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Innovation Decision Efficiency on Selected Fishing Technologies among the Steel Fishing Trawler Operators

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The innovation decision process was conceptualized as the process in which a mechanized steel fishing boat operator passes through knowledge, persuasion, decision, implementation and confirmation stages in adopting selected fishing technologies identified for the study. The overall innovation decision efficiency index was 79%. The indices on passing through the five stages of innovation decision process *viz.*, knowledge, persuasion, decision, implementation and confirmation were 96, 82, 72, 72 and 72 percentages respectively. The results revealed that 100% of the clientele reaching the decision stage were passing through the implementation and confirmation stages, establishing that passing from persuasion to decision stage was very crucial in the innovation decision process. The R^2 was 0.71, indicating that seventeen socio-personal variables selected accounted for 71% of variations in the innovation decision efficiency level. Six socio-personal characteristics such as educational status, investment on fishing craft and gear, innovativeness, extension participation, communication behaviour and extent of linkage with research and extension groups acted as crucial factors in determining the efficiency of innovation decision behaviour of the steel fishing trawler operators. The constraints in the innovation decision process pertaining to the identified technologies were also presented.

Key words: Innovation decision process, knowledge, persuasion, clientele system, fishing trawler

Innovation decision process is the process through which an individual or other decision-making unit passes from first knowledge of an innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision (Rogers, 1998). A large number of scientists, technocrats, extension personnel and other categories of personnel are involved in research, education, technology development, technology transfer and administration in fisheries. The technology utilization component encompasses the various categories such as artisanal, motorized and mechanized fishermen, fisherwomen, pre-processors and processors. User awareness and adoption of improved technology affect productivity and profitability, and ultimately economic growth at the national level. Interaction and feedback between users, researchers and extension personnel improve cooperation and the relevance of technology. The Central Institute of Fisheries Technology (CIFT), Cochin transferred several of its innovations to various categories of clients over the years. In this context, this study on innovation decision process was designed: (i) to study the socio-personal and psychological characteristics of steel fishing trawler operators; (ii) to examine the efficiency of innovation decision process among them; (iii) to study the relationship of their socio-personal characteristics with innovation decision efficiencies; and (iv) to document the constraints.

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Materials and Methods

Pertaining to the objectives of the study, ex-post-facto research design was followed. Large mechanized steel trawl boat (above 13 m L_{OA}) operators of Ernakulam district of Kerala state engaged in marine fishing were selected for the study, since most of the technologies selected were pertaining to this category of boats. Multi-stage proportionate random sampling procedure was followed to select the respondents. At the first stage, two fishing harbours of Ernakulam district *viz.*, Cochin fishing harbour and Munambam fishing harbour were selected. The total number of large mechanized steel trawl boats in the two harbours were 424 and 300 respectively (Anon, 2001). A sample size of 110 respondents, which accounted for 15 percent of the total number of trawlers available in the two fishing harbours were selected. At the second stage, a representative sample of 65 and 45 fishing vessel operators from the two fishing harbours were selected following proportionate random sampling procedure.

For the present study, the innovation decision process was conceptualized as the process in which a mechanized steel fishing boat operator passes through knowledge, persuasion, decision, implementation and confirmation stages in adopting the selected innovations in marine fisheries. Eleven technologies were identified on discussion with subject matter specialists. The technologies selected were: marine anticorrosive painting, marine antifouling painting, CIFTAL (Mercury free aluminium alloy anode), V-form steel otter boards, large mesh trawl, Turtle Excluder Device (CIFT-TED), square mesh codend trawls, appropriate engine horse power of the boat, boat designs used (size/material), trawl designs used (size/type) and use of adequate ice onboard. The measurement procedure developed by Reddy (2003) was adopted with suitable modifications for studying the innovation decision process. The Innovation Decision Efficiency Index (IDEI) of a respondent was calculated for each of the eleven technologies as:

$$IDEI = \frac{\text{Total score of an individual for passing through the five stages}}{\text{Maximum score}} \times 100$$

The maximum score was taken as five. The mean of eleven indices was calculated for a respondent to know about the overall innovation decision efficiency index of all the eleven innovations.

Structured and pre-tested interview schedules were used for data collection from the respondents. Using Statistical Packages for Social Sciences (SPSS), the statistical analysis of the data was carried out.

Results and Discussion

The socio-personal and psychological characteristics of the respondents indicate that nearly equal proportion of the fishing boat operators belonged to old and middle-aged groups (50 and 49%, respectively). More than one-third of them (35%) was educated up to primary school level while none of the respondents was illiterate. The relatively higher literacy rate in Kerala state might be one of the reasons for that. Nearly two-thirds of the fishermen (63%) belonged to nuclear family systems, with a little more than one-third (36%) belonging to joint family system. The declining trend in joint family system which is the general trend in any Indian family system was observed in the case of fishermen communities also. The mean family size was five. A vast majority of the respondents (91%) had fishing alone as their primary occupation and only 9% of them had other occupations in addition to fishing.

The mean investment on a fishing unit was Rs. 15.19 lakhs which comprised of one fishing craft, eight to ten fishing nets and one engine (with a horse power of 104 -140 hp) and for the electronic instruments used in the fishing vessels such as, Geographical Positioning System (GPS), echosounder and wireless transmitter. The average experience of the clientele in fishing was 24 ± 7 years.

Out of 365 days in a year, the fishermen were spending only 188 days in fishing due to the mandatory ban on fishing for 45 days during the breeding season enforced by the state department, rough seas, climatic factors, availability of resources, lay-offs during festive seasons, frequent repair or maintenance works and the ever-increasing operational expenditure limiting their days of fishing. This is in agreement with Balasubramaniam *et al.* (2000) and Unnithan *et al.* (2004) that the number of fishing days per year ranged from 187 to 210, among the mechanized boat operators.

The mean annual income (Rs. in '000) of the respondents was 97.86 ± 38.50. The average annual expenditure on repair and maintenance of fishing craft and gears was (Rs. in '000) 158.86 ± 57.62. It was inferred that the average annual expenditure on repair and maintenance was increasing due to the frequent repair of engine, high costs of spare parts, damage of the vessel hull and loss or damage of nets during trawling due to rocky bottom. It was also reported that the facilities for repair and maintenance of craft and availability of boat yards are very limited.

The majority of the respondents (64%) was categorized under medium category, followed by high (27%) and low (8%) categories, in their level of innovativeness. Seventy percent of them were possessing medium level of economic motivation, followed by high (20%) and low (9%) levels. It could also be observed that almost equal percentages of the respondents belonged to low (40%) and medium (37%) categories in their social participation. High social participation was observed among one-fifth of them only. Nearly sixty percent of the mechanized boat operators had low level of extension participation. Majority (90%) of them had low level of exposure to training programmes.

The respondents' communication behaviour was medium in the case of 62% of the respondents. Majority of the respondents rarely utilized the formal sources of information such as researchers (80%) and NGO officials (77%), though more than half of them (55%) had occasionally used extension personnel for receiving technological information. Among the mass media sources, television (97%) and newspaper (90%) were regularly utilized for gathering information related to their occupation. Therefore, the attention of researchers and extension personnel is to be focused to these two channels for information dissemination to ensure better outreach. The use of Information and Communication Technology (ICT) based sources are yet to take up among the clientele in fisheries. The clientele's extent of linkage with researchers and extension groups was moderate in the case of nearly 50% of the respondents, weak in the case of 17% of the respondents and strong in the case of 33% of the respondents.

The overall and technology-wise innovation decision efficiency index scores and index scores on passing through the five stages of innovation decision process are given in Table 1.

The overall innovation decision efficiency index score was 79. The index scores on passing through the five stages of innovation decision process *viz.*, knowledge, persuasion, decision, implementation and confirmation were 96, 82, 72, 72 and 72 percentages respectively. This is in accordance with Reddy (2003), who provided ample evidence to establish that the innovation decisions are made in stages. The results indicated that vast majorities of them (96%) were possessing knowledge about all the eleven technologies and only a meager proportion of three percentage skipped this stage. The periodical extension efforts, such as field level demonstrations and awareness campaigns, carried out by the research institutions in co-operation with extension organizations and fishermen associations have created a good impact on them. This might be also possible due to the relatively

Table 1. Technology-wise Innovation Decision Efficiency Index (IDEI in percentage) (n=110)

Innovation Decision Stages	Technologies 1	2	3	4	5	6	7	8	9	10	11	Over-all
Knowledge												
Passed	100.00	100.00	90.91	100.00	100.00	76.36	94.55	100.00	100.00	100.00	100.00	
Skipped	0.00	0.00	9.09	0.00	0.00	23.64	5.45	0.00	0.00	0.00	0.00	
Knowledge Index	100.00	100.00	90.91	100.00	100.00	76.36	94.55	100.00	100.00	100.00	100.00	96.53
Persuasion												
Passed	100.00	100.00	34.55	100.00	100.00	38.18	37.27	100.00	100.00	100.00	100.00	
Skipped	0.00	0.00	65.45	0.00	0.00	61.82	62.73	0.00	0.00	0.00	0.00	
Persuasion Index	100.00	100.00	34.55	100.00	100.00	38.18	37.27	100.00	100.00	100.00	100.00	82.73
Decision												
Passed	100.00	100.00	0.00	100.00	100.00	0.00	0.00	100.00	100.00	100.00	100.00	
Skipped	0.00	0.00	100.00	0.00	0.00	100.00	100.00	0.00	0.00	0.00	0.00	
Decision Index	100.00	100.00	0.00	100.00	100.00	0.00	0.00	100.00	100.00	100.00	100.00	72.73
Implementation												
Passed	100.00	100.00	0.00	100.00	100.00	0.00	0.00	100.00	100.00	100.00	100.00	
Skipped	0.00	0.00	100.00	0.00	0.00	100.00	100.00	0.00	0.00	0.00	0.00	
Implementation Index	100.00	100.00	0.00	100.00	100.00	0.00	0.00	100.00	100.00	100.00	100.00	72.73
Confirmation												
Passed	100.00	100.00	0.00	100.00	100.00	0.00	0.00	100.00	100.00	100.00	100.00	
Skipped	0.00	0.00	100.00	0.00	0.00	100.00	100.00	0.00	0.00	0.00	0.00	
Confirmation Index	100.00	100.00	0.00	100.00	100.00	0.00	0.00	100.00	100.00	100.00	100.00	72.73
IDEI	**100.00**	**100.00**	**25.09**	**100.00**	**100.00**	**22.91**	**26.36**	**100.00**	**100.00**	**100.00**	**100.00**	**79.49**

(1 = Marine anticorrosive painting; 2 = Marine antifouling painting; 3 = CIFTAL (Mercury free aluminium alloy anode); 4 = V-form otter boards; 5 = Large mesh trawl; 6 = Turtle Excluder Device (CIFT-TED); 7 = Square mesh codend; 8 = Use of appropriate hp engine; 9 = Boat design used (size/material); 10 = Trawl designs used (size/type); 11 = Use of adequate ice on board)

better educational status of the clientele and their vast experience in the field.

Out of the 110 respondents, 82% of them passed through persuasion stage and the remaining 18% skipped it. This might be due to the fact that they required further information, more details regarding the practicability, feasibility and relative advantage of the technologies as mere knowledge of the technologies was not sufficient. It could be observed from Table 1 that 72% of the fishermen was passing through the remaining three stages *viz.*, decision, implementation and confirmation. It revealed that 100% of the clientele reaching the decision stage were passing through the implementation and confirmation stages, indicating that passing from persuasion to decision stage is very crucial in the innovation decision process. In the transition stage, the clientele are more psychologically involved with the innovation. They have started actively seeking more information about the practices and have formed favourable or unfavourable attitude depending upon the sources from where they sought information, the message they received and how they interpreted the information received. The influence of peer groups also had a great say. The role of extension agents is vital in passing from the persuasion stage to decision, and subsequently to implementation and confirmation stages. The results revealed an encouraging trend, the fairly good innovation decision efficiency of the respondents with respect to the eco-friendly and responsible fishing technologies.

The mean innovation decision efficiency index was 100% for eight technologies *viz.*, marine anticorrosive painting, marine antifouling painting, V-form otter boards, large mesh trawl, use of appropriate engine horse

power (hp), boat design used (size/material), trawl designs used (size/type) and use of adequate ice on board. The overall index scores on passing through the five stages of innovation decision process were 100% each. The result indicated that all of them passed through all the stages and none of them skipped any stage in the innovation decision process. This is due to the essentiality of the technologies and that the practices are well established and popular in the case of steel fishing trawlers. The perceived attributes of the technologies such as relative advantage and compatibility also were responsible. The popularization efforts undertaken by the research and extension organizations also have played a major role for this outcome.

In the case of the innovation *viz.*, CIFTAL (Mercury free aluminium alloy anode), the mean innovation decision efficiency index score was 25%. The index scores on passing through the knowledge and persuasion stages were 91 and 35 percentages respectively. The results indicated that 90% of the fishermen were knowing about the existence of the innovation, how it functioned and its consequences. Only about one-third of them passed through the persuasion stage and the remaining skipped it. The index scores on passing through the decision, implementation and confirmation stages were zero each, which indicated that none of them passed through these three stages. This is due to the fact that they have not witnessed any advantage of the innovation and have received conflicting messages about their innovation decision. Peer groups also have played a major role in their innovation decision.

In the case of the Turtle Excluder Device (CIFT-TED), the mean innovation decision efficiency index score was 23 percent. The results indicated that even though more than 75% of the fishermen knew about the existence of the innovation, only about one-third of them passed through the persuasion stage. This is due to the fact that they have not agreed with the attributes of this innovation and formed an unfavourable attitude towards this innovation. The index scores on passing through the decision, implementation and confirmation stages were zero each, which indicated that none of them passed through these three stages. This might be due to the fear that the use of the innovation would result in catch losses. Since the decision stage is very crucial, the fishermen could be convinced to take a decision to adopt this innovation through the use of various extension methods. CIFT studies have established that the overall catch losses during trawling operations from commercial fishing vessels, due to installation of TED, had been 0.5% for shrimp and 2.75% for non-shrimp catch components (CIFT, 2003).

In the case of the square mesh codend trawls, the mean innovation decision efficiency index score was 26%. The results indicated that a vast majority of the fishermen knew about the existence of the innovation, how it functions and its consequences. Only about one-third of them passed through the persuasion stage and the remaining skipped it. The index scores on passing through the decision, implementation and confirmation stages were zero each, which indicated that none of them were passing through these three stages. This might be due to the fear that the use of the innovation would result in catch reduction. However, studies at CIFT showed that codend mesh size of 30 mm in demersal trawls provided better chance of escapement of most of juveniles while retaining bulk of economically important species (Kunjipalu *et al.*, 2001). Since the decision stage is very crucial, the fishermen could be convinced to take a decision to adopt this innovation through the use of various extension methods, in the interest of conservation of juveniles to ensure sustainable fisheries.

The technology-wise innovation decision efficiency scores revealed that the innovation decision process was efficient pertaining to the technologies which were

Table 2. Correlation and Regression Analyses between the Socio-Personal Variables and Innovation Decision Efficiency Index

(n=110)

Sl. No.	Variables	Correlation coefficients (r)	Regression coefficients (b)	SE of 'b'	't'
1.	Age	-0.074*	0.048	0.086	0.559
2.	Educational status	0.042	0.512	0.255	2.003*
3.	Family type	0.003	0.582	0.794	0.733
4.	Family size	-0.112	-0.299	0.319	-0.939
5.	Occupational status	0.121	0.009	0.890	0.010
6.	Investment on fishing craft and gear	0.281**	0.244	0.131	1.858*
7.	Experience in the field	0.089	0.036	0.069	0.527
8.	Number of days of work in a year	0.062	0.027	0.020	1.318
9.	Average annual family income	0.269**	-0.019	0.010	-1.918
10.	Average annual repair or maintenance expenses	-0.109	0.002	0.006	0.350
11.	Innovativeness	0.128*	0.952	0.975	0.098**
12.	Economic motivation	0.155	0.364	0.266	1.368
13.	Social participation	-0.071	-0.366	0.215	-1.700
14.	Extension participation	0.259**	0.479	0.239	2.001*
15.	Training undergone	0.217*	-0.213	0.547	-0.390
16.	Communication behaviour	-0.114	0.270	0.196	1.382**
17.	Extent of linkage with research and extension groups	0.241*	0.646	0.311	2.076*

(** Significant at 1% level; * Significant at 5% level; R^2 = 0.711; F = 3.070**)

directly related to increasing production, labour efficiency, fuel efficiency, reducing the operational expenditure and increasing the income. In the case of the technologies pertaining to the conservation of resources in the interest of sustainability and environmental impact, the innovation decision efficiency scores were relatively low. However, it could be concluded that the overall innovation decision efficiency pertaining to the selected eco-friendly and responsible technologies was fairly good among the respondents of this study.

From the above findings, it could be understood that the clientele group required more information regarding the practicability, feasibility and the cost-benefit ratio of technologies, in evaluating the technologies in their innovation decision behaviour. The mass media and extension agencies have vital roles to play, to bridge the gap to pass through the different stages. At persuasion stage, they could be motivated to form a favourable attitude towards the innovation, as they are more psychologically involved with the innovation. Passing through the decision, implementation and confirmation stages is the clientele's choice, as the extension agents have minimum roles to play at these three stages. However, the extension agents can provide opportunities to the clientele, to witness the advantages of the innovation, to ensure the availability of technological inputs and resources, to put the innovation into practice and to see that the clientele are not exposed to conflicting messages about the innovation.

In order to find out the degree of relationship between the socio-personal characteristics of clientele and innovation decision efficiency index, simple correlation coefficients were worked out. To determine

the strength of various characteristics influencing the innovation decision efficiency index, the data were subjected to multiple regression analysis.

Out of the seventeen variables, the investment on fishing craft and gear, average annual family income and extension participation showed positive and highly significant relationship at one percent level, whereas the variables, innovativeness, training undergone and extent of linkage with research and extension groups showed positive and significant relationship at five percent level of probability (Table 2). The results indicated that when the scores on the above independent variables improve, the innovation decision process could be more efficient and vice-versa. Further, the variable, age had significant negative relationship, indicating that the innovation decision efficiency declines, as the age increases. Out of the seventeen variables, the regression coefficients of two variables *viz.*, innovativeness and communication behaviour were significantly and positively influencing the efficiency in innovation decision process at one percent level of probability. The variables, educational status, investment on fishing craft and gear, extension participation and extent of linkage with research and extension groups had contributed significantly and positively towards the dependent variable at five percent level of probability (Table 2). Brajmohan *et al.* (2003) also reported significant relationship between contact with extension agency and technology adoption. The regression coefficients for the other eleven technologists were non-significant and were not significantly influencing the variation in the innovation decision efficiency of the fishermen. The R^2 value was found to be 0.711, indicating that the seventeen characteristics taken together accounted to 71.10% of variations in the innovation decision efficiency level. The 'F' value was highly significant at one percent level of probability (Table 2).

Lack of training and access to research and extension system, lack of information on technologies, increase in cost of inputs or spare parts, lack of financial resources, increase in operational expenditure, lack of infrastructural facilities, non-availability of inputs or resources and diminishing resources were perceived as constraints in the innovation decision process pertaining to most of the identified technologies. A technology is said to be successful, only when majority of the end users adopt it without any inhibition and gets satisfied with the result. So, by studying the innovation decision process, the percolation of technologies passing through knowledge, persuasion, decision, implementation and confirmation stages could be tracked. If the stage(s) where the innovation decision cease is identified, appropriate follow up measures could be taken up to make the innovation reach the confirmation stage. The findings on characteristics of clients influencing the innovation decision would help in designing a suitable extension strategy, according to their innovation decision behaviour, socio-personal profile and resource base. The findings on constraints might help to formulate appropriate remedial measures for improving the technology development, technology transfer and innovation decision processes in marine fisheries.

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