Technical efficiency and performance of the inland fisheries sector in Mannar District of Sri Lanka

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Abstract

This research has taken effort to quantify the technical efficiency of the inland fisheries sector in the Mannar district and to identify important socio-economic factors which determines final harvest of the fishermen. A structured questionnaire was designed and then pretested with selected respondents and having seen it applicable was administered to the sample community. A total of 192 fishing households were randomly selected from a database managed by NAQDA. The data were analysed within the frame work of Stochastic Frontier Production Function using Frontier 4.1c. The results from the efficiency model revealed that the stocked fingerlings, land, family labor, and training were found to be significant. When 1% increase in these variables increased the catch by 0.214, 0.025, 0.014 and 0.040% respectively. Likewise age and education were found to be significant in the inefficiency model and for a 1% increase in these variables also increased the harvest by 0.003 and 0.043 % respectively. In order to serve the needful of the local community it is suggested that fingerlings are to be introduced in excess of the optimal quantity and hatcheries could be established locally. Periodic maintenance and management of reservoirs' bed is inevitable. Government policy should also focus on ensuring easy accessibility to bank loans especially to young participants to expand their activities. Formal lending scheme would help avoiding the interferences of the informal lenders. Work of advisory service and training provisions could be extended by recruiting more extension personnel. The mean technical efficiency of the sector was estimated as 64%. This manifested that the Mannar inland fisheries sector still have room for considerable improvements.

Keywords: Stochastic production functions, Technical efficiency, Inland fisheries sector

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Introduction

In the expanding production of food supply it has to be noted that fish plays a central role in providing the required protein, mineral and food supplements. Unfortunately marine fish stocks are depleting quite fast by over fishing and the habitat have been deteriorating. Hence there is a need to increase fish production of the inland fisheries sector as the country has an abundance of inland water bodies in almost every district. The inland fishing in Sri Lanka has a long history. With a number of large, medium and minor irrigation reservoirs, seasonal village tanks and flood lakes, upland reservoirs and river basins there is huge potential to develop inland fishing. Currently inland fisheries and aquaculture segment accounts around 15% to the total fish production of Sri Lanka. The researchers have carried out this project with the express

Achankulam and Illuppakadavai followed by an analysis of literature. Live mud crab specimens were collected and the width of the carapace (CW) between the ninth teeth of left and right antero-lateral boarder was measured with a caliper and the body weight was recorded in grams with a digital weighing scale. Identification of mud crab species was performed following Keenan's (1998). Additional information regarding the capture method, capture time and number of fishermen were recorded by interviews.

Results and Discussion

Two species of mud crabs; *S. serrata* and *S. olivacea* were found in Mannar Lagoons. *Scylla serrata* was found in all study sites but *S. olivacea* was only present in mangrove forests (Table 1). Baited traps, gill nets and hand picking from crab holes with a stick are practiced for catching, but baited traps are the most dominant gear in all sites. The size of the trap and the mesh size of the nets varied in each site.

Table 1: Fishery data of study sites

Site	Capture species	Capture method	Number of fishers
Southbar	Scylla serrata	Baited Trap, Manual collection	89
Pallimunai	Scylla serrata	Baited Trap	113
Achankulam	Scylla serrata Scylla olivacea	Baited Trap, Net, Manual collection	130
Illuppakadavai	Scylla serrata Scylla olivacea	Baited Trap, Net, Manual collection	48

Carapace width varied from 12 cm to 20 cm (Figure 1). The carapace of most of the crabs in Southbar and Pallimunai were in the range of 13-15 cm, while in Pallimunai, few males were larger than 17 cm. Narrow size variations could be seen in Achankulam as most of the crabs fell between 12 cm to 16 cm range. Both males and females in Illuppakadavai were bigger when compared with other sites. In 1991, Jayamanne recorded *S. serrata* with a 28 cm CW and 3 kg of weight from Mannar, but at present, size distribution of *S. serrata* showed a narrow range below 20 cm with a mean carapace width of 15.35 cm and a mean weight of 600.89 g.

Highest catch was in Achankulam where the highest number of fishermen was recorded. When catch per fisherman is considered, Illappakkadavai shows the highest. Military restrictions in Illippakkadavai during the years of the conflict restricted the mud crab fishing, thus the area has flourishing crab resources as well as a fishing effort.

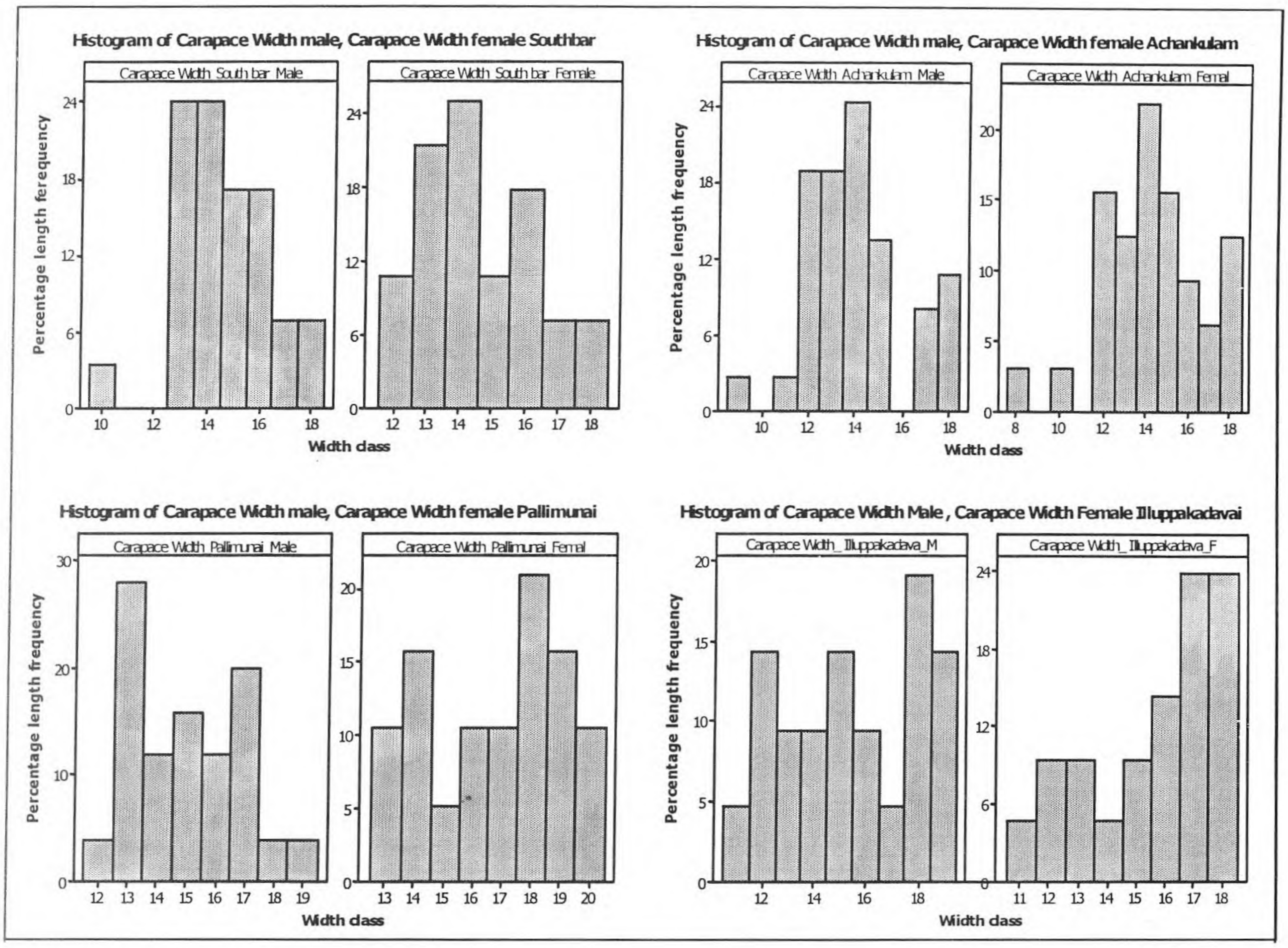

Figure 1: Size distribution of the crabs in the study area

Conclusion

Mud crab fishery is a vital livelihood in the Mannar district and employs number of fisher families. Mud crabs; *S. serrata* and *S. olivacea* are expensive commodities exploited at alarming rate in recent years from Mannar. It is important to conduct and in-depth study of the fishery and methods that can be employed for sustaining the fishery resources in the district.

References

- Davie. P. J., Keenan. C. P, F, Mann. D. L (1998). A revision of the genus Scylla de Haan, (1833) Crustacea: Decapoda: Brachyura: Portunidae. Raffles Bull Zool, 46:217–245
- Jayamanne, S. C., (1991). The mud crab fishery in Sri Lanka. The Mud Crab. A report on the seminar convened in SuratThani, Thailand, 41p.

intention of promoting and developing the existing inland fishing sector in the Mannar district with the objectives of finding out the existing production efficiency and the socio economic factors which have been influencing the income and socio-economic levels of the dependents. Mannar is one of the potential districts in Sri Lanka and nearly consist 5% (11600 Ha) of the inland fresh water bodies of the Island nation.

Materials and Methods

Productive efficiency estimates are based on Battese and Collie (1995) Stochastic Frontier model. $lnY = \beta_0+\beta_1\ln[\max(TL\alpha_i, 1\text{-}DL\alpha_i) +\beta_2\ln(Fin_i) +\beta_3 ln(Lnd_i) +\beta_4(ln(Otc_i) +\beta_5(Dfl_i) +\beta_6(Dhl_i) +\beta_7 ln(Dtc_i) +v_i-u_i$ Where, i and Ln are the i^{th} farmer and the logarithm to base e, respectively. Y denotes the kgof fish harvested. *Dfl* is a dummy variable equal to one if the number of family labor used is positive, zero otherwise. *Dhl* is a dummy variable equal to one if the number of hired labor used is positive, zero oth-erwise. *Tla*represents the number of total labor hours exhausted. Fingerling (*Fin*) denotes quantity of fingerlings (fry) used. Bed (*Bed*) is the total area of reservoirs' bed measured in square meters. Operational cost (*Otc*) for intermediate inputs measured in monitory units. It includes cost of maintenance, depreciation costs, etc. *Dtc* is a dummy variable equal to one, if fisherman participated at least one training class during the 2012 production year, zero otherwise. v_i and u_i are the random (stochastic error term) variables. With reference to Battese and Collie (1995) the Stochastic Frontier inefficiency model was specified as$i=\delta_0+\delta_1(Age_i)+\delta_2(Exp_i)+\delta_3(Gen_i)+\delta_4(Edu_i)+W_i$ Where, W is defined as unobservable random variables. Age, Experience measured in number of years, Gender and Education again measured in number of years of formal or informal education received by the corresponding respondent denoted by *Age, Exp, Gen,* and *Edu* in this model respectively.

Results and Discussion

The variable stocked 'fingerling' has manifested a positive sign and found to be statistically significant at 1% α level. The setback is being loss due to fingerlings escape through spill water, illegal catch and etc. Hence it is suggested always to introduce slightly excess of fingerlings than the optimal quantity. The variable 'bed' has manifested a positive sign and is found to be significant at 1% α level. Thus maintenance and management of reservoirs' bed is inevitable. These results found to be consistent with Olayiwola, (2013), Edward *et al.*, (2010). The variable 'family labor' also has manifested a positive sign and found to be significant at 1% α level. Hence providing access to formal credit may motivate the family members to get involved in the value addition and marketing process of their harvest. The variable 'training class' was introduced as a dummy variable in the model. The coefficient was positive and found to be significant at 10% α level in both OLS and MLE. It is apparent that training skills and technical know-how relevant to the industry bring about better returns. These conclusions are consistent with the inference made by Edward Edward *et al.*, (2010).

Table 1:(OLS) Ordinary Least Square and (MLE) Maximum Likelihood Estimate Estimates of the Stochastic Frontier Model

Variable	Coefficient		Standard Error		t-ratio	
	OLS	MLE	OLS	MLE	OLS	MLE
Constant	2.713	2.715	0.221	0.211	12.257	12.857
Total labor (Tla)	0.321	0.321	0.038	0.036	8.832	9.328
Fingerling (Fin)	0.214***	0.214***	0.026	0.025	8.600	8.802
Bed (Bed)	0.025***	0.025***	0.018	0.018	3.533	3.649
Operational cost(Otc)	-0.006	-0.006	0.037	0.037	-0.163	-0.167
Dummy family labor(Dfl)	0.014***	0.014***	0.032	0.041	2.943	2.419
Dummy hired labor(Dhl)	0.160	0.160	0.017	0.017	8.668	8.904
Dummy training class(Dtc)	0.040*	0.040*	0.022	0.022	1.783	1.804
σ2	0.016	0.016		0.001		12.152
Γ		0.000		0.030		0.007
Log likelihood function	23.145	23.145				

*Significance 10%, **Significant at 5%, ***Significant at 1%,and Mean efficiency= 0.6414

Positive contribution to the inefficiency simply implies that it is contributing negatively for the efficiency. The variable 'age' of the fishermen has manifested a positive sign and is found to be significant at 1% α level. This implies that younger generation is more efficient. The variable years of 'education' of the fishermen has manifested a negative sign and is found to be significant at 1% α level. Yet informal education involving skill in the use of equipment and maintenance of same, knowledge of market intelligence and understanding of financial and banking formalities would result in the increase of the productivity of the inland fishery. These results were consistent with Charles (2011) and Singh *et al.*, (2011).

Conclusions and Recommendations

The results from the efficiency model revealed that the stocked fingerlings, land, family labor, training were found to be significant and when 1% increase in these variables increase the catch by 0.214, 0.025, 0.014 and 0.040% respectively. It is suggested that fingerlings are to be introduced in slightly excess of the optimal quantity and hatcheries could be established locally. Periodical maintenance and management of reservoirs' bed is inevitable. Government policy should also focus on ensuring easy accessibility of bank loans, especially to young participants to expand their activities. Some form of formal lending scheme would help out in avoiding the interferences of the informal lenders. Work of advisory service and training provisions could be extended by recruiting more extension personnel. The mean technical efficiency of the existing inland fisheries in Mannar district was estimated to be 64%.Minimum technical efficiency in the fishing locality is seen to be 58%. Whereas the maximum technical efficiency within the region of the research was found to be 81%. The intention therefore is to enhance the efficiency at least to the maximum observed, that of the mean achiever and the minimum achiever. Proceeding further the objective would be to reach and efficiency of a 100% by lifting the maximum to that level, which would be a fair elevation of a 19% from 81%.

References

- Battese, G.E and T.J. Coelli. (1995). A model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data. Empirical Economics, (20):325-332.
- Charles, D. N., Ayuba, D., and Malo, M. O. (2011). Estimates of Profitability and Technical Efficiency of Artisanal Fishermen: A Case of Natural Lakes from Plateau State, Nigeria. Asian Journal of Agricultural Sciences, 3(6): 516-523.
- Edward, E.O., Hoerstgen-Schwark, G., and Brümmer, B. (2009).Productivity of hired and family labour and determinants of technical inefficiency in Ghana's fish farms (No. 0907). Diskussionspapiere//Department für Agrarökonomie und Rurale Entwicklung.
- Olayiwola, O. O. (2013). Technical Efficiency of Fish Production in Ijebu-Ode. ABHINAV-International Monthly Journal of Research in Management and Technology, 2(2): 26-42.
- Singh, S., and Sharma, S. (2011). Measurement of technical efficiency in dairy sector of India: A stochastic frontier production function approach. TMC Academic Journal, 5(2): 51-64.