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Social Impact of Cage Fish Cultivation on Livelihood of the Fish Farmers

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Abstract

Cage fish farming is emerging as an important alternative aquaculture production system for utilizing inland and coastal water resources and improving the livelihood of small and resource-constrained fish farmers. The present study was conducted in Udupi district of Karnataka to assess the social impact of cage fish farming on the livelihood of fish farmers. Udupi and Kundapura taluks were purposively selected, and a total of 120 cage fish farmers with 3-5 seasons of experience were selected randomly from the identified locations. The social impact was assessed based on six indicators, namely social responsibility, employability skills, conflict resolution, public recognition, decision-making ability and gender equity. Data were collected using structured measures and analyzed using mean, standard deviation and Wilcoxon signed-rank test to compare the situation before and after adoption of cage fish farming. The results revealed a significant positive impact of cage fish farming on all the selected social indicators at the 1 per cent level of significance. Improvement was observed in social responsibility (75.00%), employability skills (72.50%), conflict resolution (90.00%), public recognition (70.00%), decision-making ability (93.33%) and gender equity (87.50%) among the farmers. Overall, all the 120 farmers (100.00%) exhibited a positive social impact following the adoption of cage fish farming. The findings indicate that cage fish farming not only provides an alternative livelihood opportunity and off-season income but also contributes to strengthening the social and decision-making capacities of fish-farming households. Hence, promotion of cage fish farming can be considered an important strategy for improving the livelihood and social well-being of small fish farmers.

***Key words*:** Cage fish farming, Livelihood, Social impact, Fish farmers, Employability skills, Gender equity, Decision-making ability

India is the second largest fish producing country in the world accounting for 7.56 per cent of global production. Fishery sector is contributing about 1.24 per cent to the country's Gross Value Added (GVA) and 1.07 per cent of national GDP. Fishery is a fast-growing sector in India. Fishery sector has been recognized as a powerful income and employment generator as it provides income and employment to more than 28 million people. It stimulates growth of a number of subsidiary industries and is a source of cheap and nutritious food, at the same time it is a source of livelihood for a large section of economically backward population of the country. The reservoirs of India, due to their high biogenic production potentials, form very important fisheries resources of the country and are highly conducive for fishery activities [1]. The sheer magnitude of the reservoirs (3.51 m ha) provides ample opportunity to enhance fish production substantially. They also play a significant role in livelihood security to a large section of the economically underprivileged population in India and play a great role in the socio-economic development of the country [2-3]. Sustainable use of ocean, seas and marine resources is one of the key global Sustainable Development Goals [4]. Under the fourteenth Sustainable Development Goal, countries pledged to use sustainable scientific management strategies to replenish the dwindling fish stocks for safe and diversified healthy diets, environmental, social and economic developments [4]. The world wild fish capture has been declining due to overfishing [5] use of illegal equipment [6], pollution among others [7] amid increasing world population which has necessitated the development of aquaculture [8].

Today cage culture is receiving more attention by both researchers and commercial producers. Reason for this is increasing consumption of fish, declining stocks of wild fishes and poor farm economy has increased interest in fish production in cages. Many small or limited resource farmers are looking for alternatives to traditional agricultural crops. Cage culture is described by [9] as the process of raising fish in an enclosed container that keeps the fish in an existing water body while allowing water exchange and waste removal into the surrounding water body [10]. Cage aquaculture, though relatively new to the inland aquaculture scenario of the country, gives new opportunities for optimizing fish production from the reservoirs, lakes, floodplain wetlands and for developing new

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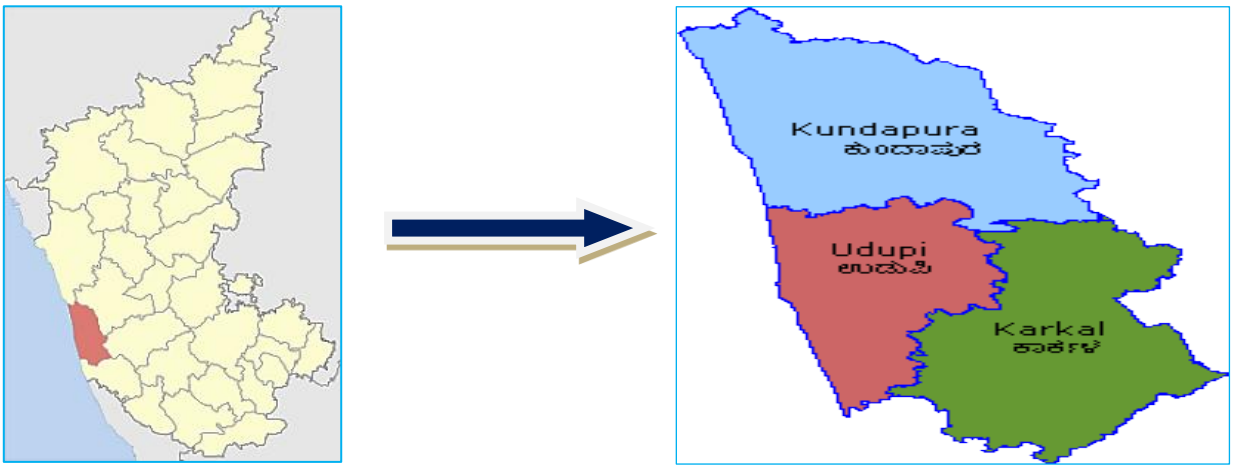
skills among fishers and entrepreneurs to enhance their incomes. A cage is enclosed on all sides with mesh netting made from synthetic material that can resist decomposition under water for a long period of time and is generally small ranging from 1 m^2 to 500m^2 [11].

Cage aquaculture raises fish in an enclosed net cage in an existing body of water while allowing the water to circulate freely. It is a production system for aquaculture that comprises a floating frame, net materials, and mooring system (with rope, buoy, anchor, etc.) with a circular or square floating net to contain and culture a huge number of fishes. This system can be deployed in a reservoir, river, lake, or ocean. Fishery cages are divided into four categories: fixed cages, floating cages, submerged cages, and submersible cages. The submerged cages are the most common type. Cage farming is a low-risk approach that yields excellent profits and produces the least carbon emissions. A considerable contribution to India's total fish output might be made by the cage culture technique, owing to the large yields that can be achieved. Cage culture is a viable option for using India's extensive coastline, large brackish water regions in coastal states, and other neglected water bodies. Auto-stocking has an extremely poor success rate in Indian reservoirs, particularly the smaller ones. During the summer, many smaller reservoirs are entirely or partially depleted, leaving no fish to sustain them. The fisheries in these bodies of water would be substantially improved if they were stocked on a regular, sound, and maintained basis. The primary goal of cage culture addressed here is to raise fingerlings at least 100 millimeters (mm) long, mainly carp, for stocking reservoirs. Looking it to all these a study has been taken up to know about the social impact of cage farming on livelihood of the fish farmers.

In India, for the first time cage culture in inland water bodies was started in air breathing fishes in swamps, for raising major carps in running waters in Yamuna and Ganga at Allahabad and for raising caps snake heads and tilapia in lentic water bodies of Karnataka [12]. Karnataka is having 300Km of cost we have least areas that are suitable for cage farming. First Marian cage culture was attempted for the first time at Uppunda by Mangalore Research Centre of central marine fisheries research institute (CMFRI).

MATERIALS AND METHODS

Study has been taken up in Udupi district of Karnataka, where cage fish farming is predominantly practiced. In Udupi district of Karnataka alone 90.00 per cent of the cage fishing is done. Udupi is having 7 taluks out of which three taluks are adjacent to coastal line (98 km) namely Udupi, Kundapur, Karkala. Udupi, and Kundapura taluks were selected for the study. From Kundapura Byndoor and Uppunda and from Udupi taluk Sasthane and Kapu were selected based on highest cage for the study. From each taluk 30 fish farmers who were practicing cage fish farming from last 3-5 seasons were selected randomly thus 60 farmers were selected from each taluk. Thus, the total sample for the study was 120.



For measuring the social impact of cage fish farming, six criteria were selected namely social responsibility, employability skill, Conflict resolution, public recognition, decision making ability and Gender equity were selected after thorough reviewing of literature and detailed discussion with the experts. These criteria were measured by considering impact before and after cage fish farming. Social responsibility is measured with a 3-point continuum always, sometime and never with a weightage of 3, 2, 1 for positive statement and 1,2,3 for negative statement respectively. Employability skill and Conflict resolution is measured in five-point continuum as very high, High, moderate, low and very low with a weightage of 5,4,3,2,1 respectively., Public recognition is measured in three-point continuum viz., regular, occasional and never with a weightage of 3,2,1 respectively. Decision making ability is measured with 3, 2, 1 weightage. Gender equity is measured with five-point continuum strongly agree, agree, undecided, disagree and strongly disagree with a weightage of 5, 4, 3, 2, 1. Based on this criteria data was collected and farmers were categorized in to three categories like low, medium and high by considering mean and standard deviation as a measure of check.

Statistical tools employed for analysis of data

Appropriate statistical tools were used for analyzing the collected data. The primary data collected from the respondents were scored, tabulated and analyzed using the following statistical tools and techniques.

Mean ($\bar{X}$)

Mean is defined as the ratio of sum of all the observations to the total number of observations. Mean was used as a measure to categorize the respondents into various categories.

$$\bar{X} = \frac{\Sigma X}{n}$$

Where;

$\bar{X}$ = Mean

ΣX = Sum of all the observations

n = Number of observations

Standard deviation (s)

The standard deviation is the square root of the mean of the square of the deviations of the set of observations from their

mean. It was used as a measure to categorize the respondents into various categories.

$$s = \sqrt{\frac{\Sigma(X - \bar{X})^2}{n-1}}$$

Where;
$\bar{X}$ = Mean
n = Number of observations
s = Sample standard deviation

Social impact of cage fish farming is measured by using Wilcoxon signed rank test. Wilcoxon signed rank test is a non-parametric test used to test whether there is any significant difference between matched or paired samples when the data is measured in an ordinal or nominal scale. In the present study, Wilcoxon signed rank test was used to assess the social impact of cage fish farming on the farmers. Difference in the social characteristics of the farmers during the before and after cage fish farming were measured and analyzed to determine the social impact of cage fish farming.

The data for the before and after cage fish farming are ranked to produce two rank totals. If there is a significant difference between the two conditions, then the rank totals will be quite different and one of the rank totals will be quite small. On the other hand, if the two conditions are similar, then high and low ranks will be distributed evenly and the rank totals will be fairly similar. If the number of paired observations whose differences shows a sign (N) is 25 or smaller, then the Wilcoxon test statistic 'W' is simply the smaller of the rank total. Whereas, if 'N' is larger than 25, compute the value of z using the following formula:

$$z = \frac{T - \frac{N(N+1)}{4}}{\sqrt{\frac{N(N+1)(2N+1)}{24}}} \sim \text{SND}(0,1)$$

Where;
T = Sum of the ranks with less frequent sign
N = Number of paired observations whose difference is not zero

RESULTS AND DISCUSSION

The results depicted in (Table 1) reveals the social impact of cage fishing on farmer's livelihood. Wilcoxon signed rank test was followed to determine the impact on each indicator variable and the overall social impact of cage fish farming. A statistically significant z-value indicates the presence of impact after the adoption of cage fish cultivation. All the indicator variables have shown a positive impact at statistically significant at 1.00 per cent level of significance (Table 1).

In the case of social responsibility, majority of the farmers (75.00%) had exhibited a positive change after the implementation of cage fish farming with a statistically significant z-value of -7.205. Nearly three fourth of the farmers (72.50%) have achieved better employability skill revealing a positive impact with a significant z-value of -7.234. This might be due to the fact that as it requires constant monitoring and highly a skill full job. Along with this they are practicing the fish cultivation in estuaries that made them to have more social responsibility as it is a continuous process and need to be maintained for the future seasons [13-15].

Table 1 Social impact of cage fishing on livelihood of the fish farmer (n=120)

Indicators	Ranks and Test Statistic		Remarks
Social responsibility	Negative ranks	14	75.00 % of the farmers exhibited better social responsibility
	Positive ranks	90	
	Ties	16	
	Z value	|-7.205**|	
Employability skills	Negative ranks	19	72.50 % of the farmers got better Employability Skill
	Positive ranks	87	
	Ties	14	
	Z value	|−7.234**|	
Conflict resolution	Negative ranks	3	90.00 % of the farmers got better Conflict resolution
	Positive ranks	108	
	Ties	9	
	Z value	|−9.081 $**$|	
Public recognition	Negative ranks	16	70.00 % of the farmers exhibited better organizational participation
	Positive ranks	84	
	Ties	20	
	Z value	|−6.55**|	
Decision-making ability	Negative ranks	5	Decision making ability has improved for 93.33 % of the farmers
	Positive ranks	112	
	Ties	3	
	Z value	|−9.33**|	
Gender equity	Negative ranks	9	Positive social impact in 87.50% of the cases
	Positive ranks	105	
	Ties	6	
	Z value	|−8.88**|	
Overall social impact	Negative ranks	0	Positive social impact in 100.00% of the cases
	Positive rank	120	
	Ties	0	
	Z value	|−9.508**|	

NB: Wilcoxon Signed Ranks test was used
** Significant at 1% level of significance, * Significant at 5% level of significance, ^{NS} Non-significant

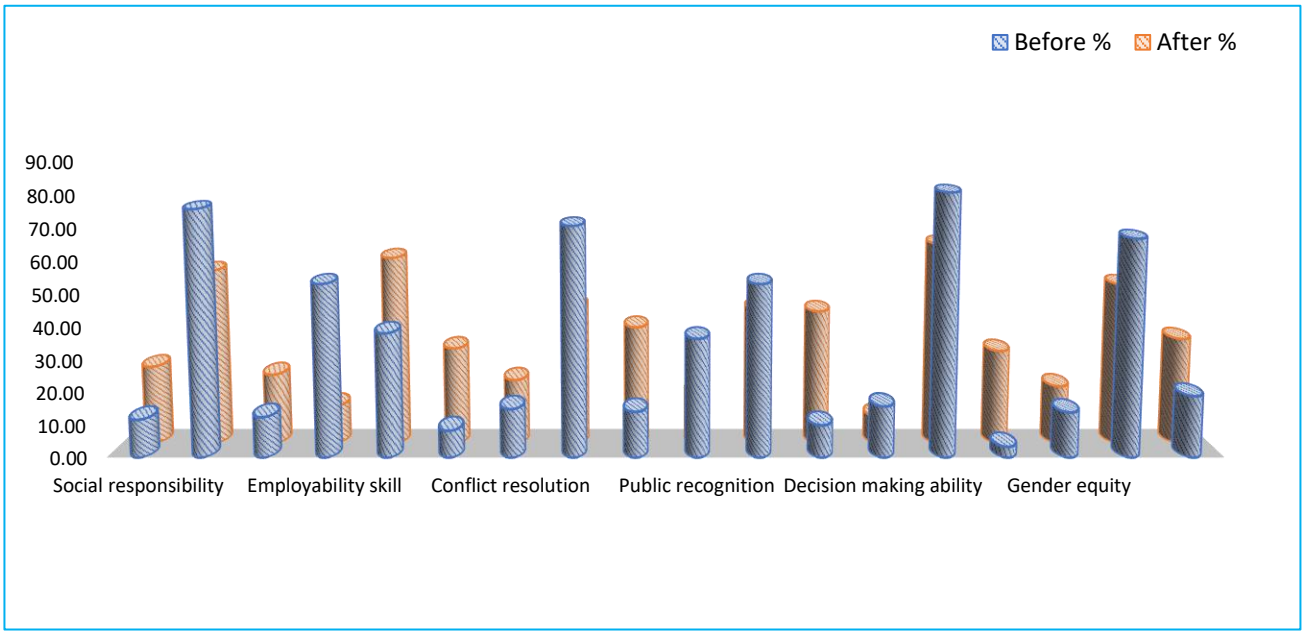


Fig 1 Impact of cage fish farming on social aspect of fish farmers

Further, in case of conflict resolution majority of the farmers (90.00%) exhibited better skill in conflict resolution after adopting cage fish farming, indicating a significant positive impact with a z-value of -9.081. As all the farmers in coastal area are depending on the estuaries near their domestic area and it is a public property nobody can claim for the right. This might have made them to maintain the harmony by resolving conflict.

Similarly, as high as 70.00 per cent of the farmers achieved better public recognition revealing a positive impact with a significant z-value of -6.55. Similarly, 93.33 per cent of the fish farmers could improve decision making ability with a z-value of -9.33. If we have a look about the gender equity it is very interesting to see that 87.50 per cent of the farmers had achieved equity after following the cage fish cultivation with a significant z-value of -8.88. This might be due to the fact that as the cage fishing is done in costal estuaries used to manage by the female flock of the family as male member may be busy in open fishing activity.

The data in (Fig 1) indicate that criteria which is impacted on social aspect of fish farming before adopting cage fish farming and after adopting cage fish farming [16]. It could be observed that majority of the respondents had medium level of social responsibility (75.83%), public recognition (53.33%), decision making ability (80.83%) and gender equity (67.00%). But it is surprising to see low level of employability skill (53.33%) before adoption of cage fish farming. The scenario has been changed further adoption of cage fish farming as majority the farmers exhibited medium to high level of employability skill (54.17% and 21.67%), public recognition (42.50% & 41.67%), decision making ability (62.50%) & 29.17%) and gender equity (50.00% & 33.00%) and conflict resolution (43.33% & 36.67%). It is interesting to see the result of social responsibility indicate medium to low level (54.17% & 24.17%) after adoption of the cage fish farming [17].

Cage fish farming is an important alternative for the small fish farmers to improve their livelihood with minimum expenditure [18]. This could be managed effectively by a family with the available resources and can get the income in the off season. This has helped the fish farmers to improve their social responsibility, public recognition, conflict resolution, employability skill, gender equity and decision-making ability. There is a need to encourage this type of farming system to improving the livelihood of the fish farmers.

CONCLUSION

The findings demonstrate that cage fish farming had a substantial and statistically significant positive influence on the social dimensions of farmers' livelihoods. The intervention improved social responsibility, employability skills, conflict-resolution capacity, public recognition, decision-making ability and gender equity, with all indicators showing significant changes at the 1 per cent level. The greatest improvements were observed in decision-making ability (93.33%), conflict resolution (90.00%) and gender equity (87.50%), while social responsibility (75.00%), employability skills (72.50%) and public recognition (70.00%) also showed considerable improvement. The overall social impact was positive for all the 120 farmers, indicating the strong contribution of cage fish farming to livelihood development. The shift from predominantly low or medium levels before adoption towards medium and high levels after adoption further confirms its beneficial role in strengthening farmers' social capabilities. Thus, cage fish farming can be considered a viable livelihood diversification strategy for small fish farmers, particularly in coastal areas, as it can be managed using available family resources while generating opportunities for skill development, improved participation, better decision-making and enhanced gender equity. The study therefore emphasizes the need for greater institutional support, capacity building and promotion of cage fish farming to strengthen the socio-economic and social well-being of fish-farming households.

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