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Research Note

INPUT USE EFFICIENCY AND INCOME DISTRIBUTION OF SMALL SCALE MARINE FISHING IN BANGLADESH

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ABSTRACT

The study was carried out to examine the input use efficiency of setbag net and longline marine fishing technologies and also to determine the sharing system and income distribution between the boat owners and fishermen. Two hundred fishing firms were randomly selected as 100 from setbag nets and 100 from longline fishing firms. Cobb-Douglas production function technique was employed to examine the input use efficiency. In the case of setbag net, all the explanatory variables were statistically significant and positive in increasing the revenue except the food cost which had a negative impact on fishing. In longline fishing, number of hooks, fuel and lubricant cost, and crew cost had negative impact on marine fishing while capacity of boat, ice and salt cost, experience of fishermen were positive to explain the variation in marine fish revenue. Small scale m2i¨ine fishing generated large income for fishermen but the income distribution among the concerned fishermen appeared to be inequitable and exploitative. The fishermen have currently been facing some serious problems in fishing activities. Further steps such as rational sharing system favourable for crews, regulations on fishing to restore fish stock to maintain the level of fish prices, life insurance for fishermen and stopping the piracy of fishes and nets by law enforcing agencies and improvement of fishing techniques may be needed for sustainable fisheries policies in Bangladesh.

I. INTRODUCTION

Marine fishing is an important source of fisheries in Bangladesh as the total marine water areas is almost as big as the country's inland fisheries. The continental self-extends over an area of about 66400 km^2 of which about 37000 km^2 is within the 50 m depth zone and has good fish resources (Rahim 1990, Islam and Elahi 1993, Rashid 2000). The fisheries sector contributed to 5.24 percent of the gross domestic product (GDP) in 2001/2002 which contributed about 20% in agriculture sector (DoF 2003). It is estimated that the standing stock of fish was around 264000 to 373000 mt and that of shrimps around 9000 mt (Hussain 1994). The marine catch has increased from 250492 mt in 1992/93 to 333799 mt in 1999/2000, which is about 24.5 percent and 20.09 percent of total catch, respectively. Exports of high value fish products like shrimp, lobster etc., are becoming an increasingly important source of foreign exchange. It contributed 6.28 percent of the export earnings in 1999/2000 (BBS 2001). In 2001/2002, Bangladesh earned Tk 1637100 million through exporting fish and fish products which shared 4.76 percent of export earnings (DoF 2003). This sector employed

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about 1.4 million full time fishermen directly engaged in fishing and about 11 million people indirectly maintained their livelihoods through the activities related to fisheries (FFYP 1998). From the nutritional point of view, this sector can also act a perfect role and meet up the shortage of animal protein in diet. Per capita annual fish intake was 13.5kg out of needed 18.Okg and fisheries supplied 63% of total animal protein in 2001/2002 (DoF 2003).

Usually three types of gears (production technologies) namely gillnet, longline and setbag net are used in marine fishing. Among these, first two methods are widely used but recently some fishermen have *started* to use the third one in small scale in marine fishing. A clear assessment of inputs use efficiency, the income sharing arrangement system and also the problems of different combination of boats and gears in an individual framework is required to guide the rational allocation of resources in small scale marine fishery within the context of national fisheries development policy. Although, the reality is that there in no coordinated government financial policies at the governmental level to develop this sector and realize its potentials. So, information is wanting to pursue policies for its development. The present study is aimed to identify problems on small scale marine fishing and come up with some recommendations for the development of small scale marine fishing in Bangladesh.

Objectives of the Study:

i. to justify the efficiency of inputs used in fish production of sethag and longline fishing in small marine fishing;

ii. to study the nature of income distribution and variation in the share system of distributing marine earnings; and

iii. to identify some basic problems and recommend some policy implications for the development of small scale marine fishing in Bangladesh.

II. METHODOLOGY

The data were collected from small scale marine fishing farms through field survey. Cox's Bazar and Chittagong from south-east as well as Barisal and Potuakhali from southwest coastal areas were purposively selected to collect required data. Considering all the small scale marine fishing technologies, two important gears such as setbag net and longline were selected and then 100 fishing firms for setbag net and 100 fishing firms for longline were randomly selected (Table 1). Data were collected for the year of 2004.

Table 1 Sampling design and distribution of marine fishing firms selected from different locations.

Types of gears	Study areas and number of fishing firms selected			
	Chittagong	Cox's Bazar	Barisal and Patuakhali	Total
Setbag net	40	40	20	100
Longline	40	40	_	100
All	80	80	40	200

The Cobb-Douglas production function in a log linear form was employed to estimate the contribution of inputs in fish production by setbag net technique. The estimated equation was:

In (revenue) =1n a + b1ln (capacity of boat) + b2ln (ice and salt) + b3 In (mouth of net) + b4 In (experience) + b5ln (food) + b6ln (crew cost) + Ui

Another Cobb-Douglas productions function in a log linear form for longline fishing was employed to estimate the contribution of inputs in fish production and the equation was:

In (revenue) = In a + $b_1$ln (capacity of boat) + b2ln (fuel and lubricant) + $b_3$ln (ice and salt) + $b_4$ln (crew cost) + $b_5$ln (hooks) + b6ln (experience) + Ui

Where, revenue = revenue earned from catch (Tk); capacity of boat = holding capacity of boat (mt); fuel and lubricant = fuel and lubricant cost (Tk); ice and salt = ice and salt cost (Tk); crew cost = cost expended for crews (labour involved in fishing except boat owner) (Tk); hooks = number of hooks (No.); mouth of net = length of mouth of net (metre); experience = experience of fishermen (years); food = food cost (Tk); In = natural logarithm; a = constant or intercept value; b; = coefficients to be estimated and Ui= disturbance term with appropriate properties.

To assess the efficiency of inputs for each type of technology, the assumptions such as (i) all the fishing units were exploiting the same fisheries in the same fishing ground or place at the same time and (ii) according to the minimum outlays of fishing, fishermen in each gear had to achieve and raise their catch as well as the revenue were considered. Simple tabular analysis was applied to deal with collected data from fishermen regarding income sharing systems in marine fishing areas in Bangladesh.

III. INPUT USE EFFICIENCY OF SETBAG NET AND LONGLINE FISHING

The values of F were highly significant for both setbag net and longline fishing in the study. These results indicate that all the included explanatory variables were important for explaining the variation of output from marine fishing. The returns to scale of setbag net and longline fishing were 0.803 and 1.481 respectively confirmed the decreasing returns to scale for setbag net fishing but longline fishing exhibited increasing returns to scale (Table 2).

Table 2 Values of coefficient and related statistics of Cobb-Doughlas production function of setbag net and longline fishing.

Explanatory variables	Setbag net	Longline
Intercept	10.634	11.475
Capacity of boat	0.131**	1.389*
	(0.060)	(0.229)
Fuel and lubricant cost	-	-0.466*
		(0.132)
Ice and salt cost	0.132*	0.570*
	(0.051)	(0.175)
Crew cost	-	-0.601**
		(0.259)
Number of hooks	0.442*	-0.136**
	(0.106)	(0.066)
Mouth of net	0.162**	-
	(0.075)	
Experience of fishermen	0.328*	0.725**
	(0.111)	(0.335)
Food cost	-0.392*	-
	(0.119)	
$_R2$	0.628	0.779
F	26.118	54.752
Returns to scale ($\sum bi$)	0.803	1.481

Note: * Significant at 1 percent level;
** Significant at 5 percent level; and
Figures within parentheses indicate standard errors.

In case of setbag net and longline fishing, the regression coefficients indicate that an increase in 1 percent of capacity of boat leads to a *0.131* and *1.389* percent increase in revenue, respectively, holding use of other inputs constant. The coefficient for fuel and lubricant was *0.466* and statistically significant at 1 percent level for longline fishing, which has the negative impact on revenue earning by longline marine fishing. It implies the excessive use of fuel and lubricant in fishing. The coefficients for ice and salt costs were statistically significant at the 0.01 level of probability for both the setbag net and longline fishing and these were positive (Table *2).* It clearly indicates that farmers could easily earn more return from both setbag and longline fishing by maintaining standard quality of fish preservation using more ice and salt efficiently. The negative sign of coefficient of crew cost indicate over spending on crews which decrease revenue earning from longline fishing. But coefficient of crew cost of setbag net fishing was positive. Number of hook's coefficient was negative and significant at *5* percent level for longline fishing. One plausible explanation for negative coefficient is that either more number of hooks were used by the fishermen or hooks were immoderately used in the coastal areas of Bangladesh. This result is quite justified in the present context of fishing. It may be noted that the unavailability of fish in the fishing ground resulted to poor catch and low revenue compared to the number of hooks used. However, one percent increase in number of hooks would decrease the revenue by *0.136* percent. The coefficient of mouth of net was positive and significant in case of setbag net and it implies that larger net's mouth was the cause of higher return. As management ability, fishermen with more years of experience in fishing were more efficient. However, it should be noted that, fishing experience, which reflected the elasticity of catch, was *0.328* for setbag net fishing and *0.725* for longline fishing (Table *2).* The high values of multiple coefficient of determination R^2 indicate a fairly high degree of "goodness of fit".

IV. SHARE SYSTEM AND INCOME DISTRIBUTION

Share system refers to a contractual agreement on the basis of which the distribution of revenue takes place between the crews and the boat owner. It specifies the principles and mechanisms of what component of costs to be shared and what not; what proportions of the revenue to be received by the crew and the boat owner (Rashid *1993).* Four categories of crew were involved in small scale marine fishing - they are head *mazhi,* assistant head *mazhi,* driver and labourers. Generally the owner at first cut his proportion from total catch revenue for using his boat and net in fishing and the rest of the revenue was then divided to the number of crew shares calculating the value according to the contract.

There were different combination of number of crews in both setbeg and longline fishing. Twenty or 17 or *12* numbers of crews and *15* or *12* or *9* numbers of crews were employed in setbeg net and longline fishing, respectively. In this study, *17* and *12* number of crews have been considered in segbeg net and longline fishing, respectively since mostly these combination of the numbers of crews were followed. This share system is widely followed by the fishermen under setbag net and longline marine fishing in the coastal region of Bangladesh. Nevertheless, an exception was found with the setbag net fishing as maintaining wage payment in monthly on seasonal basis. When a trip results in negative net earning then the earning of the following trips is distributed excluding the negative amount of the previous

trip i.e., the whole amount of loss is borne by the crew members as the situation of this is defined *"Guanagary"*.

4.1 Share System and Income Distribution of Setbag Net Fishing

It was common to pay the crews partly in terms of a fixed wage rate and partly in terms of shares. During the lean season, the fishermen operated fishing near the coastline. They hired boat and net from the owners at a fixed rate. The share of the net value of catch was divided as the boat owner got 50 percent share and the rest of the shares were distributed among the crews. Each assistant and driver got 1.5 times of the single labour fisherman's share while head mazhi got 3 times. Following this criterion, boat owner received 50 per cent of net revenue and those of head mazhi, assistant head mazhi, driver and each labour fisherman received 7.50, 3.75, 3.75 and 2.50 percent, respectively (Table 3). On the other hand, during the peak season, the remuneration system in setbag net fishing was completely different. This time the fishermen were hired by the boat owners on wage contract basis. Various rates of wages were paid to the different categories of crews for 8 months maintaining the labour market.

Table 3 Annual income of boat owner and other fishermen of setbag net fishing.

Categories of fishermen	TWyear	% of total
Boat owner	806070	50
Head *mazhi*	120911	7.5(l)
Assistant head *mazhi*	60455	3.75(l)
Driver	60455	3.75(l)
Labour fishermen	40304	2.50 (14)

Note: Figures within parentheses indicate the numbers of crews involved

The average income of the . boat owner under setbag net fishing was Tk *806070* per annum which shared about *50* percent of total return. Head *mazhi,* assistant head *mazhi,* driver and each of the labour fisherman received Tk *120911,* Tk *60455,* Tk *60455* and Tk *40304* per annum, respectively (Table *3).*

4.2 Share System and Income Distribution of Longline Fishing

The income was distributed as *60:40* shares in the coastal region of Bangladesh of which the boat owner got *60* percent and the rest of all staffs got *40* percent only. This *40* percent share again was distributed among the head *mazhi,* assistant head *mazhi,* driver and labour fishermen. The head *mazhi* got *2* times of a labour fisherman and thus both assistant head *mazhi* and driver got *1.5* times each.

Table 4 Annual income of boat owner and other fishermen of longline net fishing.

Categories of fishermen	Tklyear	% of total
Boat owner	774240	60
Head *mazhi*	73737	5.71(1)
Assistant head *mazhi*	55303	4.29(l)
Driver	55303	4.29(l)
Labour fishermen	36869	2.86(9)

Note: Figures within parentheses indicate the numbers of crews involved

Following this share system, head *mazhi*, assistant head *mazhi*, driver and each of the labour fishermen received 5.71, 4.29, 4.29 and 2.86 percent of total revenue, respectively. From the sharing system and income distribution it is evident that the average income of boat owner was Tk 774240 per year which was 60 per cent of the total revenue. The rest 40 percent was distributed among head *mazhi*, assistant head *mazhi*, driver and each of the labour fishermen as Tk 73737, Tk 55303, Tk 55303 and Tk 36869 per annum, respectively from longline marine fishing (Table 4).

V. PROBLEMS AND CONSTRAINTS OF SMALL SCALE MARINE FISHING

New people were coming to fisheries sector to live on in Bangladesh. The fishing at sea consistently increased during the last few years as well as the number of fishing boats also increased rapidly. More threatening was that the unregistered marine fishing boats and gear was multiplying as fast as the rate of actual fish stock. It was argued that the marine fishing did not lose its potential but the marine fishing that generated larger income was gradually changing. Hence, the trend in marine fish production in Bangladesh was very encouraging. But the boat owner and fishermen have been facing some serious and crucial problems and constraints in production and marketing the fishes. Brief discussions on some of the main problems were as follows:

Cyclone and bad weather: Natural calamities create problem for marine fishing. Almost, all the fishermen mentioned that it was a great problem. The forecasting of weather was not so reliable. The fishermen were also not careful to weather report announced by radio, television or newspapers etc., due to lower level of education.

Financial difficulties: During the present investigation, more than 82 percent of the fishermen reported that financial difficulties was one of the major problems as they had no access to institutional credit system. Commercial bank could not help them to purchase boat, engine, gear etc., and also to maintain these accessories. Nevertheless, the boat owners and fishermen borrowed money from *Dadonders* (local money lender) and some other commission agents with high interest rate to fulfill the financial requirement.

Piracy: Piracy was identified as another problem for which fishermen lost all of their fish and money during fishing at sea. Sometimes, pirates throw fishermen into the sea. About 88 percent head fishermen and crews reported that there were no active law and enforcing agency to protect them from pirates and to help them in fishing.

Illegal tax collection: Sometimes the illegal tax collectors came to fishing boat during the fishing period and forced the fishermen to pay extra money. It was a regular phenomenon which directly threats the marine fishing and fishermen.

Disorder of engine: Most of the engines that used in mechanized boat were reconditioned. More than 80 percent head *mazhi* and driver reported that lack of original tools and equipments of engine and good set of engine in the markets created problems during the fishing. Moreover, there was no warranty period for the engines even for tools and equipments.

Lack of insurance facilities: Fishermen of the coastal region stated that there were no insurance facilities for them. Fishermen faced uncertain situation amid bad weather condition and their lives and assets were in danger in time of fishing period at sea. During the present investigation, about 82 percent fishermen claimed this problem.

Lack of facilities in landing station: Fish landing stations in Bangladesh are small and scattered and as a rule, were very poorly equipped. Moreover, absence of organized buyers affected the prices of fish. These problems affected the marine fishing not only in short period but also in long period in marketing channel of small marine fishing.

Lack of life jacket: Life jackets were not provided to fishermen in time of fishing. In time of rough sea, fishing becomes difficult. Hence, the fishermen had to curtail the trip because they had no life jacket to rescue themselves. During the study 70 percent fishermen claimed this problem.

VI. CONCLUSIONS

The estimated production function of setbag net fishing reveals that the coefficients of capacity of boat, ice and salt cost, mouth of net, experience of fishermen, and number of crew are positive and significant in the function which declared a positive signal for scope of increasing revenue by more using those inputs, with the only exception of the variable named food cost which is negative but significant. In case of longline, the regression coefficients are negative for the variable of fuel and lubricant cost, crew cost, number of hooks but they are significant. So the farmers of longline fishing can take very careful plan for further use of these inputs in future which will increase their return for marine fishing.

Cyclone and bad weather is the main of other problems and the highest number of fishermen expect a solution form government authority. Some basic and crucial problems in marine fishing are reported by fishermen and fishing concerned people need to solve shortly to enhance and strengthen this fishing sector in Bangladesh. Income sharing arrangement is interesting and peculiar as *50* percent of share is captured by boat owners though the crews did not claim it as problem. It is also evident from the study that the sharing arrangement between the boat owner and fishermen was not rational. Income sharing system is inequitable and exploitative for the labour fishermen. It is more claimable in case of income sharing of longline marine fishing since boat owners capture 60 percent share of total revenue.

Keeping in mind the income sharing and economic efficiency of marine fishing, the following recommendations may be made:

(i) Sharing of catches revenue between fishermen and boat owner should be rational and equitable as share of boat owner would be reduced.

(ii) The regulations on fishing may be needed for the conservation of fish stock in the sea. These regulations are effective not only to restore of fish stock but also to maintain the level of fish prices.

(iii) Production technologies (gears) of fishing may be controlled and the catch per boat and number of boat should be fixed to maintain the size of fisheries stock.

(iv) Life insurance policy should be introduced in marine fishing.

(iv) Law enforcing agencies can stop the piracy of fishes and nets and also can make the fishing sector more productive and efficient by confirming the maximum security of fishermen during fishing at the sea.

Finally, today's marine fishing faces serious problems and is trying to achieve the kind of sustainability that will assure its own long range survival. If open access of fishing is curtailed and better control by the government can be assured then the sustainable solution to marine fishing can be reached.

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