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Motorization Technology Delivery in Small Scale Fisheries – Its Impact and Impediments in Adoption§

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Abstract

The impact of motorization technology on the earnings of small-scale fishermen has been quantified using decomposition analysis, and the reasons for non-adoption of motorization technology by a section of small-scale fishermen have been identified. The decomposition analysis has shown that motorization technology has an impressive impact on the monetary returns for small-scale fishermen. The reasons behind non-adoption of motorization have been identified as lack of access to institutional finance, increased operational expenditure, operational complexities and complacency. Various causative factors have been identified for each of these reasons. To overcome the problem of lack of access to institutional credit, the fishermen may be encouraged to form co-operative groups. A group lending scheme with liberal security formalities, may be extended to the interested fishermen groups through the co-operative societies.

Key words: Small-scale fisheries, motorization technology, non-adoption of motorization, Tamil Nadu

JEL classification: O33, Q14, Q16, Q18

Introduction

The socio-economic conditions of small-scale fishers, especially of non-motorized fishermen of Tamil Nadu are far from satisfactory. For the fisherfolk in the small-scale sector, daily earnings from fisheries are low, fluctuating and often uncertain, affecting their livelihood security. For them outward movement to non-fishing activities is difficult because of their social conservativeness, lack of knowledge about opportunities and poor skills. Alternative employment outside fisheries sector is less palatable for the existing fisherfolk generation. Although the state government continues with several welfare schemes like subsidy for Out Board Motors (OBMS), free housing scheme and national fishermen savings-cum-relief scheme, the overall living conditions continue to remain the same for decades, without any remarkable improvement. But among the small-scale fishers, in general, it could be observed that motorized fishermen are able to generate a reasonably higher income than non-motorized fishermen, since crafts with technology (outboard motor) have higher economic and labour efficiencies than crafts without technology (Raju, 2003). On the contrary, a parallel argument in this regard is that the correlation between the improved earnings by a motorized fisherman and his increased fishing efforts, labour and fuel expenses due to motorization is not much encouraging and appreciable. It is an issue to be noted with due concern and validated for its genuineness. Its implications on the adoption process are also to be analyzed. In India, there were 96,661 non-motorized boats, of which 23,494 crafts (24%) were in Tamil Nadu in 2005 (Marine Fisheries Census, 2005).

The introduction of outboard motors for propulsion is considered as a boon for small-scale fishers and is

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lauded as an effective technology, but 55.76 per cent of the small-scale crafts of Tamil Nadu are not motorized even after two decades of introduction of this technology (GoTN, 2010). Since motorization is the simplest and fairest option available for enhancing the standards of living of thousands of fishermen families of Tamil Nadu, who have been economically and socially backward for generations, the reasons behind this need to be addressed. To sum-up, it could be stated that as in other parts of India, the small-scale fishers of Tamil Nadu also display a very fragile socio-economic profile. Even the availability of an effective remedy, namely the motorization technology has not been adopted at the needed pace for reasons unexplored. With this background, the present study was undertaken with the following objectives:

- To quantify the impact of motorization technology on the earnings of small-scale fishermen, and
- To analyse the reasons behind non-adoption of motorization technology by a section of small-scale fishermen.

Data and Methodology

Sampling Design

A multistage stratified random sampling technique was adopted for selecting the respondents in the coastal districts of Tamil Nadu as the first stage unit, fishing villages in the coastal districts as the second stage unit and individual fisherman households in the fishing villages as the third stage of sampling.

The coastal districts (13 in number) were arranged in a descending order based on the total number of small-scale crafts which included both motorized and non-motorized fishing crafts. The top five districts, viz., Kanyakumari, Ramanathapuram, Nagapattinam, Kancheepuram and Tuticorin, were selected for study. From each selected district, one fishing village was selected purposively by arranging the fishing villages possessing a minimum of 60 crafts in each category, viz., motorized and non-motorized, in the descending order of the total number of small-scale fishing crafts. The fishing village which appeared first was taken as the sample village. Accordingly, five fishing villages, namely Enayam (Kanyakumari district), Nambuthalai (Ramanathapuram district), Arcottuthurai (Nagapattinam district), Panaiyurkuppam (Kancheepuram district) and Periyatalai (Tuticorin district) were chosen for the study.

In the third stage, 60 fishermen — 30 motorized and 30 non-motorized — were selected randomly from each of the five villages. The cumulative sample size was fixed at 300 taking into consideration the statistical requirements, time and other constraints.

The data were collected from both the primary and secondary sources. The field level primary data were collected using structured pre-tested schedules. The data pertained to the year 2009-10.

Analytical Tools

Decomposition Analysis

Research evidences clearly confirm that the gross earnings are higher for motorized than non-motorized fishermen. The increase in gross earnings is the result of following two major factors.

(i) 'The technology effect' which has been perceived in this study as the improvement in the efficiency of motorized fishermen probably by the following means:
   - Quick reach to the fishing ground when the weather is favourable.
   - Faster movement to another fishing ground for a better catch, if necessary.
   - Less physical labour in movement with consequent active involvement in fishing.
   - Tactful management of rough weather than by non-motorized fishermen.
   - Use of improved gears.

(ii) 'The input effect' which is attributed by the difference in the fishing efforts, viz., number of fishing trips, time spent on fishing, number of labourers engaged and age of crafts involved in fishing.

The decomposition analysis (Bisaliah, 1977) was employed to sort out the contribution of these two effects and quantify them in measurable units for a better understanding of the facts. In the present study, two separate production functions were estimated for motorized and non-motorized production scenarios, and these were specified in log-linear forms as given below:

Fishing with Motorized Craft

$$l_n GI_M = l_n A_M + a_M l_n CS_M + b_M l_n FT_M + c_M l_n TF_M + d_M l_n AC_M + Ui_M \quad \ldots(1)$$

Fishing with Non-Motorized Craft

$$l_n GI_{NM} = l_n A_{NM} + a_{NM} l_n CS_{NM} + b_{NM} l_n FT_{NM} + c_{NM} l_n TF_{NM} + d_{NM} l_n AC_{NM} + Ui_{NM} \quad \ldots(2)$$

where,

GI = Annual gross income (rupees),

CS = Crew size (No.),

FT = Fishing trips / annum (No.),

TF = Time spent on fishing (hours),

AC = Age of craft (years), and

Ui = Error-term.

The subscripts M and NM denote motorized and non-motorized production scenarios. 'A' is the scale parameter and a, b, c, d are all output elasticities with respect to different inputs.

Taking the difference between Equations (1) and (2), and simplification gives Equation (3):

$$l_n (GI_{NM} / GI_M) = [l_n (A_{NM} / A_M)] + [(a_{NM} - a_M) l_n CS_M + (b_{NM} - b_M) l_n FT_M + (c_{NM} - c_M) l_n TF_M + (d_{NM} - d_M) l_n AC_M] + [a_{NM} l_n (CS_{NM} / CS_M) + b_{NM} l_n (FT_{NM} / FT_M) + c_{NM} l_n (TF_{NM}/TF_M) + d_{NM} l_n (AC_{NM}/AC_M)] + [Ui_{NM} - Ui_M] \quad \ldots(3)$$

Equation (3) approximately apportions the difference in gross income between motorized and non-motorized fishermen. The first term in the square-bracket on the right hand side of Equation (3) indicates the percentage change in gross income due to shift in scale parameter A. The second term in the square-bracket measures the effect of changes in slope parameters (output elasticities). The summation of these two terms gives the technology effect. The third term in the square-bracket measures the contribution of change in input levels to changes in gross income. The last is the random error-term.

Garrett Ranking Technique

The Garrett ranking technique (Garrett and Woodworth, 1971) was used to find the reasons for not motorizing the fishing crafts by a section of traditional / small-scale fishermen.

Results and Discussion

Impact of Motorization Technology

The higher gross earnings of motorized fishermen vis-a-vis non-motorized fishermen may be attributed to two effects, viz., technology effect and input effect. The decomposition analysis was carried out to find the contribution of these two effects and quantify them in measurable units. For this analysis, two separate log-linear production functions were estimated for motorized and non-motorized production scenarios using OLS technique. The significance of the models was confirmed using respective F-values which were significant at one per cent probability level.

Production Function Estimates

The estimates of production function for motorized fishing crafts are presented in Table 1. The independent variables, namely, crew size, time spent on fishing and age of crafts were significant at five per cent level and the variable, number of fishing trips per annum was significant at one per cent level. The coefficient of multiple determination (R^2) was 0.89, which implied that the model had a good fit.

Table 1 also contains the estimates of production function of non-motorized fishing crafts. The independent variables, namely, number of fishing trips per annum and time spent on fishing were significant at one per cent level. The variable crew size was significant at five per cent level and age of craft was significant at 10 per cent level of probability. The coefficient of multiple determinations (R^2) was 0.86, which implied that the model had a good fit.

A comparison was made to understand the rationale of input usage in different production scenarios using the production estimates and geometric mean level of inputs and outputs. With regard to crew size, the production elasticities for motorized and non-motorized fishing crafts were 2.38 and 1.28, respectively. The motorized production with increasing marginal labour productivity trend implied that the process of motorization could engage still more number of labourers, although the present mean level of labourers employed in a motorized craft (4.3 persons) was higher than in a non-motorized craft (2.2 persons).

For fishing trips per annum, the production elasticities were high for both the categories, but was

Table 1. Production function estimates of motorized and non-motorized fishing crafts

Particulars	Motorized fishing crafts			Non-motorized fishing crafts		
	Co-efficient	| t-ratio|	Geometric mean	Co-efficient	| t-ratio|	Geometric mean
Dependent variable						
Gross income in rupees			3,18,372			59,977
Independent variables						
Intercept	1.32	0.51		-1.6	-0.92	
Crew size (No.)	2.38**	1.98	4.3	1.28**	2.08	2.2
Fishing trips per annum (No.)	1.68***	2.74	232	2.07***	5.53	201
Actual time spent on fishing (hours)	0.21**	2.22	7	0.8***	3.56	5
Age of craft (years)	-0.79**	2.02	7.8	-0.35*	1.78	6.9
'R' square		0.89			0.86	
No.of respondents		150			150	
F value		902.84***			215.64***	

Note: ***, ** and * denote significance at 1 per cent, 5 per cent and 10 per cent levels of probability, respectively

little less for motorized (1.68) than non-motorized (2.07) crafts, inferring that motorized fishermen were more meticulous and capable in planning and undertaking fishing trips. The geometric mean worked out for the number of trips per annum was 232 and 201 for motorized and non-motorized crafts, respectively. The higher value of geometric mean for the number of trips with motorized crafts was due to two major reasons, viz., the increased commitment of a motorized fishermen because of high investment, and improved confidence level and capability due to motorization in managing the rough sea. By looking at production elasticities, one could though infer that more number of trips could be taken up by both motorized and non-motorized fishermen, care should be taken on the physical safety of fishermen by duly considering the weather conditions.

The production elasticities of the variable, actual time spent on fishing were 0.21 and 0.8 for motorized and non-motorized crafts, respectively. The absolute values of geometric mean for the same were seven hours and five hours, respectively. Though the time spent for fishing by non-motorized fishermen was less, the magnitude of elasticities revealed that non-motorized fishermen were more judicious in avoiding time wastage. This might be due to the fact that normally a non-motorized fisherman would plan for a fishing trip only when the weather is comparatively more conducive for a good catch, whereas a motorized fisherman often takes risk because of the acquired confidence in managing even the rough sea due to motorization, resulting in more number of less-productive hours.

The production elasticities for age of the craft were -0.79 and -0.35 for motorized and non-motorized crafts, respectively, which revealed that reduction in returns with increasing age of crafts was more pronounced in the motorized crafts. This might be due to reduction in the propulsion capacity of engine of motorized craft as it becomes old, the problem which does not arise with non-motorized crafts.

Another conclusive remark which could be derived by comparing two production scenarios was that the mean level of input usage, i.e. the magnitude of fishing efforts put forth, was higher in motorized than in non-motorized fishing. This might be due to the increased commitment of motorized fishermen because of higher investment and operational expenditure.

Decomposition Analysis

Decomposition analysis revealed that a difference of 20.04 per cent in gross returns between motorized and non-motorized fishing crafts was contributed by the technology, which means that even if the level of input application is maintained same, a motorized fisherman would be able to fetch ₹ 51,782/- per annum more than a non-motorized fisherman.

Table 2. Decomposition of factors contributing to difference in gross incomes of motorized and non-motorized fishing crafts

Particulars	Difference in gross income	
	Rupees/ annum	Percentage
Due to technology	51,782	20.04
Due to input use	2,06,871	80.06
Crew size (No.)	1,29,895	50.27
Fishing trips per annum (No.)	45,478	17.60
Time spent on fishing (hours)	38,811	15.02
Age of craft (years)	-7313	-2.83
Others (due to random-error)	-256	-0.099
Total effect	2,58,395	100.00

It could also be observed from Table 2 that 80.06 per cent (₹2,06,087) of the difference in gross incomes was due to the difference in input usage. A major share (50.27%) of the difference in gross incomes was accounted for by the crew size alone, followed by differences in number of fishing trips per annum (17.60%), time spent on fishing (15.02%) and age of craft (-2.83%).

Apparently, one could infer that the technology effect was not as strong as input effect. To be more specific, it could be stated that increase in the level of fishing efforts, viz., crew size, number of fishing trips and time spent on fishing by motorized fishermen had a positive influence on the difference in gross income to the tune of 82.89 per cent of the total difference. But, an important point to be noted here is that the level of fishing efforts could never be increased as such by a fisherman, unless his craft is motorized. Hence, in real sense, except the age of craft, the contribution of other inputs, viz., crew size, number of fishing trips and time spent on fishing could be considered as an indirect effect of technology.

On an average, motorization through 'technology effect' could directly increase gross income by ₹ 51,782/- and indirectly by ₹ 2,14,154/- through increase in fishing efforts, viz., crew size, number of fishing trips and actual time spent on fishing. Since the increase in the level of fishing efforts was not feasible without motorization of crafts, the contribution of these inputs to increased gross income could also be treated as the technology effect. Hence, the cumulative impact of technology was worked out to be ₹ 2,65,936/- which is an appreciable increment.

Table 3. Reasons for non-adoption of motorization

(No. of respondent fishermen = 150)

(percentage)

Reasons	Yes	No
Lack of access to institutional finance	82	18
Increased operational expenditure	61	39
Operational complexities	50	50
Complacent attitude	27	73

Reasons for Non-adoption of Motorization

The four major reasons identified for non-adoption of motorization were: lack of access to institutional finance (82%), increased operational expenditure (61%), operational complexities (50%) and complacent attitude (27%). Hence, lack of access to institutional finance was the prime reason for non-adoption of motorization.

The analysis was extended to find the actual causative factors of all the four reasons. These have been listed along with their rankings in Table 4.

Lack of Access to Institutional Finance — Among the four causative factors of non-adoption, inability to fulfill the loan security formalities ranked first, followed by procedural complexities, lack of awareness and reluctance to approach a bank. Due to weak fixed asset position, fishermen face problems in obtaining a loan from the financial institutions. To overcome this problem, these fishermen should be encouraged to form co-operative groups, which may be funded through co-operative societies. Even a better control on repayments could be achieved, if fish sale is also made under the supervision of a co-operative society. The other factors could be addressed by dedicated extension services.

Increased Operational Expenditure — Among the four causative factors listed under this reason, the increased fuel price and increased labour cost appeared to be more influencing. But, this may not be perceived as irrational because motorized fishing can fetch back a proportionate increased income coupled with higher labour productivity.

Operational Complexities and Complacent Attitude — Lack of expertise in operation and maintenance of motorized crafts and reluctance to take up a financial

Table 4. Causative factors of various reasons quoted for non-adoption of motorization

Sl. No.	Reasons	Causative factors	Garrett mean score	Rank
1.	Lack of access to institutional finance (82 %)*	(i) Inability to fulfill the loan security formalities	65.57	I
		(ii) Procedural complexities in obtaining loan	52.24	II
		(iii) Lack of awareness on credit schemes	43.70	III
		(iv) Reluctance to approach a bank	38.49	IV
2.	Increased operational expenditure (61 %)*	(i) Increased fuel price	65.01	I
		(ii) Increased labour cost	54.60	II
		(iii) Increased expenditure on gears due to frequent damage / loss	45.47	III
		(iv) Increased repair/maintenance cost of craft and engine	34.91	IV
3.	Operational complexities (50 %)*	(i) Lack of expertise in operation and maintenance of motorized crafts	63.30	I
		(ii) Cannot keep the craft idle/needs more fishing efforts	52.84	II
		(iii) Inadequate availability of experienced crew	46.45	III
		(iv) Non-availability of repair & maintenance facilities	35.40	IV
4.	Complacent attitude (27 %)*	(i) Reluctance to take up a financial risk	64.28	I
		(ii) Involves high physical risk	57.90	II
		(iii) Reluctance to take up new technology	39.00	III
		(iv) Old age	38.80	IV

* Percentage of respondent fishermen.

risk ranked important factors in non-adoption of motorization. These problems could be solved by taking motorization as a group activity so that expertise could be shared and financial risk could be reduced through group borrowing.

Policy Suggestions

The policy options inferred from the study are:

- Since adoption of motorization has depicted an impressive impact on the returns of small-scale fishermen, the government should launch a renewed objective-specific, result-oriented programme to encourage the fishermen owning non-motorized craft to adopt the technology by providing economic and knowledge support. It would enhance the standard of living of not only the target group but also of the fellow fishermen who do not own a craft, by providing more job opportunities since motorized fishing requires more workers coupled with higher labour productivity.
- For providing an easy access to institutional loan, group lending scheme with liberal security formalities, may be initiated. The repayment of loan could be ensured by routing every fish sale of the borrowed groups through the co-operative societies.
- The motorization may be encouraged as a group activity to solve the problems of lack of expertise in operation and maintenance of motorized craft and reluctance to take up a financial risk.

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