

Fuel Consumption Pattern by the Mechanized Fishing Sector in Andhra Pradesh

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The study aims at ascertaining the fuel utilization pattern by different classes of mechanized fishing vessels in Andhra Pradesh. The estimate gives the consumption pattern of 7941 kL of diesel for small mechanized, 3818 kL for sona, 3684 kL for mini trawlers and 11256 kL for trawlers with the pooled estimate for Visakhapatnam district as a whole being 26699 kL for the year 2004. The consumption in Andhra Pradesh state was 19698 kL for small mechanized, 21744 kL for sona, 3684 kL for mini trawlers and 11256 kL for trawlers, the pooled estimate being 56382 kL. The average per day fuel utilization by different categories of crafts was 117.83 lts for small mechanized, 202.44 lts for sona, 502.54 lts for mini trawlers and 1173.26 lts for trawlers. Based on the ideal fishing trips that can be undertaken by different categories of crafts, it has been estimated that the mechanized sector as a whole has undertaken only 79.58% operation in Visakhapatnam and 79.7% in whole of Andhra Pradesh state during the year of study.

Key words : Fuel utilization, small mechanized boats, fishing capacity utilization, operating costs, sampling estimates, Andhra Pradesh.

The non-renewable source of energy in the form of petroleum products is getting depleted and is a matter of great concern the world over. The price of petroleum products has registered an upward trend (<http://www.iocl.com>) during the past years resulting in loss of precious foreign exchange towards import of fuel. This has adversely affected the Indian economy and the Government has been exploring measures to ensure fuel efficiency and conservation.

The advent and spread of mechanized fishing technology has completely transformed the fishing sector in India and the consumption of fuel has gone high as the number and size of mechanized crafts steadily increased over the years. Along with mechanized fishing, the traditional sector also has been converting to motorization in a large scale, where outboard engines of 8 hp to 40 hp are extensively used (Unnithan *et al.*, 2005).

The pattern of marine fish landings in India clearly reveals that the contribution by

the artisanal sector to the total marine fish production was significant only up to the sixties. The popularization and consequent expansion of mechanized fishing along with the motorization of the artisanal craft have resulted in a decline in the contribution by the artisanal sector. An appraisal of the fleet strength shows that while the number of artisanal fleets increased by about 110 per cent from the sixties to nineties, mechanized fleets increased by about 570 per cent during the same period (Rao, 2004).

The entire fishing fleet in Andhra Pradesh consists of a variety of non-motorized and motorized artisanal crafts, small mechanized boats, *sona* boats, mini trawlers and large trawlers (FAO, 1993). According to Government sources, the fishing industry in India is supported by 53,684 mechanized and 44,578 motorized crafts plying its waters, of which Andhra Pradesh's share is 4% and 12% per cent respectively (Anon, 2001). There are 2,278 mechanized fishing boats and 5,266 motorized crafts in Andhra Pradesh. The mecha-

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nized boats operate from four fishing harbours at Visakhapatnam, Kakinada, Nizampatnam and Machilipatnam (Govt. of AP, 2005).

An earlier study conducted at Central Institute of Fisheries Technology, Cochin (Unnithan *et al*, 2004) had revealed that as high as 77% of the operating cost of mechanized fishing went towards fuel, affecting the profitability of fishing itself. As per this study, it was estimated that the fuel utilized by the mechanized fishing sector in Kerala was over 97000 kL and fishing capacity utilization was found to be 55%. To ascertain the fuel utilization in the country and its impact on the fishing economy, it is imperative that studies should be carried out in major fishing centres. The present work aimed at studying the fuel utilization pattern by different classes of mechanized fishing vessels, and estimating the total quantity consumed by the fishing industry in state of Andhra Pradesh.

Materials and Methods

The study was carried out in 2004 in Visakhapatnam district of Andhra Pradesh, where about 30.16% of the total mechanized fleet of Andhra Pradesh operated. Andhra Pradesh ranks 5th in marine fish production in India and it's mechanized and motorized sectors together contribute 61% of the total marine landings in Andhra Pradesh. Among the nine coastal districts, northern coastal districts comprising of Srikakulam, Vizianagaram, Visakhapatnam and East Godavari contribute 70% of the landings in Andhra Pradesh (Rao, 2005).

For making a sampling frame for the study, the number of crafts operating in the district was collected from secondary sources. The crafts were classified into four categories depending upon the LOA and type of fishing, either single day or voyage fishing, as small mechanized boats, *sona* boats, mini trawlers and trawlers. The number of fishing vessels in Visakhapatnam and Andhra

Pradesh during the year under study is given in Table 1.

The data collected included the fuel utilization, hp of the engine, average speed and rpm, area of operation, fishing time, duration, trip cycle etc. The actual quantity of fuel utilized per trip was taken as the fuel utilized for reaching and returning from the fishing ground and the fuel spent for fishing.

Data were collected by trained field staff, based on structured proforma developed for the study. Random sampling was adopted for collection of data from each stratum on every fifth day to give a complete coverage of the month. Data were collected for 10 months excluding the two months trawl ban period from April 16 to May 30. A total of 433 trips were covered for the study, of which 293 for small mechanized, 108 for *sona* boats, 15 for mini trawlers and 17 for trawlers. The estimates were made using the stratified random sampling method (Sukhatme & Sukhatme, 1970).

The formula used for the estimation was

$$\sum^h \hat{Q}_h = \sum^h \left(\frac{N_h}{n_h} \times \sum_{i=1}^{n_h} q_{hi} \right), \text{ where } n_h \text{ is}$$

the number of trips sampled and the N_h is the total number of trips in the h^{th} stratum. q_{hi} is the fuel consumption of the i^{th} observation in the h^{th} stratum and \hat{Q}_h is the estimate at the h^{th} stratum. The summation is taken over h strata for pooling the fuel consumption to obtain estimate at the district and state levels. The variance of estimates were worked out by calculating,

$$V(\hat{Q}_h) = \frac{N_h(N_h - n_h)}{n_h} \times \frac{1}{n_h - 1} \left[\sum_{i=1}^{n_h} q_{hi}^2 - \frac{\left(\sum_{i=1}^{n_h} q_{hi} \right)^2}{n_h} \right]$$

The percentage error of pooled estimate is

$$SE = \frac{\sqrt{\sum_h v(\hat{Q}_h)}}{\sum \hat{Q}_h} \times 100, \text{ summation run-}$$

ning over all strata at the respective levels and SE denotes the standard error of the estimate.

The analysis of data was performed by single stage stratification technique and estimates made based on the class of vessels. The estimates were pooled for making the overall estimate for Visakhapatnam district and for Andhra Pradesh.

The population of trips in the study in Kerala (Unnithan *et al*, 2005) was worked out based on the actual number of crafts landed at various harbours in the district where the study was carried out. But since this data was not available for Andhra Pradesh, the population was arrived at using primary data collected on average number of fishing trips per annum, from the sampled boats in each class, and multiplying it with the total number of crafts operating in the state in each class. On this basis, the number of trips performed by small mechanized, *sona*, mini-trawlers and trawlers was worked out at 11503, 3580, 286 and 237 respectively. The respective figures for the state as a whole are 28531, 20386, 286 and 237. Since the entire fleet of mini trawlers and trawlers operate from Visakhapatnam, the number of trips remains the same for the state as a whole.

Table 1. Number of fishing vessels

	Small mechanized	<i>Sona</i>	Mini-trawlers	Trawlers
Visakhapatnam	358	226	38	65
Andhra Pradesh	888	1287	38	65
% Fishing crafts in Visakhapatnam	40.36	17.53	100.00	100.00

Results and Discussion

The general particulars of the categories of vessels chosen for this study, and their operational aspects have been presented in Table 2.

Small Mechanized and *Sona* boats: Wooden boats with inboard engines were first introduced at Kakinada in 1964. The boat 'Pablo' with an LOA of 9.14 m, originally intended for gillnetting was also used for trawling. A second generation of mechanized wooden craft, 'Pomfret', 9.75 m

Table 2. Specifications of different categories of crafts

Specifications	Small mechanized	<i>Sona</i>	Mini Trawlers	Trawlers
Overall length (m)	11-13	13-15	16.5-20	20-28
Breadth (m)	2.49-4	4.20-4.34	5.08	7.46-7.48
Gross tonnage	16	18	42.0	156-180
Type of engine	Ashok Leyland	Ashok Leyland	MWM, Caterpillar, Ashok Leyland	Yanmar, MAN
Horse power	70-110	90-110	145-210	350-624
Crew strength	6	6-8	8-10	12-15
Fish hold capacity	3-4 t	3-5 t	7.5-15.0t	60-110 m ³
Type of hull	wood	wood	wood	steel
Endurance in days	Upto 7 days	Upto 15 days	18-25	30-45
Fuel capacity	3-5 kL	4-5 kL	9-12 kL	43.5-78.96 kL
Number of fishing trips/year	40	20	8-12	4-6
Duration of each trip (days)	1-5	8-13	20-25	30-40
Fishing grounds	Off North Andhra Coast	Off North Andhra and Orissa coasts	Off North Andhra, Orissa West Bengal coasts	Off North Andhra, Orissa West Bengal coasts
Depth of fishing	10-60 mts	30-100 mts	40-100 mts	60-100 mts

LOA fitted with engines of 45-65 HP, was designed for trawling with a mechanized winch. These boats were first introduced at Kakinada in 1966, at Visakhapatnam in 1967 and at Paradeep in 1975. The third generation named 'Sorrah' was introduced at the end of 1967. This type, wooden hull (11.4 m LOA) with an engine of 60-75 HP operated same type of gear as the 'Pomfrets'. However they proved to be inferior to the 'Pomfrets' and were phased out. Their operation was limited to the Kakinada area (FAO, 1993).

In the early years, 1964-75, the mechanized boats were harvesting the resources of the 10-40 m depth zone by conducting single day fishing. They operated at a maximum distance of 20-30 km from their port of operation. In 1973, the mechanized boats of Kakinada and Visakhapatnam started to migrate to Paradeep in the fair weather period of October-January, exploiting the resources around this port. A major breakthrough occurred in 1974 when a few mechanized boats started night fishing, landing good quantities of shrimps. Since then, night fishing became a regular practice. With these changes, the profitability of small mechanized boats increased considerably and as a result, the fleet increased year after year. This led to a reduction in the profit margin. As a consequence, a few boats

ventured for 3 to 4 days fishing covering a distance of 60-70 km from the port of operation. This type of voyage fishing or stay fishing, which started in 1981 made it possible for the small mechanized boats to fish all along the northeast coast down to 70 m depth, concentrating in the 10-50 m depth range. In the mean time, several owners of mechanized boats have shifted to the larger *sona* boats (FAO, 1993).

The most important technological development in the northeastern demersal fisheries has been the emergence of *sona* boats. They became popular in the wake of increased fuel prices and the desire to extend the stay of the voyage upto 15 days to minimize fuel costs. As the boats were landing larger quantities of shrimp resulting in increased earnings, the operators began to call them *sona* boats (Sona=gold) (FAO, 1993). At present, there are an estimated 2278 mechanized fishing boats in Andhra Pradesh (Anon, 2005).

The small mechanized boats are wooden boats of 11-13 m LOA, considerably smaller than the *sona* boats. They operate with inboard engines of 70-110 hp. The crew strength is 6. On an average, these crafts make 40 trips in a year with duration of 1-5 days per trip. At present, 358 small

Table 3. Estimate of fuel used for different types of crafts - Visakhapatnam

	Small mechanized	<i>Sona</i>	Mini-trawlers	Trawlers	TOTAL
Fuel used (kL)/ Yr	7941.24	3818.31	3683.68	11256.11	26699.34
SE	2.24	1.80	4.60	1.96	

Table 4. Estimate of fuel used for different types of crafts - Andhra Pradesh

	Small mechanized	<i>Sona</i>	Mini-trawlers	Trawlers	TOTAL
Fuel used (kL)/ Yr	19697.82	21744.08	3683.68	11256.11	56381.69
SE	3.70	4.62	4.60	1.96	

mechanized boats are operational at Visakhapatnam base.

The *sona* boats are wooden boats of 13-15 m LOA, considerably larger than the small mechanized boats, with an average gross tonnage of 18, operating one trawl net from the stern. They operate with inboard engines of 90-110 hp. The crew strength is 6-8. On an average, these crafts make 20 trips in a year with duration of 13 days per trip. Their large size permits longer voyages (upto 10-15 days) and hence operations in areas far away from the main ports. The fishing areas are usually in the depth range of 30-100 m. Longer voyages of upto 15 days led to reduction in per day fuel utilization and consequently reflected on the fuel costs. Although most of the *sona* boats are registered in Kakinada and Visakhapatnam, they operate along the entire north east coast, including Orissa in the depth range of 10-100 m. At present, 226 *sona* boats are operational at Visakhapatnam base.

Mini Trawlers: The first mini trawler was introduced in 1981. This type of vessel is a smaller variant of the large trawlers. It operates at the same depths and in the same areas as the large trawlers. There are no freezing facilities and the shrimp catch is stored on ice. Most of the fish is discarded

because of lack of space (FAO, 1993). They are mechanized crafts in the size range of 16.5-20 m LOA, wooden hull, with an average gross tonnage of 42. They operate with inboard engines of 145-210 hp. The crew strength is about 8-10. These trawlers have a sea endurance of 18-25 days, and on an average, they make 9 trips in a year with duration of 21 days per trip. 38 mini trawlers are operational off Visakhapatnam.

Large Trawlers: The success of mechanized boats attracted trawler companies from the west coast. The large trawler fleet rapidly increased in size when the new fishing harbour opened in Visakhapatnam in 1978. Some 38 Mexican trawlers were added to the fleet in about one year. Large numbers of vessels were added in the period 1985 to 1988, 61 vessels were imported from several countries (Netherlands 28, Australia 18, South Korea 8, USA 5, Hong Kong 1 and Singapore 1), while 47 were constructed in India. The introduction of larger trawlers has been sponsored by the Government of India that provided most of the capital. Fuel had been subsidized for those companies that export the shrimp landed. The large vessels registered in Visakhapatnam reached 182, but many of these vessels ceased to operate. The latest data available shows that there are 65 trawlers at Visakhapatnam base.

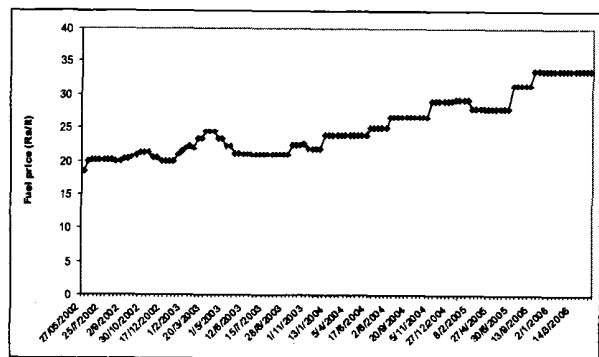


Fig. 1. Changes in fuel prices during 2002-06

Trawlers are steel made with the size group of 20- 28 m LOA, with the gross tonnage of 156-180. They operate with Caterpillar/ Yanmar/ MAN engines with 350-624 hp. They have the sea endurance of 40 days, operate 4 to 6 trips in a year with a duration of 30-40 days per trip.

The estimates have been made based on the class of vessels, and further, the estimates

were pooled for making the overall estimate for Visakhapatnam district and for Andhra Pradesh state as a whole. The mechanized crafts were divided based on their LOA into small and medium types (*sona*) since there was variation in fuel utilized by the two groups for their fishing operations as could be observed from the data collected and after discussions with boat operators. The estimate has thus been separately for the two categories within the mechanized crafts, besides estimates for mini-trawlers and trawlers.

The estimate of fuel used for different types of crafts in Visakhapatnam and Andhra Pradesh are presented in Tables 3 and 4. The estimates of SE were in the range 1.80 & 4.60 for Visakhapatnam and 1.96 & 4.62 for Andhra Pradesh which shows the uniformity of the observations.

The estimate gives the consumption pattern of 7941.24 kL for small mechanized, 3818.31 kL for *sona*, 3683.68 kL for mini trawlers and 11256.11 kL for trawlers with the pooled estimate for Visakhapatnam as a whole being 26699.34 kL for the year 2004.

The consumption in Andhra Pradesh state was 19697.82 kL for small mechanized, 21744.08 kL for *sona*, 3683.68 kL for mini trawlers and 11256.11 kL for trawlers, the pooled estimate being 56381.69 kL (Table 4).

The average per day fuel utilization by different categories of crafts was 117.83 lts

Table 5. Ideal number of fishing trips per annum

	Small Mechanized	<i>Sona</i>	Mini trawlers	Trawlers
Visakhapatnam	14320	4520	380	390
Andhra Pradesh	35520	25740	380	390

for small mechanized, 202.44 lts for *sona*, 502.54 lts for mini trawlers and 1173.26 lts for trawlers.

Based on the data collected from boat operators, the ideal number of trips that can be undertaken by different categories of boats was arrived at as given in Table 5.

Taking into consideration the ideal fishing trips that can be undertaken by different categories of crafts, it has been estimated that the mechanized sector as a whole has carried out only 79.58% of the possible fishing operations in Visakhapatnam and 79.70% in Andhra Pradesh during 2004. Among the different categories studied, most of the boats have reported undertaking fishing trips of shorter duration than ideally possible.

The demand for fuel at varying fishing capacity utilization levels has been extrapolated as given in Table 6.

The domestic fuel price for the past four years is furnished in the graph below (Fig.1.) indicating an annual price rise of 13.17%. At price levels of 2004 (Rs. 25.95 per lt), the total expenditure on fuel by the fishing industry works out to Rs. 146.29 crores in Andhra Pradesh. Assuming 100% capacity utilization at 2004 fuel prices, the expenditure on fuel would be Rs. 183.55 crores.

Table 6. Demand for fuel at different capacity utilization

% fishing capacity utilization	Fuel demand (in kL) in Andhra Pradesh
79.70	56381.69
90	63668.16
100	70742.40

A scheme for providing fuel at subsidized rates is prevalent in Andhra Pradesh. Under this scheme, 100% rebate on Central Excise Duty is given by Government of India at Rs. 1.50 / litre of HSD oil and exemption of sales tax of Rs. 4.08 / litre of diesel oil, subject to 3000 lts / month for mechanized fishing boats. The expenditure under plan schemes for the above two components was Rs. 25 lakh during 2003-04 and Rs. 14.15 lakh during 2004-05 (<http://www.ap-fisheries.org>). In effect, this subsidy only helps the fishermen or boat operators marginally.

Considering the prices in 2005 and assuming the fishing capacity to be unchanged, the expenditure on fuel would have increased to Rs 189.61 crores, a difference of Rs. 43.33 crores, over 2004. This is directly the loss incurred by the primary producer. With fuel prices showing an increasing trend, this does not augur well for the fishing industry and calls for drastic managerial intervention in fisheries policies and also for stepping up R&D activities with a view to development of fuel-efficient fishing vessels.

To ascertain the fuel utilization in the country and its impact on the fishing economy, it is imperative that studies be carried out in major fishing centres and the present study aimed at fuel utilization pattern by different classes of mechanized fishing vessels, and estimate the total quantity consumed by the fishing industry in Andhra Pradesh. The expenditure on fuel in the sector is highly substantial and calls for optimum fuel utilization measures like introduction of new generation, fuel efficient fishing vessels along with appropriate management measures like optimization of the fishing fleet in the state.

The authors express their sincere thanks to Dr. K. Devadasan, Director, CIFT, Cochin for granting permission to publish this paper. They are also thankful to the boat operators of Visakhapatnam coast for providing the necessary information for this study. Thanks are also due to the Dept. of Fisheries, Govt. of AP for providing information on the number of craft operating in the state and also the details about the fuel subsidy policy.

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