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Economic sustainability of the trawl fishery of Kerala

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Abstract
The study has found that there is proliferation in the number of trawlers operating in Kerala in all maritime districts except Thiruvananthapuram and Alappuzha. The growth rate is the highest (4.24 %) in Kollam, followed by Ernakulam (2.42%) and Kozhikode (1.64%). The all Kerala compound annual growth rate is 8.91 per cent (1980 – 2009). The result of the Fox model revealed that the estimated catch at maximum economic yield (MEY) is 1.95 lakh tones and the effort needed to catch the MEY is only 31.56 lakh hours. With the average 199 days of fishing trips, the actual fishing effort is 63.7 lakh hours. The actual fishing effort is found to be more than double the effort needed to attain the MEY. This finding of the Fox model concludes that with the present fleet size of trawlers, the trawler fishery is operating not at economically optimum or economically sustainable level.

Keywords: Maximum economic yield, Economic sustainability, proliferation, Fishing trips and Economic optimum.

1. Introduction
The trawler sector plays a decisive role in the economy of Kerala through production, export and employment (GoK, 2007) [1]. The trawler sector is not a simple enterprise as it was in the beginning of 1950s, when the trawlers got introduced into the Kerala fishery through the well-known project called the Indo Norwegian project (INP) (Kurien, 1985) [2]. Recently the trawler technology has become highly complex and ramified. The wooden boats of the past have given way to steel boats, 20 and 30 footer boats have been replaced by 50, 60 and 70 plus footers. Many more mechanical gadgets such as Global Positioning System (GPS), echo-sounder and wireless sets have made these boats ultra-modern and high tech. So much so, now these boats can fish ten to fifteen days at a stretch. Commensurate with this technological complexity, volume of investment also got accelerated. If the investment was around two lakhs in the early 1980s, now it is around 55 to 57 lakh rupees. Adding to this, the total fish catch has declined and resource depletion crisis has taken place as is revealed from various studies of the Central Marine Fisheries Research Institute (CMFRI) and the periodic reports of the directorate of fisheries in Kerala. So it is the need of the hour to study the economic sustainability of the trawler sector.

2. Statement of the problem
From 1982 onwards various studies on cost and earnings in Kerala fishery had found out that net profit in the trawler fishery of Kerala is negative. Serious erosion of net profit in the trawler sector since the year 1982 was further observed in the mid-1980s. Following the recommendations of the Balakrishnan Nair Committee Report, a ban on trawling was introduced along the Kerala Coast and it affected the profitability and economic sustainability. This is evident from the protest made by the trawler sector against the trawl ban. At the same time, it is reviewed that the catch rate during the post monsoon period has increased (Balakrishnan Nair Committee Report 2000) [3]. It is not substantiated that the trawl ban has affected the profitability of the trawler sector. The shrimp trawler operators of Kerala ventured into deep sea fishing for the first time in November in 1999. Up to a maximum depth of 100 m of catching the prawn were undertaken from four equidistant bases in Kerala, including Neendakara Shakthikulangara and Cochin. However by 2000, the length of the vessels in the trawl sector was found varying from 48 feet to 60 feet in overall length. Accordingly the investment cost also got accelerated. Further the possibility of catching haul pink prawns by deep sea operations attracted the new investors into the sector and the number of the fishing vessels proliferated.

Thereby overcrowding and overfishing took place in the trawler fishery of Kerala and how they affected profitability and economic sustainability is an investigative question to be researched. There are some trawlers that make profit but there are some others that make losses and some others are at breakeven. More interestingly trawlers are still entering the fishery. Such a strange phenomenon raises certain basic research questions.

How is it that the trawler units proliferate even when it is assumed that the sector is not profitable?

Is the trawler fishery of Kerala sustainable in the long run?

As we come to the first research question, we come across certain crucial issues that challenge the pure economics of fishery operation. For instance, in 1985, Kalawar Committee had recommended to restrict the fishing effort in the trawler sector of Kerala to 1145 vessels so as to catch the maximum sustainable yield. Nevertheless their number is 3982 **(**Marine Fisheries statistics 2009) [4]. Another important issue is that property right that though with the introduction of Kerala Marine Fisheries Regulation Act (KMFRA 1980) [5] Kerala Marine Fishery could be conceived as a state regulated property. It has become effectively an open access fishery wherein trawlers proliferate even when the number of loss - making ones are on the increase? Why Kerala Marine Fisheries Regulation Act (KMFRA) including the prohibition of night trawling fails to get implemented?

As to the last research question cost and earnings from the trawler fishery becomes crucial in determining the economic sustainability of the trawler fishery. The fishing operation to sustain in the long run the net profit should be non-negative.

These are all important issues to be analysed in length. In the light of the above research questions, the following objectives shall be pursued in our study.

3. Objectives

3.1 To analyse the growth of the trawlers since 1980s and to identify the reasons for the proliferation of the trawlers.

3.2 To analyse the economic sustainability of the trawl fishery of Kerala.

4. Methodology

The secondary data on annual landings of the centres, Neendakara Shakthikulangara of Kollam district, Munambam of Ernakulam district were collected from the Central Marine Fisheries Research Institute (CMFRI) for the period from 2002 to 2011. CMFRI collects the statistics on marine fish landings in major and minor landing centres of all the coastal states using the multi–stage stratified random sampling design. The secondary data on the proliferation of the number of trawlers from 1980 to 2009 is collected from Marine Products Export Development Authority (MPEDA), fisheries Directorate Thiruvananthapuram, Port offices of Kollam and Munambam, fisheries offices of the maritime districts and from the publications of CMFRI.

4.1 Area of the study

The two districts selected for the study are Kollam and Ernakulam districts of Kerala. Neendakara – Shakthikulangara of Kollam district and Munambam of Ernakulam district are the areas selected for the study. Neendakara-Shakthikulangara is selected because it is the pioneer base of trawler operation in Kerala. The trawlers were introduced into the Kerala Fishery through the Indo Norwegian Project (INP) in Neendakara-Shakthikulangara belt and the highest number of trawlers land in the Neendakara harbour in Kerala. Munambam is selected because it is second only to Neendakara- Shakthikulangara belt in having the highest number of trawlers landing in a single harbour. In munambam, there are the three types of trawlers identified for the study namely the small, medium and large trawlers comparable to Neendakara Shakthikulangara and in the Cochin harbour there are only two types of trawlers operating namely the small and medium types of trawlers. In these two districts selected for the study 61.42 per cent of the trawlers cluster. By studying the trawlers of these two centres a better picture of the trawl operation in Kerala can be elicited.

4.2 Sample Frame

The list of trawlers in the selected two areas of the study constitutes the sampling frame. First of all a composite list of all boat owners were extracted from the port offices of Neendakara and Munambam, MPEDA, fisheries offices of Neendakara and Vypin. The composite list thus received was sorted out on the basis of the continuous service of ten years, i.e. since 2002 to 2011. The veteran leaders from the Deep Sea trawl boat owners associations helped to identify the size of the trawlers.

4.3 Sample design

The sample design is done on the basis of stratified sampling, the stratum being the length of the boat. In both Neendakara-Shakthikulangara and Munambam, the length of the boat varies from 48-70 plus footers. The secondary data obtained from CMFRI for the period from 2002 to 2011 were analysed as follows. First of all a compound growth rate for each species in the two selected centres namely Neendakara Shakthikulangara and Munambam are found out for the logarithmic form of the equation.

$Y = ab^{t}e^{t}$ [1]…… (1)

The compound growth rate was obtained for the logarithmic form of the equation below.

Iny = Lna + Lnb ……. (2)

Then the compound growth rate (r) was computed by using the relationship

R = (Anti log of b-1) x 100 …… (3)

The compound growth rates were tested for their significance by the statistics given by r

To find out the Maximum Economic yield (MEY) and Economic sustainability, for the time series data obtained from CMFRI, the analysis was carried out in the following way. The basis for the estimation of the economically sustainable yield was the time series data for the two important landing centres in Kerala i.e., Neendakara – Shakthikulangara (Kollam), and Munambam (Ernakulam), for the period 2002 to 2011. The operational cost per trawler per day (C) for the years 2002 to 2011, together with the production data formed the basis for evaluating the unit economics.

The Maximum Economic Yield was estimated using the Fox model. The equations used to estimate the MEY were

[1] Y = growth rate, a = Intercept b = Regression Co-efficient , t = Time variable, e = Error term

$Y = Ee^{a+bE}$

and since at Maximum Economic Yield Marginal Cost = Marginal Revenue,

$$\frac{dTR}{dE} = \frac{dTC}{dE}$$

$MR = P(bE + 1)\, e^{(a+bE)}$

$MC = P(bE + 1)\, e^{(a+bE)}$

By further simplifications

$$(bE + 1)e)^{bE} - \frac{C}{P \cdot e^{a}} = 0$$

$$^{E}MEY = \frac{1}{b}\left[-1 + \frac{\sqrt{c}}{Pea^{2}}\right]$$

$$MEY = E_{MEY}\, e^{(a+bE_{MEY})}$$

[1] Y = growth rate, a = Intercept b = Regression Co-efficient, t = Time variable, e = Error term

5. Result and Discussions

5.1 Growth in the Number of Trawlers in Kerala Fishery Since 1980:

Modernization on a vast scale took place in the trawl fishery from 1980 onwards. The wooden vessels slowly gave way to new steel vessels made in the different boat building yards in Kerala. According to the census of the mechanized fishing boats in Kerala, there were 2961 boats of various types using different gears (ring seine, purse seine and trawl net) in Kerala by 1982 and private boat building yard constructed a major part of boats. (Government of Kerala, 1981) [6]. This information when juxtaposed with the availability of marine diesel engine drives home the reality that trawlers of any size could be manufactured by private boat builders in Kerala in the eighties. From the unofficial information received from the pioneer trawler owners in Neendakara – Shakthikulangara who got trained from the INP that majority of the old wooden vessels of 22-32 feet from the Neendakara – Shakthikulangara belt were sold out to the fishermen investors from other states especially from Kanyakumari and Thuthukudi in Tamil Nadu and the investors from Mangalore. With the advent of the decade 1980, the investors both fishermen and others started to buy new trawlers with modern equipment's thereby enabling themselves for modernization (Report, Expert Committee, 2007) [7].

The registration of trawlers from 1980 onwards is set forth in table 1.1. The number of trawlers registered in 1980 is 34. Only the two maritime districts of Kollam and Ernakulam.

Table 1.1: Growth of Trawlers in Kerala from 1980 to 2009

Year	Total (KL)	TVM	KLM	ALP	EKM	TSR	MLP	KKD	KNR	KSGD
1980	34	0	19	0	15	0	0	0	0	0
1981	13	0	1	0	1	0	0	11	0	0
1982	17	2	2	0	3	0	5	2	0	3
1983	24	1	1	0	4	11	2	5	0	0
1984	49	0	2	5	28	3	0	6	0	5
1985	27	3	7	2	7	0	0	4	1	3
1986	60	3	21	1	11	7	0	13	3	4
1987	68	2	25	3	13	0	2	17	4	2
1988	111	4	11	44	21	0	15	12	3	11
1989	93	7	10	2	33	13	4	16	4	4
1990	105	3	44	3	18	1	4	18	7	7
1991	111	2	46	4	27	3	4	15	1	9
1992	99	1	59	2	10	7	5	6	2	7
1993	96	2	39	8	7	5	7	17	3	8
1994	118	3	63	7	15	7	5	12	5	11
1995	109	4	37	2	18	6	11	17	7	7
1996	97	3	8	3	28	4	13	27	9	2
1997	98	4	2	7	37	5	12	22	6	3
1998	309	2	1	8	221	3	24	45	3	12
1999	104	1	5	4	29	2	5	39	14	5
2000	139	3	21	5	44	3	11	44	5	13
2001	353	2	12	3	205	15	13	97	6	0
2002	268	1	20	6	117	13	8	101	2	10
2003	408	0	201	4	49	11	15	117	8	3
2004	203	0	20	2	79	5	13	78	5	11
2005	87	1	28	3	14	6	13	19	2	10
2006	173	0	32	3	103	5	0	27	3	10
2007	202	0	162	2	14	11	4	5	4	11
2008	277	1	228	2	27	4	5	5	4	10
2009	269	0	220	1	21	3	11	8	5	10

Source: Unpublished data from MPEDA and Fisheries offices of all maritime districts (2010)

KL - Kerala, TVM - Thiruvananthapuram, ALP - Alappuzha, EKM - Ernakulam, TSR - Thrissur, MLP - Malappuram, KKD - Kozhikode, KNR - Kannur, KSD - Kasargode.

In 1981, the number of registrations in the districts of Kollam and Ernakulam were just one each and the district of Kozhikode had 11 new registrations. In 1982, 17 trawlers were registered and two fishermen owners from Thiruvananthapuram for the first time bought two trawlers and registered them in the port office of Kollam (Government of Kerala, 1983) [8]. New registrations were taking place year after year adding to the size of the fleet of trawlers in Kerala. Figure 3.1 explains the trend of the growth of trawlers in Kerala. The number of registrations varies from year to year. During the year 1998 comparatively high registrations (309) were noticed and the contribution is mainly made by Ernakulam, Kozhikode and Malappuram districts and particularly by the contribution made by the registrations in Ernakulam district. This is due to the fact that, attracted by the catch of hauls pink prawns; new investors came forward to invest in trawl fishery in Munambam (Nandakumar G, 1999) [9]. During the same period, multiday or stay over fishing took place and modern vessels above 61 feet were introduced in Kerala Fishery. This was also started by the investors in Munambam. The investors in Neendakara – Shakthikulangara copied the same in the later years particularly in the year 2003. The All Kerala Registrations went up to 408 in the year 2003 which is mainly contributed by Kollam and Kozhikode districts. During the years 2007, 2008 and 2009 the registrations were comparatively high in Neendakara – Shakthikulangara, since by then new trawlers were acquired by the investors in Neendakara- Shakthikulangara. This trend is depicted in figure.

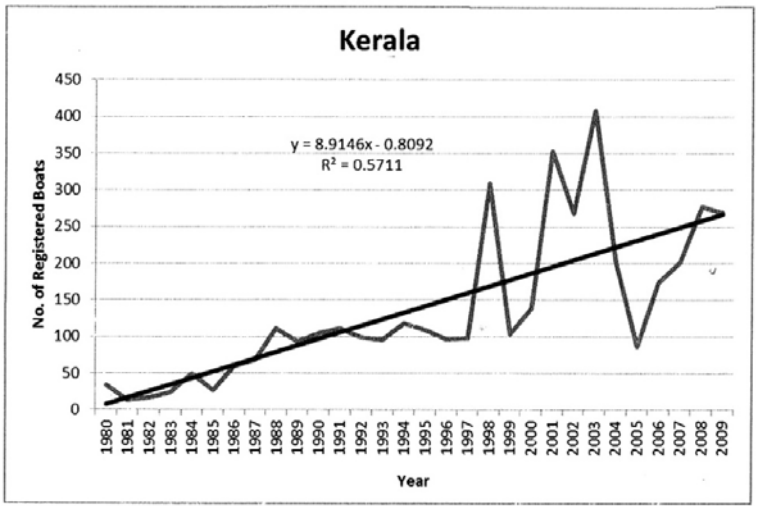

Fig 1.1: Growth of Trawlers in Kerala

Source: MPDEA and Fisheries offices of Maritime Districts (2010).

The figure 1.1 explains the trend of the growth of trawlers in Kerala fishery. The trend line fitted through the growth curve of trawlers shows that there is increase in the number of trawlers in Kerala. The trend line in general shows an upward trend. From the year 1998, there is a fluctuation in the growth of trawlers. A peak is experienced in registrations in the year 1998 and in the next year a fall is recorded in registrations. This increase is mainly contributed by Ernakulam district. The same trend of the year 1999 is repeated in the year 2003 and immediately after that a fall in registrations is recorded. Now this is contributed by Kollam district and thereafter the all Kerala registrations are mainly contributed by Kollam district. The reasons for the fluctuations as explained by the executives of the Deep Sea Boat Operators' Associations and the experts are as follows; (a) Investment cannot take place continuously, naturally there can be fluctuations. (b) Investment in new vessels is made depending on the catch and profit that the owners get during the previous years. (c) Increased availability of Haul Pink Prawns and Tiger Prawns and other high valued species during the years 1998 and 2002. (d) Movement of Prawn beds from one place to another which causes abundance of resources in certain areas during different seasons. Thus, the investments in trawlers are likely to be high in those areas where the harvest is high. According to the registrations there are 4225 trawlers in the year 2010 in Kerala. Counter checking the number of trawlers in operation in Kerala, with the All Kerala Deep Sea Boat Operators Associations that 243 trawler boats are not in active operation. Thus the number (3982) matches with the statistics of trawlers provided by the department of fisheries of Kerala (2009) [10].

5.2 District wise Growth rate of Trawlers during the period from 1980 – 2009

An analysis of growth of trawlers from 1980-2009 is done by using the following equation.

$y = ab^{t}et$ …….. (1)

The compound growth rate was obtained for the logarithmic form of the equation (i) is given below.

$\ln y = \ln a + \ln b$ …….. (2)

The compound growth rate (r) was computed by using the relationship;

$R = (\text{Antilog of } b - 1) \times 100$ …….. (3)

The compound growth rates were tested for their significance by the statistics given by

$t = r/SE(r)$ ……. (4)

Where $SE(r) = [100\ b \times SE(\ln b)] \ln e$ …… (5)

(SE = Standard Error)

Whereas, The equation used here in the exponential growth function y =growth rate, a = intercept, b = regression co-efficient, t = Time variable, e = error term.

Table 1.2: Compound Annual Growth Rate of Trawlers from 1980 – 2009

District	Growth Rate
Thiruvananthapuram	-.05
Kollam	4.34
Alappuzha	-0.04
Ernakulam	2.42
Thrissur	0.19
Malappuram	0.34
Kozhikode	1.64
Kannur	.17
Kasaragod	.28
Kerala	8.91

Source: Computed from the data obtained from MPEDA and Fisheries Offices of the Maritime Districts (2010).

The table 1.2 reveals that out of the nine maritime districts only two districts (Thiruvananthapuram and Alappuzha) have negative growth rate of trawlers. Kollam district has the highest growth rate followed by Ernakulam and Kozhikode. These districts have positive growth rate of trawlers due to the fact that they have well developed harbours and landing centres. The inspiration from the INP trained fisherman in Kollam and Ernakulam could be one of the reasons of more trawlers entering into the business of trawl fishing. It is to be noted here that all the trawlers operating in a particular district are not owned by the natives of the place.

5.3 Decadal Growth of Trawlers in Kerala

The entire study period from 1980 to 2009 is divided into three decades; 1980 to 1990, 1990 to 2000 and 2001 to 2009. Figure 1.2 gives information about the decadal growth of trawlers in Kerala fishery.

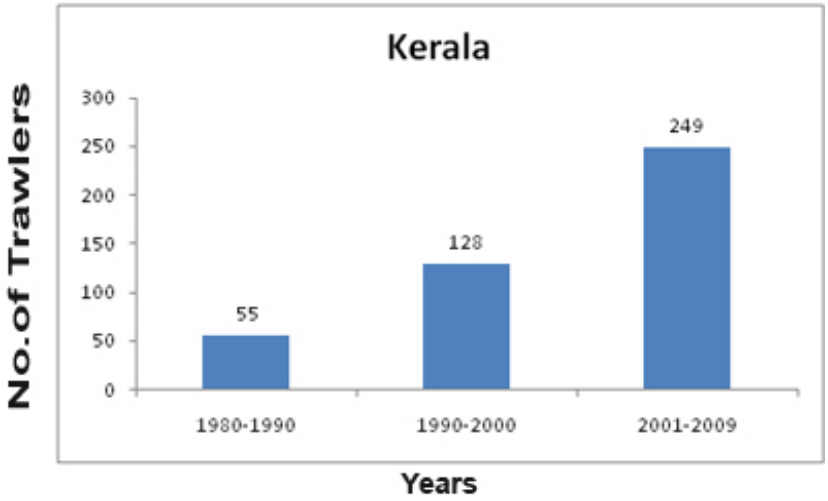

Fig 1.2: Decadal Growth of Trawlers in Kerala Fishery (%)

Source: Computed from the data obtained from Directorate of Fisheries 2011

Figure 1.2 puts forth that the decade 2001-2009 has more growth of trawlers relative to other two decades (1980- 1990 and 1990-2000). The reason for such a growth is the wide spread of investment in modern trawlers during the decade 2001-2009. It implies that investors were interested in acquiring most modern vessels with all high tech facilities during the decade 2001-2009.

5.4 Factors behind the Proliferation of the Trawlers

Experts selected as key informants from academicians working in the field of fisheries, members of the trawl boat owners, government officials, NGOs and members of the crew of trawl boats through a semi structured interview expressed the reasons behind the proliferation of the trawl boats in Kerala and thus the reasons were formulated. The reasons thus formulated can be short listed as follows.

- Lucrative returns to capital especially in the initial stages owing to steep rise in the price of fish (1980 to 1990)
- Availability of institutional credit on liberal terms along

with large amounts of subsidies and more financial institutions coming forward to finance the trawler owners. E.g.: Loans issued by co-operative societies to the boat owners.

- Development of harbours in all maritime districts and more shore based facilities from the 70s onwards.
- High demand for fish even in the domestic markets from the 1990s onwards.
- Continuously expanding and diversifying export market for marine fish products.
- The presence of money lenders in each district ready to issue loans without proper security.
- The possibility of increased employment generation.
- To overcome the negative profit in the existing vessel, an attempt is made to acquire modern vessel with all technical advancement.
- Process of registration and licensing is rather easy.
- It is considered as a prestige to own a trawl boat among the fishermen.
- Application of the demonstration effect.
- Availability of fishery equipment and requisites on subsidized rate.
- Replacement of the existing boats keeping the same registration or the registrations of the old boats is not cancelled.
- The old boats are sold out or exchanged without the permission of the department.
- The Kerala Marine Fisheries Regulation Act (1980) is not implemented well in giving license and proper monitoring is not done by the department of fisheries.
- The size and composition of the boat is expanded without the prior permission and proper monitoring is not done by the department of fisheries.
- The old boats are sold out or exchanged without the permission of the department.
- No checking on the increase in the number of boats.
- Inspite of the active involvement of the Marine Enforcement and vigilance (MEV) in Kerala, malpractices are taking place in the case of registration, licensing and selling of boats.

Kerala fishery inspite of the existence of KMFRA (1980) is considered as an open access fishery wherein trawlers enter and exit.

Lack of proper checking of license and renewal of license

6 Maximum Economic yields (MEY) and Economic Sustainability

Various studies reviewed from 1980 onwards revealed that the net profitability in trawler sector was negative. Restoration of the profitability of the trawl fishery and rehabilitation of the trawlers is one of the problems confronting marine fisheries sector in Kerala. MEY is calculated to find out the economically optimum levels of catch and to estimate the economic sustainability. Maximum economic yield is analysed for the marine production in Kerala, using the Fox model. Maximum economic yield was worked out based on total catch and effort data obtained from CMFRI for the period from 2002-2011.

Table 1.3: Results of the Fox model

Particulars	Parameters
Intercept	4.71**
Slop	-1.87514E **
Cost per hour of fishing	Rs. 1300
Fishing Effort at MEY	31.56 lakh hours
Maximum Economic Yield	1.95 Lakh tonnes
R^2	.87

Source: Data from CMFRI

** Significant at one per cent level.

The results of the Fox model regression showed that the MEY levels of catch and effort are 1.95 lakh tonnes and 31.56 lakh hours respectively. With the average number of 199 days of fishing trip, the average fishing hours is 63.7 lakh hours whereas the MEY effort (^{E}MEY) is only half of that of the current effort which means that the current trawl operations is not at economically optimum or sustainable level. The average catch during 2002 to 2011 is 1.87 lakh tonnes. The catch has exceeded the MEY yield in the years 2004 and 2011. The result is significant at one per cent level since R^2 is 0.87.

The results of the Fox model reveals that the use of the existing number of fishing hours (63.7 lakh hours) is more than double in terms of the economically optimum hours (31.56 lakh hours) estimated by the study. This clearly indicates that the present fleet size is in excess. It was already analysed and found out that the growth rate was 8.5 per cent. Together with the growth in the number of trawlers and the decline in catch rate and the estimated MEY, the study can be concluded that the fleet size of trawlers should be reduced, to restore the trawler sector to its pre-1980 level of the economic performance

7. Conclusions

Considering the co-existence of high fishing effort in trawl fishery which is more than double and the average catch which has not exceeded the MEY, the economic sustainability of the trawler sector has to be addressed by focusing on the former issue. By phasing out the old trawlers and restricting the entry of new ones or refusing license to the trawlers entering into the trawl fishing sector at least for five years, the present effort of the trawlers can be reduced. Active intervention of the government of Kerala is needed to make the trawler sector an economically sustainable venture. The motto of the government towards this sector should be to make the sector and economically sustainable and viable one. Efforts should be made to enable to sector economically viable at least by the end of the year 2020.

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