towards protein security, income generation, employment creation etc. directly in a holistic perspective. Further analysis of data also proved that farmers culturing with lower stocking density by mono culture method with Pearl spot resulted only in less income per cage, on the other hand lower optimum stocking density cultured in bi-culture method along with Asian seabass resulted in higher income per cage, thus signifying a scope in bi-culture method for improving productivity.

However, Aswathy and Joseph (2019) in their study on economic feasibility had stated that an increase of 1% in stocking density and feed quantity will increase production. The selection and importance of optimum stocking density was also proven by Ghosh et al. (2016) in their brackishwater cage culture experiment undertaken at Godavari estuary in Andhra Pradesh where they concluded that the optimum stocking density of Asian seabass with maximum survival rate was 30 numbers per cubic metre for maximizing production. Hence, the adoption of optimum stocking density will be helpful for the conservation of fish seeds for other projects and will improve the sustainability. The availability of fish seed to farmers especially the species Asian seabass and Pearl spot continues to be a

major constraint in the cage culture scenario of the State. The former species is mainly brought from other states of the country after long term transportation which creates higher stress and mortality rates of the fish seeds. The unhealthy seeds after the severe stress results in lower productivity in any culture system. The higher demand of seeds during certain seasons leads to severe exploitation by the seed traders and sellers belonging to other states. For meeting the demand, farmers collect natural seeds from the wild which is a major threat to the sustainability and species conservation. The shortage of fish seed of a particular species is a major problem during the onset of cage culture operations in the state. A study by Kappen et al. (2019) had revealed that constraints like non-availability of quality fish seed, high cost of feed affect the development of sustainable cage farming.

CONCLUSION

Cage farming is developing rapidly because of its socio-economic viability when compared to other aquaculture systems. A host of dependent and independent variables influence the cage culture farming. Socio-demographic variables such as age and experience are correlated when it comes to maximizing the production. In the study area, maximum production and profitability were observed from the locations where farmers with improved technical skills and experience were present. The occupation, educational level and literacy also enhances the productivity. Farmers' knowledge on the cage culture protocols and experience is directly linked to the literacy which incidentally also benefits in higher income generation and improve the financial status of the farmer. Women participation will benefit the cage farmers to manage the operational and maintenance costs, the study has revealed.

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