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Socio-economic Factors Influencing Technology Adoption among Fishermen Operating Motorized Fishing Craft

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Abstract

In Kerala, there are about 1.90 lakh active marine fishermen operating about 14 151 motorized fishing craft. The investment pattern, number of fishing days, fuel utilization and technological changes in the motorized fishing sector during the recent years indicate the extent of investment on fishing units, the relationship between the extent of adoption of technologies and the corresponding annual income. This paper presents the results of a study conducted among random samples of 33 fishermen respondents in Thiruvananthapuram district and 31 fishermen respondents in Alappuzha district operating 8.4 m L_{OA} motorized FRP craft. It is seen that monofilament gillnets for mackerel, sardine and other were mostly operated by the fishermen in the FRP craft. Single day fishing was practised and night fishing was not undertaken by these respondents. The adoption behaviour scores explained the extent of adoption of various improved practices/technologies and the variables influencing the technology adoption were determined in the multiple regression analysis. The constraints such as poor landing centre facilities, inadequate kerosene subsidy, inadequate developmental/extension schemes, ever-increasing maintenance costs, diminishing fish catches, ever-increasing fuel prices, occasional conflicts with the mechanised boat operators, ineffective insurance coverage, damages caused to the fishing gears by puffer fishes, inadequate relief measures during natural calamities, financial constraints and excessive fishing capacity were reported as factors inhibiting the adoption of sustainable fishing practices.

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Introduction

In Kerala State, about 1.90 lakh active marine fishermen are engaged in fishing and they operate about 14 151 motorized fishing craft in the nine coastal districts (www.fisheries.kerala.gov.in). The contribution of the fisheries sector to the economy of Kerala has been very substantial and also the growth trend is positive. It has contributed directly or indirectly to the development of transportation facilities, electricity, water supply and improved communication facilities in the rural interior areas. A number of hotels and restaurants have also come-up, numerous banks and other financial institutions started functioning and all of which have transformed the quality of life of the poor fishermen community (Geethalakshmi et al., 2007).

Fisheries around Cochin are dominated by relatively capital intensive large motorised crafts (>12 m L_{OA}), small sized motorised crafts (<12 m L_{OA}) and non-motorized crafts. It is obvious that these three types of craft operations represent three different levels of technology within the artisanal fisheries. The gradation involves different levels of investment per fishing unit as well as crew size. The three categories represent three levels of technological sophistication. The non- motorised craft category represents the least improved of the technologies, operating in the near-shore waters of the sea or in the backwaters, and the input in terms of capital and material are minimal. Small motorised craft are fitted with one engine each and use a variety of gillnets. The large motorized craft on the other hand have a large complement of nets and are fitted with 2-3 motors each (Nikita et al., 2000).

The time lag in adoption varies between the technologies and it is found to be influenced by variables such as the attributes of the technology, efforts of the extension/ development organizations, communication channels used and characteristics of the target stakeholders (Balasubramaniam et al., 2000; Balasubramaniam et al., 2003; Krishna & Balasubramaniam, 2005; Balasubramaniam & Ashaletha, 2007). As the socio-personal and economic variables of fishermen could influence their adoption behaviour and also on annual profit, this study was undertaken to determine the association between the socio-economic profile characteristics of fishermen and their adoption behaviour among fishermen operating 8.4 m (L_{OA}) motorized FRP crafts in two coastal districts of Kerala.

Materials and Methods

The study was conducted during 2011-12 in two coastal villages each of Thiruvananthapuram (Vizhinjam and Anchuthengu) and Alappuzha districts (Punnapra and Ambalapuzha) in Kerala. The total number of motorized craft operating in the two villages of Thiruvananthapuram and Alappuzha was 778 and 91 respectively (CMFRI & DAHDF, 2010). Through multistage proportionate random sampling technique, 33 fishermen respondents operating 8.4 m L_{OA} FRP crafts were selected as respondents in Thiruvananthapuram district and similarly, 31 fishermen respondents were selected from Alappuzha district, covering a minimum sample size of about 5%. The operational definitions of quantitative and qualitative variables and their measurement procedures were finalized. Structured interview schedules were used to collect data on the socio-economic variables and the extent of adoption of technological practices.

A two-point rating scale was used to measure the adoption of eight improved practices *viz.,* use of improved craft material, use of appropriate size of craft, use of appropriate size of eco-friendly gillnets, use of appropriate engine power (hp) for outboard engines, economy in fuel consumption, less time lag in disposal of catch, less maintenance cost, and use of responsible fishing practices. The adoption index score for each respondent was calculated as a ratio of the actual score obtained to the maximum score possible expressed in percentage. The collected data were analyzed using mean, standard deviation, two-sample 't' test, correlation and multiple regression coefficients and 'F' test.

Results and Discussion

The adoption indices and socio-economic profile of fishermen respondents in the two districts *viz.,* Alappuzha and Thiruvananthapuram are given in Table 1. The mean adoption index on the extent of adoption of eight improved technological practices among the respondents in Alappuzha and Thiruvananthapuram was 82.26 and 68.94 respectively. The results revealed that out of the 23 socio-economic variables taken for the study, the fishermen respondents of Alappuzha had significant mean differences with the Thiruvananthapuram district fishermen respondents on 17 variables. Only on six variables *viz.,* social participation, information source utilization-informal channels used, size of fishing craft, investment on engine, total investment, and crew size, they had almost equal mean scores and had no significant differences between the two sample respondents.

It is seen that on an average, though fishermen from Alappuzha district had more number of fishing days in a year (mean: 296), higher annual revenue (mean: Rs. 8 08 323), and higher Adoption Index (AI) scores (mean = 82.26), their mean operational profit (mean: Rs. 1 64 871) was significantly lesser than the fishermen respondents from Thiruvananthapuram district (mean: Rs. 2 79 862). This might be due to the higher expenditure incurred by the Alappuzha district fishermen respondents. It indicated that more number of fishing days though yielded higher revenue, due to high expenditure, the economic efficiency has been significantly reduced resulting in lesser profits. Balasubramaniam et al. (2005) reported that the fishermen at Quilon had an average of 258 days of fishing in a year while at Veraval, it was about 191 days, and their annual income ranged from Rs. 43 000 to Rs. 46 000. Jeeva et al. (2011) reported that the investment on the fishing unit ranged from Rs.1.70 to Rs.2.70 lakhs for one FRP craft of 9 m L_{OA} with outboard engine of 9-11 hp and 350 kg of gillnets. On an average, 10-15 l of fuel was consumed for daily trips to cover 20 km, with an expenditure of Rs. 500/- per trip. Another study observed that the expenditure towards repairs and maintenance was the single largest item of fixed cost contributing to 35% of total expenditure (Senthiladeban et al., 1999).

The results on the correlation and regression analyses between the socio-economic variables and adoption index scores of Alappuzha respondents are

Table 1. Socio-economic profile of fishermen

Var. No.	Variables	Alappuzha (n_1=31)		Thiruvananthapuram (n_2=33)		't' value
		Mean	SD	Mean	SD	
X_1	Age (yrs)	39.97	6.74	45.03	10.61	2.259*
X_2	Education (scores)	7.77	1.73	5.39	3.51	3.288**
X_3	No. of fishing days in a year	295.81	11.19	224.24	31.23	11.935**
X_4	Experience (yrs)	21.35	5.94	29.73	10.97	3.504**
X_5	Family size (no.)	6.58	1.54	5.15	1.35	3.940**
X_6	Social participation (scores)	1.10	0.30	1.24	0.61	0.902
X_7	ISU-Informal (scores)	4.71	0.74	4.33	2.51	0.596
X_8	ISU-Formal (scores)	10.29	0.46	7.94	2.36	5.506**
X_9	ISU-Mass media (scores)	10.65	0.49	5.15	3.38	8.417**
X_{10}	Size of craft (ft)	28.06	1.31	28.58	1.09	1.524
X_{11}	Investment-Craft (Rs.)	141129.03	26258.64	98181.82	21584.80	7.430**
X_{12}	Investment-Gear (Rs.)	92580.65	23694.97	148151.52	64080.09	4.915**
X_{13}	Investment-Engine (Rs.)	162580.65	9989.24	163151.52	52890.88	0.078
X_{14}	Investment-Total (Rs.)	396290.32	13414.40	409484.85	101460.00	0.860
X_{15}	Crew size (no.)	4.45	0.51	4.39	0.50	0.465
X_{16}	Engine operating hrs (peak season)	7.94	0.25	6.85	1.58	4.622**
X_{17}	Engine operating hrs (lean season)	3.16	1.10	8.27	1.27	11.904**
X_{18}	Maintenance cost (Rs.)	30645.16	6019.68	46181.82	16823.45	4.163**
X_{19}	Actual time lag (hrs)	2.77	0.43	7.24	1.62	14.747**
X_{20}	Expenditure (Rs.)	643451.61	218564.08	418168.48	142271.15	5.778**
X_{21}	Revenue (Rs.)	808322.58	262923.99	698030.30	233793.24	2.226*
X_{22}	Operational profit (Rs.)	164870.97	47533.67	279861.82	137241.30	4.503**
X_{23}	Adoption Index (scores)	82.26	6.27	68.94	8.91	4.349**

**Significant at 1% level; *Significant at 5% level; ISU- Information Source Utilization

given in Table 2. It is seen that three variables such as experience, investment on fishing gear and time lag in the disposal of fish catch had shown significant positive correlation with the adoption behaviour while four variables *viz.,* family size, mass media channels utilization, size of craft and maintenance cost of the craft had shown significant negative correlation. In the multiple regression analysis, among the six significant regression coefficients, three variables *viz.,* number of fishing days, size of family and size of crew had positive influence over the adoption behaviour and three variables *viz.,* experience, informal information source utilization and maintenance cost had significant negative influence over the adoption behaviour. This implied that adoption behaviour could be positively influenced by effectively manipulating the six independent variables given in the above results.

In Table 2, the R^2 value was 0.861 and the F was highly significant at 1% level of probability. This indicated that 86% of the variation in the technological adoption scores of fishermen respondents were explained by the 23 independent variables studied. The results on the correlation and regression

Table 2. Correlation and regression analyses between the socio-economic variables and adoption indices (Alappuzha; n_1=31)

Var. No.	Variables	Correlation coefficients (r)	Regression coefficients (b)	SE of 'b'	't'
X_1	Age (yrs)	0.331	0.372	0.179	2.003
X_2	Education (scores)	-0.190	-0.233	5.137	0.171
X_3	No. of fishing days in a year	0.151	1.919	0.127	8.827**
X_4	Experience (yrs)	0.343*	-2.032	0.807	2.768**
X_5	Family size (no.)	-0.536**	2.371	2.308	4.338**
X_6	Annual income (Rs.)	0.093	0.083	0.000	0.074
X_7	Social participation (scores)	0.278	0.084	3.307	0.554
X_8	ISU-Informal (scores)	-0.160	-1.148	2.126	4.763**
X_9	ISU-Formal (scores)	0.256	0.110	2.379	0.654
X_{10}	ISU-Mass media (scores)	-0.357*	0.143	2.643	0.724
X_{11}	Size of craft (ft)	-0.362*	0.896	3.085	1.440
X_{12}	Investment-Craft (Rs.)	-0.292	-1.947	0.000	1.870
X_{13}	Investment-Gear (Rs.)	0.822**	0.260	0.000	1.350
X_{14}	Investment-Engine (Rs.)	-0.214	0.263	0.000	1.923
X_{15}	Investment-Total (Rs.)	-0.338	0.092	0.000	0.748
X_{16}	Crew size (no.)	0.246	2.134	3.298	8.341**
X_{17}	Engine operating hrs (peak season)	0.309	0.165	2.311	1.866
X_{18}	Engine operating hrs (lean season)	-0.176	0.000	1.860	0.000
X_{19}	Maintenance cost (Rs.)	-0.846**	-0.657	0.000	2.191*
X_{20}	Time lag (h)	0.635**	-0.122	12.365	0.152
X_{21}	Expenditure (Rs.)	0.186	0.000	0.000	0.000
X_{22}	Revenue (Rs.)	0.171	-0.459	0.000	0.753
X_{23}	Operational profit (Rs.)	0.091	-0.039	0.000	0.058

** Significant at 1% level; * Significant at 5% level; R^2= 0.861; F=17.830**; ISU- Information Source Utilization

analysis between the socio-economic variables and Adoption Index scores of Thiruvananthapuram respondents are given in Table 3.

Of the 23 correlation coefficients, only mass media sources used by the fishermen respondents had significant positive association with the adoption index scores, while investment on engine had significant negative association with the adoption. However, in the regression analysis, the R^2 value was 0.307 and the 'F' value was not significant. Therefore, the selected socio-economic variables had no significant influence over the adoption behaviour of Thiruvananthapuram fishermen respondents. Specifically, it is seen that the economic variables such as revenue, expenditure and profit did not have positive association with the adoption behaviour of fishermen in both the districts. In an earlier study (Balasubramaniam et al., 2005), it was reported that the variables such as the age, size of FRP craft operated, investment on nets, annual income and average sale value of catch were found to have positive and significant correlation with the fish productivity levels. Annual maintenance cost of craft and net was found to have negative and significant correlation with the fish productivity level. In the regression analysis, the regression coefficients of two variables such as the size of FRP craft operated and the average sale value of fish catch had shown significant and positive influence

Table 3. Correlation and regression analyses between the socio-economic variables and adoption indices (Thiruvananthapuram; n_2=33)

Var. No.	Variables	Correlation coefficients (r)	Regression coefficients (b)	SE of 'b'	't'
X_1	Age (yrs)	-0.111	-0.873	0.501	1.433
X_2	Education (scores)	-0.046	-0.223	0.715	0.774
X_3	No. of fishing days in a year	0.141	-0.114	0.073	0.434
X_4	Experience (yrs)	-0.117	0.457	0.476	0.764
X_5	Family size (no.)	-0.117	-0.110	1.225	0.580
X_6	Annual income (Rs.)	-0.166	-0.587	0.000	1.884
X_7	Social participation (scores)	-0.075	0.297	3.068	1.378
X_8	ISU-Informal (scores)	0.115	0.358	1.238	1.008
X_9	ISU-Formal (scores)	-0.065	-0.415	0.880	1.745
X_{10}	ISU-Mass media (scores)	0.360*	0.126	0.842	0.384
X_{11}	Size of craft (ft)	0.241	0.058	1.851	0.252
X_{12}	Investment-Craft (Rs.)	0.014	0.023	0.000	0.072
X_{13}	Investment-Gear (Rs.)	0.100	0.019	0.000	0.061
X_{14}	Investment-Engine (Rs.)	-0.377*	-0.366	0.000	1.400
X_{15}	Investment-Total (Rs.)	-0.131	-0.122	0.000	0.674
X_{16}	Crew size (no.)	-0.059	-0.104	4.062	0.449
X_{17}	Engine operating hrs (peak season)	-0.287	-0.318	1.733	1.010
X_{18}	Engine operating hrs (lean season)	-0.317	0.372	1.102	1.358
X_{19}	Maintenance cost (Rs.)	-0.213	-0.149	0.000	0.484
X_{20}	Time lag (hrs)	-0.135	0.110	1.592	0.371
X_{21}	Expenditure (Rs.)	0.204	0.540	0.000	1.928
X_{22}	Revenue (Rs.)	0.026	0.546	0.000	1.749
X_{23}	Operational profit (Rs.)	-0.166	-0.348	0.000	1.245

* Significant at 5% level; R^2=0.307; F= 1.709^{NS}; ISU- Information Source Utilization

over the fish productivity levels while the regression coefficients of investment on craft and annual maintenance cost of craft and net had shown significant and negative influence over the fish productivity levels.

Since the higher adoption index scores did not result in corresponding higher economic returns as seen in the case of Thiruvananthapuram respondents compared to Alappuzha fishermen, the fishermen's attitude towards technological practices could become negative or neutral in some of the fishing centres. Keeping in view the sustainability of fishing operations to exploit the coastal fishery resources, there is an urgent need to create awareness regarding the important responsible fishing techniques such as regulating the operation of ring seines and standardisation of ring seine unit, bycatch and discards issue, ghost fishing due to discarded nets, use of fuel efficient techniques for propulsion of craft and prevention of targeted fishing for juveniles and brood stock. Senthiladeban et al. (2010) reported that about 26% of the fisherfolk were unaware of the consequences that the capture of brood stock and small-sized fishes would result in the decline of total fish catch. The non-adoption of conservative measures was because of the reason that the fishermen cannot predict the nature of fishes caught. The entire catch from gillnet was marketed irrespective of brood stock and small-

sized fishes. The knowledge level of fishers on marine policies and regulatory measures showed that 61.34% of the fishers were in medium level, followed by 19.33% in high level and 19.33% in low level of knowledge. Sabari et al. (2014) reported that the fishers had adequate knowledge on marine fishing regulations which included the monsoon ban period (Rank 1), bottom trawling operations (Rank 2), fishing with illegal mesh size nets (Rank 3) and modernised fishing methods (Rank 4).

Further, the constraints *viz.,* poor fish landing centre facilities, inadequate kerosene subsidy, inadequate developmental/extension schemes, ever-increasing maintenance costs, diminishing fish catches, ever-increasing fuel prices, competition within the group for fishery resource sharing, occasional conflicts with the mechanised boat operators, ineffective insurance coverage, damages caused to the fishing gears by puffer fishes and dolphins, inadequate relief measures during natural calamities, financial constraints and excessive fishing capacity in the fish landing centres were reported as factors inhibiting the adoption of sustainable fishing practices. Besides adoption, annual fish catch is another dimension which needs to be periodically monitored. The association between annual fish catches and the socio-personal and technological variables have to be determined for assessing the management of fishery resources and to identify the areas for government sponsored technological interventions. On an average, the awareness about improved practices was found to be between 61 to 66%, indicating the scope for information dissemination and utilization of communication channels (Balasubramaniam et al., 2000).

The mean adoption index on the extent of adoption of eight improved technological practices among the respondents in Alappuzha and Thiruvananthapuram was 82.26 and 68.94 respectively. The variables *viz.,* number of fishing days, mass media sources used by the fishermen and size of crew had positive influence over the adoption behaviour whereas investment on engine and maintenance cost had significant negative influence over the adoption behaviour. Specifically, it could be seen that the economic variables such as revenue, expenditure and profit did not have positive association with the adoption behaviour of fishermen in both the districts. The socio-economic variables influencing adoption behaviour vary from district to district and hence, the situational variables may have to be monitored in implementing extension programmes. This implied that adoption behaviour could be positively influenced by effectively manipulating these independent variables. Further, the fishermen have to reduce the annual expenditure particularly on fuel used so as to increase their profit, by way of following the measures such as selection of low powered engines, reducing operating speed, keeping the hull clean from fouling, regular engine maintenance, changing the mode of operation by staying longer time in the sea for reducing the uneconomical operations. Use of fuel efficient fishing methods need to be popularized through extension schemes in the coastal districts. Policies are needed for increased extension efforts to create more awareness and adoption on the sustainable and improved technological practices.

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