PURSE-SEINE FISHING IN GOA: A COST BENEFIT ANALYSIS

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Abstract: This study explores the economic performance of the mechanized fishing vessels (purse-seiners) as these contribute to the fishing industry of Goa. The costs and profit analysis of mechanized fishing vessels (purse-seines) help the fishers to understand whether they can attain profits despite high operating costs. The primary data was collected from 73 respondents owning purse-seine through pre-tested interview schedule using random sampling method on three jetties in Goa from August 2016-17. The present study was carried out to analyze the inputs of factors of production used which will give maximum output. The Cobb Douglas production function approach was used to find out the most influential variables influencing the earnings from fish catch. The production function analysis using Cobb-Douglas model indicated that there was ample scope for the respondents to enhance the net profit from purse-seine business at all jetties in Goa by increasing the number of fishing hours, increasing the input variables such as enhancing fuel utilization and increasing number of skilled labourers. The findings of the study suggest that the medium and large sized vessels in Goa are economically and financially viable and generate reasonable revenue to cover fixed and variable costs. Purse-seine fishing business has improved the socio-economic status of the fishermen in Goa. The purse-seine fishing activity is capable of creating additional employment, through Government support, through Fisheries department in augmenting income and improving the standard of living of the purse-seine owners in Goa.

Index Terms : Purse-seiners, Fishing business, Mechanized fishing vessels in Goa

I. INTRODUCTION

Purse-seine, an important bulk catching method was first evolved in the Atlantic Coast during the last quarter of the 19th century and in India it was initiated by the Indo-Norwegian Project in 1954 and the operations on commercial lines were taken up from 1976 onwards (Hameed & Mukundan, 1991). Purse-seining was started in Goa on an experimental basis in 1957 when the union territory of Goa was under the Portuguese rule (Desai, Sharangdhar, & Mohite, 2016). However, it was successfully commercialized in Goa in 1964, with only two purse-seiners under operation. Purse-seining is a method to capture large shoals of demersal fish such as prawns and pelagic fish close to the surface such as sardines, mackerals, tuna, anchovies, herring, salmon by encircling them with a large purse-seine net (Kamble, Chaudhari, Shirdhankar, & Markad, 2013). The purse-seine vessels are equipped with purse-seine nets as well as dingy boats and hence they are called as purse-seiners. During 1991-1992, there were 225 purse-seiners in Goa and the total marine fish landings of Goa was estimated at about 96,000 tonnes, of which the purse-seine contribution was about 75% of the marine fish landings (Panikkar, Sehara, & Kanakkan, 1994). The mechanized sector in Goa contributes to 76% of the marine production. In 2016-17 there were 301 purse-seine vessels operating on Goa's coast. In Goa, Purse-seining is carried out on three jetties viz. Cutbona, Malim and Mormugao (Vasco). Purse-seining is carried in Goa throughout the fishing season, from August to May. However, 1st June to 31st July is observed as fishing ban of 61 days, as per Government rules in Goa. The activities are intense during August to November when oil sardines and Indian mackerels are available in large shoals.

Objectives: The specific objectives of the study are:

1. To estimate the costs and profitability among medium and large size purse-seine vessels from purse-seine fishing activities in Goa.
2. To study the impact of input of factors of production on the earnings from fish catch.

The costs and profit analysis of mechanized fishing vessels (purse-seines) help the fishers to understand whether they can attain profits despite high operating costs. Another research question involved was that whether there is a variation in costs and profits among different levels (means different size vessels, medium and large) of mechanized vessels in Goa. The variations in profits of purse-seine vessels is due to differences in the input combinations and earnings was the third query involved in this study. There is a need to investigate whether the purse-seine vessels are economically feasible for the fishers in Goa. It is against this background; this study explores the economic performance of the mechanized fishing vessels (purse-seiners) as these contribute to the fishing industry of Goa.

2. REVIEW OF LITERATURE

There were several studies conducted in India and abroad on the economic as well as commercial aspects of fishing activity using purse-seine fishing.

Nguyen and Nguyen (2010) studied factors affecting revenue of trawling and light purse-seining vessels in Ben Tre province, in Vietnam by using a multivariate regression model. Factors such as size of the vessel, capacity of the engine, captain's experience, fishing gears, and life of the vessel have considerable effects on revenue of single-boat trawlers and lighted purse-seiners. The results showed that single boat trawlers achieved the highest, return on investment (ROI) followed by pair trawlers and light purse-seiners, respectively. Dhulkhed and Bhat (1985) evaluated purse-seine fishery, at Mangalore, Malpe, and Gangolli, for a period from 1976-77 through 1980-81, by studying 300 samples of boats. As per their study it shows that oil sardine fish count in the sea has declined heavily due to the severe harsh fishing technique using the purse-seine fishing gears. Pattanayak (1988) examined the mechanized fishing, in the coastal state of Karnataka and finds that after the introduction of 398 purse-seine fishing fleet vessels in the state in the mid seventies, the total marine fish production during 1987-88 to the end of March 1988 was 1,29,659 tonnes valued at Rs.48.05 crores had reached initially a peak and then remained static. A study by Kumar and Panikkar (2000), in Karnataka in 1978 to assess the socio-economic impact of mechanization on traditional fishermen operating rampon gear reveals that the introduction of commercial purse-seiners had affected the income of traditional fishermen using rampon fishing gear. Another study on socio-economic characteristics of fishermen by Kumar and Panikkar (2000), in 1981 covering 41 landing centers between Quilon and Manjeshwar in Kerala state to study the impact of purse-seine operations on the indigenous fisheries, indicated that heavy landings by purse-seiners at Cochin and Mangalore showed that introduction of purse-seiners had also reduced the catch of country crafts. A study by Panikkar, Sehara, and Kanakkan (1994) in Goa on purse-seining in 1991-92, shows that the average profit per unit by the purse-seiners during 1992 worked out at Rs. 1.19 lakhs and the rate of return was 34%. However, a study by Gaonkar, Rodrigues, and Patil (2008) on the economic analysis of purse-seine boats in Goa in 2004 by using variables such as fixed costs, variable costs, gross revenue and gross profit of purse-seine boats finds that the purse-seine boats were running in profits in Goa in 2004.

Analysis of the above literature shows that studies have been conducted on the economic analysis on mechanized purse-seine fishing in the world. However, the researcher could not find reports of research conducted on the costs and returns on mechanized fishing vessels (purse-seiners) in Goa since 2004. The present study is an attempt to fill this research gap. The study is performed with two hypothesis mentioned as follows:

a. *There is no significant difference between costs, catch and profits of purse-seine vessels across size of vessels in Goa".*

b. *"The input of factors of production has no impact on the earnings from output of fish catch."*

3. RESEARCH METHODOLOGY

The methodology section outlines the plan and method and shows how the study is conducted. This includes universe of the study, sample of the study, data and sources of data, variables used in the study and analytical framework. The details are as follows;

3.1 Population and Sample

In Goa there are 301 operational purse-seine vessels which are operating on three jetties in Goa namely Malim, Mormugao and Cutbona jetty, which are treated as universe of the study and the researcher has used the selected sample from these universe using the Salant and Dillman (2007) formula. The sample consists of the 73 purse-seine owners chosen from the universe having medium and large purse-seine vessels which use purse-seine fishing methods operating from the three jetties in North and South Goa. The sample size is given in Table 1.

Table 1. Sample Size for Mechanized Purse-seine owners

Jetties and Taluka	Operational purse-seiners	Number of operational purse-seine vessels surveyed(sample)	Percentage of operational purse-seine vessels surveyed
NORTH GOA			
Bardez (Malim Jetty)	75	17	22.66
Total North Goa	75	17	22.66
SOUTH GOA			
Mormugao (Vasco Jetty)	61	17	27.86
Salcete (Cutbona Jetty)	165	39	23.63
Total South Goa	226	56	24.77
Total	**301**	**73**	**24.25**

Note: Salant and Dillman 2007 formula used to calculate sample size, **Source:** Researchers compilation from the data of Department of Fisheries, Goa

Among various statistical methods, the researcher used Priscilla Salant and Don A. Dillman method to determine the sample size for the study. Dilman(2007) provides the following formula for estimating desired sample sizes.

$$N_s = \frac{(N_p)(p)(1-p)}{(N_p - 1)(B/C)^2 + (p)(1-p)}$$

Where: N_s = completed sample size needed (notation often used is n)

N_p = size of population (notation often used is N)

p= proportion expected to answer a certain way (50% or 0.5 is most conservative)

B= acceptable level of sampling error (0.05= ± 5%; 0.03= ± 3%)

C= Z statistic associate with confidence interval (1.645= 90% confidence level; 1.960= 95% confidence level; 2.576= 99% confidence level)

3.2 Data and Sources of Data

The study uses primary cross-sectional data and comprised of mechanized fishing vessels (purse-seine) owners doing purse-seine fishing business in Goa. The entire data was collected using a structured interview schedule administered to 73 purse-seine vessel owners in Goa. The interview was conducted during the period from August 2016 to May 2017 by using random sampling method. The data was collected from the mechanized fishing vessel (purse-seine) owners from the talukas namely Tiswadi and Bardez, who operate their purse-seine fishing vessels from Malim jetty in North Goa. In South Goa, the two jetties from where the purse-seiners operate are (Vasco/Khariwada) in Mormugao taluka and Cutbona jetty in Salcete taluka.

In Goa, as per the purse-seine owner's views, they benchmark the vessels as shown in Table 2. The following classification given in Table 2 regarding fishing operations of purse-seine vessels in Goa are used for the present study. The researcher also classified the mechanized vessels (purse-seiners) into medium and large vessels after consulting the technicians and respondents to

Table 2. Classification of Mechanized Fishing Vessels (Purse-seiners)

Size of mechanized fishing vessels (Purse-	Size in feet	Overall Length in meters	No of Cylinders	Horsepower of engine	Number of vessels surveyed	Number of fishing days

seiners)						
Medium	46-60ft	14.76-18.46	6	98-210	46	1-5days
Large	61-75ft	18.76- 23	6 and 8	210-400	27	8-15days

Source: Researchers compilation from the Primary survey

make the data collection process easy. In the mechanized fishing sector, fishing is performed through inboard engine. As per Table 2, the size of vessel namely overall length (OAL) varied between 14.76 to 18.46 m, with 6 cylinders and using 98-210 inboard motor engines varying from 98-210 horsepower are classified under medium size vessels. Similarly, the large vessels OAL varies between 18.76- 23m using 6-8 cylinders, and horsepower engine varying from 210 to 400 horsepower.

3.3 Theoretical framework

The variables of the study contains dependent and independent variable. The economic performance was measured by net cash flow which is equivalent to net profit Tietze (2005). The dependent variable is cost, catch, gross revenue, gross and net profit per trip and independent variables is size of vessel. The Cobb-Douglas production function, was used by (Asamoah, Ewusie Nunoo, Osei-Asare, Addo, & Sumaila, 2012) to relate production output to several independent input variables, to determine the inputs that affect productivity. In the present study Linear and Cobb-Douglas (log-log) production functions were estimated using the Ordinary least square method. The independent variables chosen for the multiple regression model namely experience of the purse-seine owners, horse power of vessel, cost of fishing gear, total wages paid to labour, fishing hours, fishing trips, fuel cost and the dependent variable is earnings from fish catch.

3.4 Statistical tools and econometric models

This section elaborates the proper statistical/econometric models which are being used to forward the study from data towards inferences. The detail of methodology is given as follows.

3.4.1 Descriptive Statistics

Descriptive Statistics has been used to find the mean and normality of distribution of the data of all the variables of the study. Shapiro Wilk test has been used to test the normality of the data. In order to find the impact of input of factors of production on earnings, the dependent and independent variables were transformed into log to satisfy the Shapiro test of normality value of more than 0.05. The parametric Independent sample *t*- test was conducted to find the statistical relationship between size of the vessel towards costs and profit of purse-seine fishing business. Besides this A Cobb Douglas production function model using multiple linear regression model was used to examine the relationship between the input of factors of production and the earnings from the output of fish catch in the study area. Assumptions of linearity and homoscedasticity were verified by scatter plot of standardized residuals over predicted values. There were no outliers identified in the case-wise diagnostics using cooks distance formula. All the standardized residual values were within ± 3 standard deviations. The assumptions of multicollinearity was also observed using VIF values which were less than 5 concluding that the assumptions of multicollinearity is met.

3.4.2 Economic Indicators of Costs and Returns of Purse-seine vessels

The costs incurred for purse-seine vessels are classified into two categories namely operating costs and fixed costs. Operating costs includes the cost of running the vessel such as fuel, wages, cost of ice, mending of nets, repair and maintenance, cost of oil and lubricants marketing and transportation costs and other miscellaneous expenses. Fixed costs includes the cost of depreciation on the vessel and fishing related equipment, interest on loan, insurance on vessel and crew, net and boat license fee paid by the purse-seine vessel owners respectively. Total cost is the sum of operating and fixed costs. Catch per trip is computed by taking the total average catch (in kgs) divided by the average number of fishing trips. Gross revenue (earnings) per trip is calculated by taking the average earnings divided by the average number of trips. The costs and returns could be measured by different formula, but the present study adopted this method. Gross profit is the difference between Gross revenue (earnings from catch) and variable costs(operating costs) (Panayotou & Jetanavanich, 1987). Gross revenue is calculated from the species composition of the catch and the price of species of fish. The gross revenue (earnings from fish catch) are calculated by multiplying the catch per kg of fish catch with the price per kg. The formula is given in Equation 1, Equation 2 and Equation 3.

$$GR \sum_{i=1}^{n} qi \; x \; pi \; \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(Equation 1)}$$

Where, q^1 is the quantity of catch in kgs of the i^{th} variety, p^1 is the price per kg of fish of the i^{th} variety (Geetha et al., 2014).

Gross profit/margin=Gross Revenue (earnings)-Total variable cost………(Equation 2)

Net profit = Gross Profit – Fixed cost……………………………………. (Equation 3)

The linear production function using the Cobb Douglas model assumes a linear relationship between the dependent and independent variables and is specified in Equation 4 and Equation 5 as follows:

$$\mathbf{Log}Y=\alpha_0+\beta_1\log X_1+\beta_2\log X_2+\beta_3\log X_3+\beta_4\log X_4+\beta_5\log X_5+\beta_6\log X_6+\beta_7\log X_7+u_i \quad \ldots\ldots\text{(Equation 4)}$$

For Equation. 4 to capture the influence on **Log *Y***

Where it is expected that $X_1>= 0$, $X_2>0$, $X_3>0$, $X_4>0$, $X_5>0$, $X_6>= 0$, $X_7> 0$,with respect to log of earnings given in equation……………………………………………………(Equation 5)

where **Log *Y***= Earnings from fish catch from purse-seine vessels from August to May, X_1= Log of experience in fishing(in years), X_2= log of horse power of trawler unit(in unit), X_3= Log of total cost of fishing gear(Rs), X_4 = log of wages of labour for August to May (Rs), X_5 = Log of total fishing hours for August to May, X_6= Log of fishing trips for August to May, X_7 = Log of fuel cost after subsidy for August to May (Rs) and u_1 is the residual error term assumed to have zero mean and constant variance. To maintain uniformity log was taken for all seven explanatory variables and the results of Cobb Douglas model are given in Table 4.

4. RESULTS AND DISCUSSION

The key economic indicators are operating costs, fixed costs, total costs, gross revenue, gross profit and net profit. According to (Gulbrandsen, 2012) in order to reduce fuel costs fishers examine closely the costs and profit of various factors and this influences their decision-making. For example, when deciding whether to go fishing, a fisherman would consider the following factors such as weather situation, distance to the fishing grounds, time of fishing trips, quality of fish, demand and supply of fish to the market. The cost of fuel in trip with bad weather will certainly be more than in good weather. However, this can be offset by a good market price upon landing.

The results of the Statistical Independent sample *t*- test conducted are shown in Table 3.

Table 3: Statistical test results of key Economic Indicators of Costs and Returns of Purse-seiners as per Size of Vessel for Entire Season (August-May)

Variables	Size of vessel category		Independent Samples Test	
	Medium vessel	Large vessel		
	Mean	Mean	*t*	Sig

Total operating costs per trip(Rs)	146195_{a}	191141_{b}	-3.50	0.001**
Total fixed costs per trip(Rs)	17024_{a}	31074_{b}	-4.50	0.00**
Total costs per trip(Rs)	163219_{a}	222215_{b}	-3.89	0.001**
Total catch for entire season per vessel (in kgs)	89300_{a}	108553_{a}	-1.49	0.13
Catch per trip (in kgs)	2147_{a}	2681_{a}	-1.64	0.10
Gross revenue per trip (Rs)	199104_{a}	258993_{b}	-3.04	0.003**
Gross profit per trip(Rs)	52909_{a}	67852_{a}	-1.91	0.05*
Net profit per trip (Rs)	35887_{a}	36778_{a}	-0.12	0.89

Note: ** Variable significant at 5% and * variable significant at 10% significance level, * subscript" a, a" means no significant difference and "a, b" means there is a significant difference. **Source:** Researcher's compilation from the Primary survey.

The Independent sample-t test results given in Table 3 reveals that operating costs, fixed costs, total costs, earnings per trip are statistically significant across size of vessels, at 5% and gross profit per trip at 10% level of significance, rejecting the null hypothesis. The average operating costs to the total costs per trip of medium vessels is 89.57%, and average fixed costs to the total costs per trip is 10.43%. In case of large vessels, the operating cost per trip is 86.01%, and an average fixedcost to the total costs per trip is 13.99%. The costs and earnings increased with multiday operations. The cost of fuel was the major factor contributing to operating costs, ranging between 37 -38% followed by wages of labour ranging between 36-35% for medium and large vessels. This is because after mid December to mid April, fish is not available in close vicinity and hence the purse-seine vessels owners spend more amounts on fuel searching for fish catch. The average number of trips for one fishing season between August to May are 46 for medium and 40 for large vessels. The medium vessels go for fishing on an average between 1-5 days consuming on an average 100-150 litres fuel per day. Large vessels travel a longer distance for multi-day fishing ranging from approximate 10-15 days duration per trip, consuming average fuel from 200-400 litres per day. Purse-seine gear is highly labour intensive with an average of 25 workers on medium vessels and 31 average labourers on large vessels per trip. This findings corresponds with the results of the study by (Aswathy, Shanmugam, & Sathiadhas, 2011) who finds that purse-seine vessels employ 30 workers per trip. In the study it is observed that the purse-seine business of large sized vessels are self-sustainable in the long run, as they get more fish catch compared to medium vessels, they also earn more gross profit per trip compared to the medium vessels.

Factors of production influencing the earnings from fish catch

In this study, Cobb Douglas production function is used and an attempt is made to identify whether the input of factors of production, the independent variables have impact on earnings from fish catch.

For the multiple linear regression model, using Cobb Douglas production function, the null hypothesis is that "*The input of factors of production has no impact on the earnings from output of fish catch.*"

The production function was specified as log of earnings from output of fish catch as the dependent variable and seven independent variables namely log of experience in fishing, log of horsepower of trawler, log of total cost of fishing gear, log of total wages paid to labour, log of fishing hours, log of fishing trips, log of fuel cost after reimbursement of diesel VAT subsidy. There were 73 responses considered for this multiple regression. The multiple regression model given in the Table 4 and Equation 4 was fitted and it was found to be statistically significant model, $F(7,65)$ =93.61 p=<0.05, at 5% significance level. The coefficient of multiple determination, Adjusted R^2 for the overall model was 0.90, suggests that all the seven independent variables included in the function jointly explain 90% variation in the dependent variable log of earnings, only 10% variation is due to other factors not explained. The negative slope coefficients were observed for log of cost of fishing gear and fishing trips. It is observed that there are positive slope coefficients for log of experience in fishing, log of horsepower of vessel, log of wages paid to labour, log of fishing hours, log of fuel cost after reimbursement of diesel VAT subsidy. Out of the seven independent variables, those that are statistically significant at 5% significance level, are log of wages paid to labour (p=0.00),log of fishing hours (p=0.00), log of fishing trips (p=0.01), fuel cost (p=0.00). These variables have statistical significant influence on earnings.

Table 4: Impact of Input of Factors of Production on the Earnings from Catch

Variables	Equation 4 (Log of earnings from fish catch)			
	Unstandardized Coefficient (Beta)	Beta x100	*t*-value	*p*-value
(Constant)	0.40	40	0.58	0.56
X_1 ln experience in fishing business	0.03	3	1.38	0.17
X_2 ln horse power	0.04	4	0.74	0.46
X_3 ln total cost of fishing gear	-0.002	-0.2	-0.05	0.95
X_4 ln total wages	0.47	47	7.00	0.00**
X_5 ln fishing hours	0.49	49	6.60	0.00**
X_6 ln fishing trips	-0.13	-13	-2.64	0.01**
X_7 ln fuel cost after VAT subsidy	0.37	37	5.73	0.00**
Adjusted R^2	0.90	***F***-value = 93.61		p=0.00

Note: Variable significant at **5% , **Source**: Computed by researcher from Primary survey.

It was expected from the Equation 4, in the model to observe a positive relationship between all the seven independent variables and dependent variable. However, only in the case of the variable log of fishing gear and the log of fishing trips contrary to what we expected was observed. A negative coefficient for log of fishing gear and log of fishing trips was observed, although they are not statistically significant. This implies that for 1% increase in the log of cost of fishing gear, there is 3.0% decrease in the log of earnings on an average, but not statistically significant, (p=0.95 >0.05) and hence failed to reject the null hypothesis. In case of log of fishing trips and log of earnings there is negative relation but statistically significant. It means that for 1% increase in the log of fishing trips, there is 13% decrease on an average in the log of earnings, which is statistically significant, (p<0.05), rejecting the null hypothesis. Thus, only increasing unnecessary fishing trips without getting sufficient fish catch will increase the operational costs resulting in reduced earnings. Thus, fishing trips will increase the earnings provided they get sufficient catch for every trip. In case log of experience and log of horsepower, there is positive relation as expected but their impact on log of earnings is not statistically significant at 5% level. The values for log of experience, (p=0.17 >0.05), and log of horsepower, (p=0.46> 0.05), were more than 0.05, hence, failed to reject the null hypothesis. A positive relation is expected between log of wages and log of earnings, and it is in line with the results, expected, statistically significant at 5% level, (p< 0.05), rejecting the null hypothesis. It means that one percent increase in wages of employing experienced and skilled labour would result in 47% increase in the log of earnings on an average. Investing and employing in the right skilled and adequate number of experienced labour in purse-seine fishing will help the purse-seine owners to increase their earnings from fishing business, as the labour will have the knowledge of fishing grounds. As expected there is a positive relationship between log of fishing hours and log of earnings, and it is in line with the results expected, statistically significant at 5% level, (p< 0.05). It means that one percent increase in the number of productive fishing hours will result in 49% increase on an average in earnings, keeping all variables as constant, thus rejecting the null hypothesis. Therefore, productive fishing hours during the peak season will help the respondents to get more fish catch resulting in more earnings.

It is expected to have a positive relation between log of fuel cost after subsidy and log of earnings, and it is in line with the results obtained, statistically significant at 5% level, (p=<0.05). This implies that one percent increase in the fuel expenditure in the purse-seine vessel will result in an increase in the earnings from fish catch by 37% keeping all other variables constant. The operating costs incurred on fuel by the respondents will help them to take their vessels for deep sea fishing, search the fish catch in the sea, resulting in more earnings. The Cobb Douglas production function model shows that wages paid to labour, fishing hours, fuel costs has a statistical significant positive functional relationship on the log of earnings from fish catch. In this model, it is found that all independent variables jointly determine the dependent variable and the model is statistically significant. Though the other variables namely experience in fishing, horsepower of vessel, fishing gear, has positive relation on the output of fish catch, their impact on log of earnings from production is not significant. Thus, the Cobb Douglas model is found to be statistically significant at 5% level. The production function analysis using Cobb-Douglas model indicated that there was ample scope for the respondents to enhance the net profit from purse-seine business at all jetties by increasing the number of fishing hours, increasing the input variables such as enhancing fuel utilization and increasing number of labourers. The results are in line with (Najmudeen & Sathiadhas, 2007) who used the Cobb-Douglas model and found that fishing days, and increasing fuel would help to earn more profit for mechanized vessels.

5. FINDINGS OF THE STUDY

The analysis of cost and profit reveals that there are variation in costs and profit across different sizes of vessels and jetties in Goa. The findings of the study also reveals that fuel costs is major component of the total operating costs ranging between 40-50% for all sizes of vessels. All the respondents used fish finders on their vessels to locate the fish shoals during the fishing season and such equipment has helped them to reduce searching time. The findings of the study suggest that the medium and large sized vessels in Goa are economically and financially viable and generate reasonable revenue to cover fixed and variable costs. They get sufficient gross profit and net profit and generate sufficient funds for reinvestment. However, the high percentage of operating costs is compensated by the respondents only due to continuing increase in the fish prices of quality species of fishes. The mechanized sector has higher returns and this is attributed due to better technical efficiency. Medium purse-seine vessels are older in age as compared to large purse-seine vessels in the study area. It is economical for the respondents to invest in large size vessels ranging between 65 to 75ft to get the advantages of economies of scale. Large vessels have the capacity to face storm and rough weather, has bigger fish holds to store ice and fish, water tanks to retain more water, can carry more diesel, and can accommodate more labourers on an average of 30-40 per vessel, thus helping them to bring more fish catch, and earning more returns and net profits. The economic analysis of purse-seine vessels shows that earnings from fishing are economically rewarding and profitable. Purse-seine fishing business has improved the socio-economic status of the fishermen in Goa. There is further scope for the respondents for medium sized purse-seine vessels to enhance the revenue earned by them if they replace medium vessels with large size vessels.

6. CONCLUSION

The Government can encourage the fishermen owning medium vessels to invest in large vessels by providing subsidized loan facilities. The policy intervention of the Government of Goa, through Fisheries Department could ensure easy credit facilities through banks to the fishermen in Goa. The respondents expressed that 100% VAT reimbursement subsidy on fuel from the government is inadequate, due to the increasing high cost of fuel. In this regard, it is suggested that Government has to retain 100 % VAT reimbursement fuel subsidy on two vessels per respondent. The purse-seine fishing activity is capable of creating additional employment, through Government support, augmenting income and improving the standard of living of the purse-seine owners in Goa. Measures to improve surplus fishing competence, rules on vessel capacities, adopting monitoring and control measures by the government to check the mesh size of gear, juvenile fish catch, fishing methods such as bull trawling and LED fishing banned by the Fisheries Department of Goa need to be strictly implemented for the sustainability and conservation of marine fish resources in Goa.

REFERENCES

Asamoah, E. K., Ewusie Nunoo, F. K., Osei-Asare, Y. B., Addo, S., & Sumaila, U. R. (2012). A Production Function Analysis of Pond Aquaculture in Southern Ghana. *Aquaculture Economics and Management*, *16*(3), 183–201. https://doi.org/10.1080/13657305.2012.704616

Aswathy, N. A., Shanmugam, T. R., & Sathiadhas, R. (2011). Economic viability of mechanized fishing units and socio-economics of fishing ban in Kerala. *Indian Journal of Fisheries*, *58*(2), 115–120.

Desai, S. S., Sharangdhar, M. T., & Mohite, A. S. (2016). Comparative study of gross tonnage of wooden purse seiners of Ratnagiri, Maharashtra. *Engineering and Technology in India*, *7*(2), 84–86. https://doi.org/10.15740/HAS/ETI/7.2/ 84-86

Dhulkhed, M. H., & Bhat, K. U. (1985). The purse-seine fishery for Oil Sardine in the South Karnataka coast and its effects on the indigenous fishery. *CMFRI Institute, Mangalore*, 1–9. Retrieved from http://eprints.cmfri.org.in/406/1/Article_07.pdf

Gaonkar, R. R., Rodrigues, M. D. C., & Patil, R. B. (2008). *Fishery Management*. Delhi: A. P. H Publishing Corporation.

Geetha, R., Narayanakumar, R., Salim, S. S., Aswathy, N., Chandrasekar, S., Raghavan, V. S., & Divipala, I. (2014). Economic efficiency of mechanised fishing in Tamil Nadu – a case study in Chennai. *Indian Journal of Fisheries*, *61*(4), 31–35.

Gulbrandsen, O. (2012). Fuel savings for small fishing vessels. *Food & Agriculture Organization*. Retrieved from http://www.fao.org/docrep/017/i2461e/i2461e00.htm

Hameed, M. S., & Mukundan, M. (1991). Strategies for the development and management of purseine fishing in Karnatka. In *National symposium on research and development in marine fisheries* (pp. 643–647).

Kamble, S., Chaudhari, K., Shirdhankar, M., & Markad, S. (2013). Economics of Purse-Seine Fishing Along Ratnagiri Coast of Maharashtra State Economics of Purse-Seine Fishing Along Ratnagiri Coast of Maharashtra State. *The Indian Veterinary Journal*, *90*(6), 74–76.

Kumar, R. N., Panikkar, K. K. P., Sehara, D. B. S., & Sathiadhas, R. (2000). *Socio-economic analysis of marine fishermen in India*. *Central Marine Fisheries Research Institute*.

Najmudeen, T. M., & Sathiadhas, R. (2007). Economic efficiency of input utilisation of mechanised trawlers along the Kerala coast. *Journal of the Marine Biological Association of India*, *49*(2), 113–117. Retrieved from http://eprints.cmfri.org.in/2122/1/Najmudeen113-117.pdf

Nguyen, K. A. T., & Nguyen, D. Van. (2010). Economic performance of offshore fisheries -The case of Trawling and Purse -seining in Ben Tre Province, Vietnam. In *IIFET Montpellier* (pp. 1–11).

Panayotou, T., & Jetanavanich, S. (1987). *The economics and management of Thai Marine Fisheries*. *ICLARM Studies and Reviews* (Vol. 14).

Panikkar, K. K. P., Sehara, D. B. S., & Kanakkan, A. (1994). An Economic Evaluation of Purse Seine Fishery Along Goa Coast. *Marine Fisheries Information Service*, *127*(March), 4–8.

Pattanayak, S. . (1988). Impact of Mechanisation of Fisheries Development in Karnataka. *Journal of the Indian Fisheries Association*, *18*, 151–154. Retrieved from http://aquaticcommons.org/15964/1/JIFA18_151.pdf

Tietze, U. (2005). *Economic performance and fishing efficiency of marine capture fisheries*. Food and Agriculture Organization of the United Nations.