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PRODUCTIVITY, PROFITABILITY AND FINANCIAL FEASIBILITY IN CAPTURE FISHERY - A STUDY IN ORISSA COAST

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Half of the world marine catch used for direct human consumption is produced by ten million small scale[1] or artisanal fishermen, even though their economic position remained unchanged (Thomson, 1980). It has been estimated that the small scale fishery uses one-fifth as much capital and one-fourth to one-fifth as much fuel per tonne of fish landed and creates hundred times more employment per rupee invested as compared to large scale fishermen[2] (Thomson, 1980). Yet in many developing countries, artisanal fishermen live close to or below the subsistence level or at any rate they are among the lowest socio-economic groups in the country (Smith, 1979; Panayotou, 1980).

Despite decades of fishery development programme, the small scale fishermen around the developing world are still living in absolute and relative poverty.[3] A large volume of literature on marine and inland fisheries is available in India, studying, among other things, the managerial aspects of fish marketing (Gupta *et al.*, 1979; Srivastava *et al.*, 1979, 1985 *a*, *b*; Srivastava and Reddy, 1983; Srivastava and Vathsala, 1984). There is, however, a need to examine whether there is any impact of the mechanisation programme on the incomes of various groups of fishermen because one of the commonly accepted notions about mechanisation is that it would impart an element of stability into the returns in any process of production and hence influence the yield rates favourably. The present study deals with the above aspects both for the non-mechanisd and mechanised fishing units[4] in Orissa coast.

METHODOLOGY

The Central Marine Fisheries Research Institute (CMFRI) conducted a socio-economic survey throughout the coastal area of Orissa during 1985-87. Of the 13 districts in the State, four are characterised as coastal. They are Balasore, Cuttack, Puri and Ganjam, covering a coastline of 480 km. in length, constituting 8 per cent of the coastline in India. Balasore and Cuttack are in North Orissa whereas Puri and Ganjam are in South Orissa. According to the census conducted by the Department of Fisheries, Government of Orissa and the Bay of Bengal Programme in 1982-83, there are 30,050 artisanal marine fishermen in Orissa. At present, there are about 673 mechanised crafts and 7,156 non-mechanised crafts in the State. About 56 per cent of the non-mechanised crafts are katamarans.

There is diversification of craft-gear use pattern between South (Ganjam and Puri districts) and North (Balasore and Cuttack districts) Orissa because of professional skills, cultural ethnic background of the fishermen as well as availability of species. Mechanisation in craft-gear is faster in the northern coastal part as compared to the southern, mainly because of harbour and other infrastructural facilities. Mechanised units mainly consist of motorised boats and trawlers. The maximum number of trawlers was observed at Paradeep in Cuttack district. In 1983, there were 395 trawlers in the State of which 203 were in Cuttack district

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(Government of Orissa, 1983). An increase in the number of motorised boats was also observed with a major concentration in Balasore district. In 1980, the number of motorised boats was 102 which increased to 278 in 1983 (CMFRI, 1981).

The availability of quality fishes like prawn, hilsa and pomfrets is an incentive for rapid mechanisation in Balasore district. In the non-mechanised sector, plank built canoes which are locally called *nava* and *tappa* and displacement craft such as *salti*, *dingy* and *palia* are the major crafts in Cuttack and Balasore districts. In the southern districts (Ganjam and Puri) log crafts which are locally called big and small katamaran, are the main crafts in use.

Most of the motorised and non-motorised boats operate gillnets. At Ganjam and Puri districts the fishermen use different mesh size gillnets according to the availability of species. The criteria used for selecting the centres are as follows: *(i)* number of units operated, *(ii)* number of fishing days, *(iii)* category of fishing units operated and *(iv)* method of fishing. Accordingly, Bahabalpur, Talsari and Balaramguri from Balasore, Paradeep and Badapadia from Cuttack, Pentakota and Puri from Puri and Gopalpur and Bandar from Ganjam districts were selected. From the selected centres, 20 sample units each were taken randomly for mechanised and non-mechanised units. A total of 232 samples were used in this analysis. The owners of the boats as well as the crew were personally interviewed and information was collected about sources of finance, year of purchase of craft-gear, cost of craft-gear, arrangements between the owner and the crew, etc. In addition to survey data, relevant information was also collected from secondary sources. The data were derived from the survey to determine the cost and returns of different craft-gear combinations.

Different criteria were used to work out the financial feasibility of investment of different types of craft-gear combinations. These are net present value (NPV), internal rate of return (IRR) and pay-back period. The feasibility analysis is based upon the following assumptions:

(i) The market rate of interest is equal to 12 per cent per annum.
(ii) The life expectancy of a craft is 10 years and for gear it is 5 years.
(iii) Costs and returns are assumed to remain at the level obtaining in the initial year.
(iv) The effect of future price inflation is not taken into account.

The NPV, IRR and pay-back period are worked out through the UNIDO (1978) method. The conventional method to discount the present net cash flow and express the result as net present value has been used. The internal rate of return (IRR) has to be found by interpolation between two discount rates for which NPV is positive for one and negative for another. In other words,

$$\text{IRR} = \text{Lower discount rate} + \text{Difference between the discount rates} \times \frac{\text{Net present value at the lower discount rate}}{\text{Sum of the net present value at the two discount rates}}$$

The pay-back period is the time required to recover the investment costs out of its cash flow.

Net benefit-investment (N-K) ratio (Gittinger, 1982) has also been worked out.

$$\sum_{t=1}^{n} \frac{N_t}{(1+i)^t} \Big/ \sum_{t=1}^{n} \frac{K_t}{(1+i)^t}$$

where, N_t = incremental net cash flow in each year after the stream has turned positive,

K_t = incremental net cash flow in the initial year when the stream is negative,

n = life of craft-gear, and
i = interest (discount) rate.

COST AND RETURNS OF DIFFERENT CRAFT-GEAR COMBINATIONS

In this analysis gross return is defined as the money received from the total catch during the survey year (1985-87). As expected, annual gross returns from the trawlers were considerably higher than the returns from other types of fishing units (Table I).

TABLE I. ANNUAL GROSS INCOME OF DIFFERENT CRAFT-GEAR COMBINATIONS IN THE SELECTED CENTRES OF ORISSA, 1985-87

District	Centres	Craft-gear combinations	Annual catch (kg.)	Annual income (Rs.)	Average price (Rs. per kg.)
Balasore	Bahabalpur	Mech boat with gillnets	16,291	68,158	4.18
		Non-mech boat with gillnets	6,860	24,956	3.64
	Talsari	Mech boat with gillnets	16,612	59,963	3.61
		Non-mech boat with gillnets	5,184	15,807	3.05
	Balaramguri	Trawler	40,282	1,80,401	4.48
Cuttack	Paradeep	Trawler	31,311	1,73,306	5.53
	Badapadia	Non-mech boat (*Tappa*) with gillnets	8,748	31,751	3.63
		Non-mech boat (*Nava*) with gillnets	5,821	13,958	2.40
Puri	Pentakota	Non-mech boat (big katamaran) with gillnets	4,599	20,718	4.50
	Puri	Non-mech boat (small katamaran) with gillnets	1,793	4,731	2.64
Ganjam	Gopalpur	Non-mech boat (big katamaran) with gillnets	4,685	14,445	3.08
	Bandar	Non-mech boat (smal katamaran) with gillnets	2,432	4,937	2.03

The estimated gross returns per unit from the Balaramguri based trawlers were 4 per cent higher than those from Paradeep based trawlers. This may be attributed to the fact that the fishing ground is more lucrative in the former than in the latter. Trawling intensity is, however, greater at Paradeep due to jetty and harbour facilities.

The annual gross returns of gillnet with motorised boat were 14 per cent higher at Bahabalpur than those in Talsari, even though the annual catch at Talsari was comparatively higher than in Bahabalpur. This may indicate that the fishermen at Bahabalpur could fetch a higher value of their catch. Looking at Table I more critically, it is observed that within the mechanised sector, the annual total catch of the trawler was lower than that of the motorised boat but the gross returns from the former were higher mainly because of its prawn catch.

In the case of non-mechanised sector, the *Tappa* unit at Badapadia showed maximum returns (Rs.31,751). The variation in the annual gross returns within the katamaran units ranged from Rs.20,718 to Rs.4,731. The big katamaran unit at Pentakota earns an annual income which is higher by 43 per cent as compared to that of Gopalpur. However, the variation in annual catch was not so significant within these two areas. This shows that the fishermen of Pentakota received a higher price for their product because of the availability of quality fishes. It is interesting to note that the fishermen at Paradeep could get a relatively higher price (Rs.5.53/kg.) for their catch than in other areas. This may be due to better

TABLE II. ANNUAL OPERATING COST OF DIFFERENT CRAFT-GEAR COMBINATIONS IN THE SELECTED CENTRES IN ORISSA, 1986-87

(Rs.)

District	Centres	Craft-gear combinations	Fuel	Reparing of craft and gear	Food	Ice	Landing/ harbour charges	Auction charges	Others (cigarettes, drinks, etc.)	Grand total
Balasore	Bahabalpur	Mech boat with gillnets	14,351 (55)	1,826 (7)	2,609 (10)	2,087 (8)	1,826 (7)	1,305 (5)	2,087 (8)	26,092 (100)
		Non-mech boat with gillnets	-	2,920 (45)	649 (10)	-	324 (5)	549 (10)	1,946 (30)	6,488 (100)
	Talsari	Mech boat with gillnets	12,498	1,736	2,314	1,851	1,620	1,157	1,967	23,144
		Non-mech boat with gillnets	-	1,871 (43)	392 (9)	-	218 (5)	435 (10)	1,436 (33)	4,351 (100)
	Balaramguri	Trawler	61,406 (70)	7,895 (9)	8,772 (10)	6,141 (7)	877 (1)	-	2,632 (3)	87,723 (100)
Cuttack	Paradeep	Trawler	54,896 (72)	5,337 (7)	6,862 (9)	6,100 (8)	762 (1)	-	2,287 (3)	76,245 (100)
	Badapadia	Non-mech boat (*Tappa*) with gillnets		2,570 (48)	1,660 (31)		268 (5)	535 (10)	321 (6)	5,355 (100)
		Non-mech boat (*Nava*) with gillnets		1,974 (49)	1,209 (30)		242 (5)	403 (10)	201 (5)	4,030 (100)
Puri	Pentakota	Non-mech boat (big katamaran) with gillnets		542 (50)	325 (30)		76 (7)	108 (10)	32 (3)	1,084 (100)
	Puri	Non-mech boat (small katamaran) with gillnets		261 (47)	111 (20)		28 (5)	56 (10)	100 (18)	556 (100)
Ganjam	Gopalpur	Non-mech boat (big katamaran) with gillnets		548 (44)	249 (20)		87 (7)	124 (10)	237 (19)	1,245 (100)
	Bandar	Non-mech boat (small katamaran) with gillnets		264 (53)	124 (25)		25 (5)	50 (10)	35 (7)	498 (100)

Figures in parentheses are percentages to total operating cost.

infrastructural as well as marketing facilities. The variations in average price per kg. are given in Table I. The fishermen at Pentakota realised a higher value (Rs.4.50/kg.) for their product as compared to other areas.

Production costs are categorised as fixed cost and operational cost. The fixed costs include cost items that do not vary with fishing days, like investment costs on craft and gear. The operational costs include cost of fuel (for mechanised unit), repairing charges for craft and gear, food for the crew members, cost of ice (if any), land/harbour charges, auction fees, etc. Wages/shares were not included in the operational cost, because of various modes of labour engagement in different units in different areas. Generally, the crew receives a share from net income.

The annual operating cost per unit for a trawler at Balaramguri was Rs.87,723 whereas at Paradeep it was Rs.76,245 (Table II). Variations in the annual operating cost may occur due to variations in the number of fishing days and fishing hours within those areas. In the case of gillnets, the annual operating cost for a motorised unit was Rs.26,092 at Bahabalpur and Rs.23,144 at Talsari.

In the non-mechanised sector, the operating cost was the lowest for small katamarans of Gopalpur (Rs.498) followed by at Puri (Rs.556). Repairing charges for craft-gear are the major expense component in the operating cost. Repair charges varied from 43 to 53 per cent in the case of the non-mechanised sector whereas in the mechanised sector it was 7 to 9 per cent. Fuel accounted for the major expense incurred in the mechanised units. It varied from 60 to 71 per cent in the total operating costs.

FACTORS AFFECTING PROFITABILITY

An attempt has been made to identify the factors that might be associated with the profitability of fishing units. The number of fishing days is chosen because it is an indicator of fishing efforts. Investment on craft and gear is also chosen because there is a well known belief that profit is directly associated with the level of investment. Fishing experience is chosen as a determinant or profit. The length of the craft could influence profit because it costs more to run a large craft than a small one. Lastly, age of the craft is taken into consideration because most people would consider that, *ceteris paribus*, aged crafts are less productive than the new craft. It is also hypothesised that profits and gross returns are highly correlated. Correlation analysis was used and the results are presented in Table III.

TABLE III. CORRELATION COEFFICIENTS OF PROFITS AND FISHING FACTORS IN ORISSA BY DIFFERENT CRAFT-GEAR COMBINATIONS (1985-87)

Landing centres	Craft-gear combinations	No. of fishing days	Investment	Fishing experience	Length of the craft	Age of the craft
Bahabalpur	Mech boat with gillnets	.77	.36*	.96*	-.28*	-.23*
	Non-mech boat with gillnets	.82	.18*	.91*	.30*	-.07
Talsari	Mech boat with gillnets	.91*	.01	.91*	-.02*	.09
	Non-mech boat with gillnets	.90*	-.02*	.75*	.04*	-.48*
Balaramgun	Trawler	.98*	.76*	.79*	.85*	-.95*
Paradeep	Trawler	.95*	.56*	.83*	.56*	-.83*
Badapadia	*Tappa* with gillnets	.99*	.22*	.79*	.13	.18
	Nava with gillnets	.99*	.34*	.87*	.06*	.05
Pentakota	Big katamaran with gillnets	.20*	.21*	.41*	.04*	.07
Puri	Small katamaran with gillnets	.24*	-.15*	.40*	.17*	-.35*
Gopalpur	Big katamaran with gillnets	.62*	-.11	.53*	-.03	-.03
Bandar	Small katamaran with gillnets	.81*	.22*	.96*	-.08	.03

* Significant at 1 per cent probability level.

The correlation between profit and the age of the craft in most of the cases was negative and statistically significant. This indicated that the older the craft, the lesser would be the profit that may be realised from it. Variables with positive and statistically significant coefficients observed for capture fishery are fishing days and experience. These variables have had a positive impact on profit. It indicates that if a more experienced crew is engaged in fishing, then that unit can expect to realise more returns. It suggests that there is scope to increase gross returns by increasing the number of fishing days.

Negative and significant coefficients of investment were observed in a few areas. This indicated that capital investment on craft and gear in those areas did not bring profits to the unit owner. But in most of the areas, the coefficient of investment was positive and significant.

PRODUCTIVITY OF RESOURCES

Labour and capital are the most important inputs in any production process. The labour requirements of different craft-gear combinations are generally fixed in nature. The capital-labour requirements for different craft-gear combinations are given in Table IV. With the given level of these resources, the fishermen can maximise their income by varying the fishing days, experience in fishing, etc.

TABLE IV. CAPITAL AND LABOUR REQUIREMENTS ON DIFFERENT CRAFT-GEAR COMBINATIONS IN THE COASTAL DISTRICT OF ORISSA (1985-87)

Sr. No.	Type of craft	Type of gear	Investment on (Rs.'000/unit)			Number of crew required (per unit)
			Craft	Gear	Total	
1.	Trawler (32 ft. length; 65 H.P.)	Trawlnets	150	5	155	5
2.	Motorised boat (32 ft. length; 60 H.P.)	Gillnets	60	20	80	10
3.	Non-motorised boat (30′ × 7′ × 6′)	Gillnets	10	13	23	5
4.	Tappa (8.3 m × 1.5 m × 0.5 m)	Gillnets	7	5	12	5
5.	Nava (3.5 m)	Gillnets	4	3.5	7.5	4
6.	Big katamaran (8.3 m × 1.6 m)	Gillnets	8.2	4	12.2	4
7.	Small katamaran (4.5 m × 1 m)	Gillnets	4.5	2.5	7	2

In Table V, the marginal productivity of different inputs is given. The marginal productivity of a resource is simply the addition to gross returns associated with the addition of the unit of a given resource. The marginal productivity of fishing days was Rs.3.27 for a trawler unit at Balaramguri and Rs.2.03 at Paradeep. In other words, with an increase in the fishing activity by one more day beyond the mean level, per unit sample trawler would be able to add Rs.3.27 and Rs.2.03 to gross returns in the respective areas.

The marginal productivity of fishing days for the non-mechanised units was maximum at Talsari (Rs.12.67). In other areas like Badapadia, it was Rs.2.35 and Rs.1.87. The marginal productivity of the mechanised unit at Talsari was Rs.1.64, the same as for a non-mechanised katamaran unit at Gopalpur. It indicates that both the types of units are able to add the same amount to gross returns by increasing the fishing activity by one more day. The marginal productivity of fishing days was Re.0.01 for the mechanised unit at Bahabalpur and Re.0.02 for the small katamaran at Bandar, which suggests that those units should not increase their fishing days.

TABLE V. PRODUCTIVITY OF RESOURCES FOR DIFFERENT CRAFT-GEAR COMBINATIONS IN ORISSA (1985-87)

Centres	Craft-gear combinations	Average product at resource means (Rs.)			Marginal productivity at resource means (Rs.)		
		Fishing days (X_1)	Investment capital (X_2)	Fishing experience (X_3)	Fishing days (X_1)	Investment capital (X_2)	Fishing experience (X_3)
Bahabalpur	Mech boat with gillnets	2.90	0.99	5.90	0.01	0.41	5.06
Talsari	Mech boat with gillnets	2.61	0.99	5.50	1.64	0.05	1.84
Balaramguri	Trawler	2.65	1.06	5.58	3.27	-0.05	0.63
Paradeep	Trawler	2.74	1.00	5.59	2.03	-0.17	0.32
Bahabalpur	Non-mech boat with gill-nets	2.49	1.06	4.02	0.87	-0.009	8.68
Talsari	Non-mech boat with gill-nets	2.25	0.99	3.94	12.67	-1.30	9.57
Badapadia	Non-mech boat (*Tappa*) with gillnets	2.52	1.17	4.27	1.87	-0.06	1.65
	Non-mech boat (*Nava*) with gillnets	2.40	1.20	5.51	2.34	0.18	1.04
Pentakote	Non-mech boat (big kata-maran) with gillnets	2.16	1.03	3.66	0.36	0.06	0.35
Gopalpur	Non-mech boat (big kata-maran) with gillnets	2.14	1.05	4.17	1.64	-0.04	1.21
Puri	Non-mech boat (small katamaran) with gillnets	1.95	0.96	3.43	0.31	0.06	0.02
Bandar	Non-mech boat (small katamaran) with gillnets	1.88	0.96	5.61	0.02	-0.06	5.44

Fishing experience also has a significant role in the value added process. In most of the cases, it was more than one, indicating increasing returns to sale. Fishing experience can enhance the earnings particularly for non-mechanised units at Talsari (Rs.9.57) and Bahabalpur (Rs.8.68).

Thus fishing experience and fishing days could be increased to yield greater gross returns to fisheries. However, this may not always exist because of higher degree of uncertainty in capture fishery. The average productivity of resources is measured by gross returns/resources used. The average productivity of all resources was less for small katamaran at Puri than in others.

FINANCIAL FEASIBILITY

Net benefit-investment (N-K) ratios for all types of units exceeded and have positive NPVs (Table VI), indicating the financial feasibility of the investment for all types of units. The IRR in all types of units was impressive and ranged from 12.97 to 18.50 per cent. It is interesting to note that even though the initial investment of the non-mechanised units was less than that of the mechanised units, it generated maximum returns.

TABLE VI. ECONOMIC INDICATORS OF DIFFERENT TYPES OF FISHING UNITS IN ORISSA COAST (1985-87)

Centres	Craft-gear combinations	NPV (Rs. 000/unit)	IRR	N - K ratio	Pay-back period
Bahabalpur	Mech boat with gillnets	179	14.41	4.54	2
Talsari	Mech boat with gillnets	147	18.50	3.99	2
Balaramguri	Trawler	461	14.76	6.20	1
Paradeep	Trawler	476	14.51	5.96	1
Bahabalpur	Non-mech boat with gillnets	83	14.36	5.78	1
Talsari	Non-mech boat with gillnets	41	13.14	3.66	2
Badapadia	*Tappa* with gillnets	112	15.68	10.41	1
	Nava with gillnets	39	16.61	9.91	1
Pentakota	Big katamaran with gillnets	99	16.33	5.45	1
Gopalpur	Big katamaran with gillnets	63	13.68	6.31	1
Puri	Small katamaran with gillnets	17	16.33	3.60	2
Bandar	Small katamaran with gillnets	18	12.97	3.76	1

The pay-back period shows that most of the non-mechanised units are able to repay their initial investment amount within a year. The net benefit-investment ratio which maximises the return per unit of available investment was maximum in the case of *Tappa* and *Nova* units, being Rs.10.41 and Rs.9.91 respectively. This suggests that the net returns from each rupee invested in the non-mechanised unit at Badapadia were higher as compared to the other units, even though these fishing units do not compete with each other and the composition of their catch is different. It is suggested that appropriate credit policy and development plans should be formulated for capture fishery.

CONCLUSIONS

The net income before sharing was the highest for the trawler unit at Paradeep (Rs.97,061) as compared to Balaramguri (Rs.92,678). The average net returns of the mechanised gillnet units were higher at Bahabalpur (Rs.42,066) compared to Talsari (Rs.36,819). In contrast to these units, the non-mechanised units realised low net returns. But in relation to the investment of capital as well as operating cost, the net returns of the non-mechanised units were higher than that of the mechanised units.

The correlation analysis was employed to determine the correlation between profitability and socio-economic factors. The gross return was considered as an indicator of profit, because it is the most important factor to determine the profit level.

Even though fishing days and fishing experience are the most important factors determining the gross returns, there is no guarantee of realising higher returns due to the uncertainty in capture fishery. The field survey showed that the same effort of different fishermen did not yield a uniform catch. Better efforts sometimes result in low returns and vice versa. Bad luck in fishing is a common idiomatic expression used by fishermen when, despite their efforts, good weather and adequate gear, they catch less than other fishermen who exert the same amount of effort with similar gear.

Education and training for fishermen are necessary because fishing is an hazardous occupation which encourages extreme individualism and requires special skill.

From a social point of view, if the objective is to create more employment with less investment, then the non-mechanised units are most suitable as a policy prescription. Similarly, to augment fishery production, mechanisation in capture fishery is required. If the government takes the necessary steps to enforce rules for different fishing grounds for different craft-gear combinations, then both the objectives, *i.e.*, more employment and more

production will be fulfilled. In that case, one will complement the other and will maintain socio-economic balance in the remote coastal areas instead of creating socio-economic conflict among the fishermen.

NOTES

1. There is no standard categorisation between small and large scale fisheries. Here we are using the definition which was given by Smith (1979). The small scale fishermen has a limited fishing range and a host of related socio-economic characteristics, are forced to restrict their activities within a narrow strip of land and sea around their community, faced with a limited set of options, if any, and intrinsically dependent on local resources.

2. The large scale fishermen have a broad spectrum of options both in terms of fishing ground and non-fishing investment opportunities.

3. The relative poverty of small scale fishermen has been defined and measured in relation to incomes and amenities of similar socio-economic groups, *e.g.*, farmers, other rural workers (Panayotou and Jetanavich, forthcoming).

4. A craft, mechanised or non-mechanised, along with gear pieces and its crew member form a unit.

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