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# Enforcement of Minimum Legal Size on Fishers in Kerala, India: An Economic Appraisal

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## Abstract

The implementation of Minimum Legal Size (MLS) as a tool for managing fisheries and addressing the menace of juvenile fishing was first implemented by the state of Kerala in India in 2015. Since sustainability and profits offer a dramatic trade-off, the study has been conceptualized on the hypothesis that MLS has negatively affected the income of fishers. Primary data from 210 respondents across mechanized, motorized, and non-motorized fishing sectors were collected from six districts of Kerala to analyze and assess the change in income of fishers after the adoption of minimum legal size. The income of fishers who adopted MLS were found to be reduced in all the sectors *viz*. purse and ring seiners, single day trawlers, motorized gillnetters, and non-motorized crafts with 4.04, 2.31, 2.14, and 1.48 per cent reduction in income respectively. The benefit-cost analysis between compliers and non-compliers of MLS revealed that the adoption of minimum legal size has not significantly affected the fishers, as they could fetch higher price for their catch which negated the loss of income due to MLS adoption. These results highlight the necessity of implementing management measures like MLS to achieve sustainability and better management of marine capture fisheries.

**Keywords:** Fisheries management, minimum legal size, sustainability, economic analysis

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## Introduction

Overfishing and overexploitation of marine fishery resources, driven by technological advancements (Pauly et al., 2002), powered by rising demand for fish, is a major challenge faced by the fisheries sector and posing threat to sustainability. The world's marine fisheries production has shown a declining trend since the 1980s and the proportion of fishery stocks maintained at biologically sustainable levels decreased to 64.6 % in 2019, which is a 1.2 % decline from the figures recorded in 2017 (FAO, 2018; FAO, 2022). Besides, problems such as juvenile fishing, by-catch discards, and pollution continue to jeopardize the marine fisheries sector. The total by-catch (catch that is either unused or unmanaged) from marine fisheries accounts for 40.4 % and the annual discards from marine capture fisheries between 2010-2014 was estimated as 9.1 million tonnes world wide (Davies et al., 2009; Roda et al., 2019). Based on a recent study, it has been found that a considerable proportion of India's significant fish stocks are facing issues of overfishing. Specifically, 36.3 % of the major fish stocks are currently overfished, while 3.1 % of the fish stocks are facing the problem of overfishing (Sathianandan et al., 2021). The juvenile cephalopods exploited from India by small meshed trawlers were 4,625 tonnes per annum (Mohamed et al., 2009) and the economic cost due to juvenile fishing in India is estimated at US$ 190 million (Najmudeen & Sathiadhas, 2008), which clearly indicated the extent of exploitation of juvenile fishes. It was rightly concluded by Zeller et al. (2018) that poor fishing practices in conjunction with inefficient management measures are responsible for discards and over exploitation. All these factors will significantly impact the livelihood of millions of people around the globe who rely on the fisheries sector for food, nutrition and income. In this context, management and sustainability of fisheries

resources should be a top priority for the long-term sustainability of available resources. There are several management measures like demarcation of fishing zones, monsoon fishing ban, licensing system, mesh size regulation, minimum legal size, summer fishing moratoria, monsoon trawl ban, prohibition of certain fishing gear, fish catch limit rules, marine protected areas etc. that have been widely adopted around the world to ensure sustainability of the fisheries resources (Sinclair, 1990; Bohnsack, 2000; Heikinheimo et al., 2006; Shen & Heino, 2014). According to the World Bank report (2010), the management methods adopted in India are insufficient to control over exploitation of fishery resources, necessitating the implementation of new innovative management strategies to supplement the existing ones.

Marine fish production in Kerala was stagnant for two decades before declining to 5.44 tonnes in 2019, with a drastic decline in sardine landings due to overfishing and juvenile fishing (Kripa et al., 2018; CMFRI, 2020). Kerala's fisheries industry is crucial to the state's economy, contributing 1.4 % to the GDP and stands third in total fish production of the country. The diminishing harvests and unanticipated drop in fish availability in Kerala have had a negative impact on the economy and livelihood of fishermen (Devi et al., 2018), prompting the government to investigate the issue. The studies on fish stock and causes for decline in fish availability by ICAR-Central Marine Fisheries Research Institute (ICAR-CMFRI), have found that overfishing and juvenile fishing were the main reasons for decline in catches (Najmudeen & Sathiadhas, 2008; Mohamed et al., 2009; Sathiadhas & Shyam, 2012; Gopalakrishna & Satheeshkumar, 2012; Mohamed et al., 2014). In response to this, ICAR-CMFRI recommended implementing Minimum Legal Size for commercially important marine species to control juvenile fishing. Considering the recommendation, Government of Kerala implemented MLS initially for 14 fishes on 24-July-2015 (Notified vide GO (P) No. 40/15/ F&PD dated 24.7.2015) and another 44 species have been added and updated to the list after two years (Notified vide GO (P) No. 11/2017/ F&PD dated 17-05-2017). The measure was anticipated to have huge implications in the State where 8 lakh fishermen are working in the marine sector and many livelihoods are highly dependent on this fishery in Kerala (Directorate of Fisheries, 2019). This necessitated assessing the real economic effects of MLS implementation on fishers and the results will help in implementing the same across the coastal states of the country.

Minimum Legal Size (MLS) is implemented as a fisheries management tool with the potential to protect juvenile fish, sustain spawning stocks and manage the sizes of fish captured (Hill, 1990; Mohamed et al., 2014). MLS is referred to as the minimum size at which a particular fish species can be legally kept in the boat if caught (Hill, 1990) and this will be mainly achieved by altering the mesh size of the fishing gears. This management tool is used to protect immature fish ensuring that enough fish survive to spawn, control the numbers and sizes of fish landed, maximize marketing and economic benefits, and increase the yields (Winstanley, 1992; Gilbert et al., 1996). The tool was enacted in the State of Kerala to enhance the economic efficiency of the fishery in terms of protecting juvenile fishes and enabling them to grow in length and weight (Mohamed et al., 2014). The implementation can be considered as useful management measure to minimize overfishing with the positive stance of stakeholders (Kearney, 1992). But the implementation of MLS in Kerala resulted in difference of opinion among fishers of the three fishing sectors, due to decrease in landings leading to a further decrease in income (Martin, 2015; Navamy, 2018; Times News Network, 2018). The main aim of implementing MLS in Kerala is to reduce juvenile fishing by giving fish at least one chance to reproduce, hence contributing to recruitment and minimizing overexploitation of fishery resources. So, it is necessary to analyze the efficiency, compliance, and effects of MLS on fishers welfare. Many countries are widely implementing the MLS without assessing the practical, economic, and ecological adequacies (Stergiou et al., 2009). Without such understanding, efforts to implement policy among fishers are likely to backfire since there are studies showing the ill effects of lopsided policy implementation (Sinclair, 1990; Mora, et al., 2009). In this backdrop, it is necessary to assess the effect of MLS implementation on fishers' income. Hence this study was conducted to assess the economic effects and financial changes due to MLS implementation on fishers of Kerala.

## Materials and methods

This study was carried out in Kerala where MLS was initiated and implemented. In this study we had analyzed the current economic situation of the

fishers and further assessed the change in economic condition with the implementation of MLS. The state is blessed with rich fisheries resources along a coastline of 590 km, accounting for 7.26 % of the country's total coastline, as well as a continental shelf area of 40,000 sq.km which is close to the land area of the State. The State is having an Exclusive Economic Zone (EEZ) of 2.18 lakh $Km^2$ with marine fishing villages (222), marine fish landing centers (187), registered fishing crafts (34,801) and gears (17,555) (Marine Fisheries Census, 2010; CMFRI, 2020). Approximately 81 % of the fishing vessels in Kerala are motorized, with a total of 28,252 vessels. Mechanized vessels make up 12 % of the total, with 4,165 vessels, while non-motorized vessels make up the remaining 7 %. In terms of fishing gear, gill netters account for 35 % of the total (6,112), followed by drift netters at 16 % (2,875), and trawl netters and ring seiners at 11 % each with 1,980 and 1,970 numbers respectively (Marine Fisheries Census, 2010; CMFRI, 2020).

A pilot survey was conducted initially involving 30 fishers in the area to collect the demographic information, type of fishing, craft and gear characteristics, cost and earnings of fishing, awareness on MLS, information on fishing practices etc. During the second phase, an in-depth interview was conducted with pretested and well-structured schedule and focused group discussion with key stakeholders to understand about the pros and cons of MLS adoption. Secondary data were collected from the Department of Fisheries (DoF), Kerala and ICAR-Central Marine Fisheries Research Institute regarding MLS, craft and gear details, market prices and the cost details. Also, the literature review helped to understand the management measures in the marine fisheries sector and the countries adopting MLS. In this study, to analyze the economic impact, two groups were selected that includes the compliers, those who adopted the MLS post implementation and the non-compliers, those who have not adopted the MLS. To select the first sampling units, i.e., the number of fishers to be selected from each maritime district, a proportionate sampling method has been carried out and districts have been selected according to the proportion of crafts in each district. Further, a total of 210 fishers (crew members) were selected randomly from the six coastal districts of Kerala, with 68 from the mechanized sector (including single-day trawlers, purse, and ring seiners), 92 from the motorized sector, and 50 from the non-motorized sector and necessary information has been collected. Specifically, in the mechanized, motorized, and non-motorized sectors, there were 46, 61, and 26 fishers who complied with the MLS regulations, while 22, 31, and 24 fishers did not comply with the regulations. The sampling details and sampling sites are furnished in the Table 1 and Fig. 1 respectively. A detailed comparison and analysis of income, fishing months, time spend for fishing, catch per trip, and revenue per trip were collected between the compliers and non-compliers of MLS to analyze the economic impact of MLS implementation.

The economics of fishing for mechanized, motorized, and non-motorized crafts were assessed using the financial performance indicators that include gross revenue, gross profit, annual operating cost, annual operating income, total cost, benefit-cost ratio, and operating ratio. Cost and returns analysis (Narayanakumar et al., 2017; Van Anrooy et al., 2020) were used for analyzing the profit obtained in fishing by mechanized, motorized and non-motorized sectors. This analysis reveals the profitability and financial strength of the sectors and the same has been used to analyze impacts on fishers'

Table 1. Respondents selected from different districts

| Districts | Mechanized | Motorized | Non-motorized | Total |
|---|---|---|---|---|
| Thiruvanathauram | 0 | 16 | 15 | 31 |
| Kollam | 14 | 13 | 7 | 34 |
| Ernakulam | 21 | 13 | 7 | 41 |
| Malappuram | 11 | 16 | 7 | 34 |
| Kozhikode | 17 | 21 | 7 | 45 |
| Kasaragod | 5 | 13 | 7 | 25 |
| Total | 68 | 92 | 50 | 210 |

income after MLS adoption. Data on fixed and operating costs were collected from mechanized, motorized and non-motorized crafts respectively from the compliers and non-compliers of MLS. Since the fixed costs were same for both compliers and non-compliers of MLS, the data were pooled. Total fixed cost (TFC) includes cost of craft, gear and accessories, labour cost, interest on fixed capital, and depreciation on fixed assets and its repair and maintenance. Total cost includes total variable cost (TVC) and total fixed cost (TFC). Wherein, total variable cost includes costs of all the inputs like fuel, food, wages, and annual maintenance. From the collected data, the operating cost per trip, gross revenue per trip, and net operating income were worked out. The statistical and econometric tools such as benefit cost ratio, annual net income, and paired t-test were used for the analysis. The financial performance was assessed using Benefit-Cost Ratio (BCR) which is the measure of the gross amount of annual discounted net cash flows over the investment's economic life. This ratio must be equal to or larger than unity for the investment to be regarded feasible (Shafiee et al., 2020).

BCR = Discounted stream of benefit / Discounted stream of cost

$$BCR = \frac{\left\{\frac{\Sigma_t B_t}{(1+r)^t}\right\}}{\left\{\frac{\Sigma_t C_t}{(1+r)^t}\right\}}$$

$B_t$ = total revenue earned at year $t$

$C_t$ = total costs at year $t$

$t$ = average number of years of operation of fishing units

$r$ = discount rate

$$Gross\ returns = Q * P$$

$Q$ = quantity of produce (kg)

$P$ = Selling price (₹/kg)

*Annual net income = (Gross revenue) – (Annual fixed cost + Annual Variable cost))*

*Operating ratio or capital productivity = Operating costs/ Gross returns*

The operating ratio pertains to the ratio of total variable costs and revenues generated by the sale of fish. It is said to be one of the major indicators of economic efficiency of the fishing system and shows the efficiency of fishing system by comparing the operating expenses to the GR. Paired t-test was used to compare means (McDonald, 2009). In this study it is used to test the significance difference between compliers and non-compliers of MLS. The observations were taken for income of fisher, fishing months, time spent for fishing, catch per trip and revenue per trip before and after MLS implementation from the compliers and non-compliers of MLS.

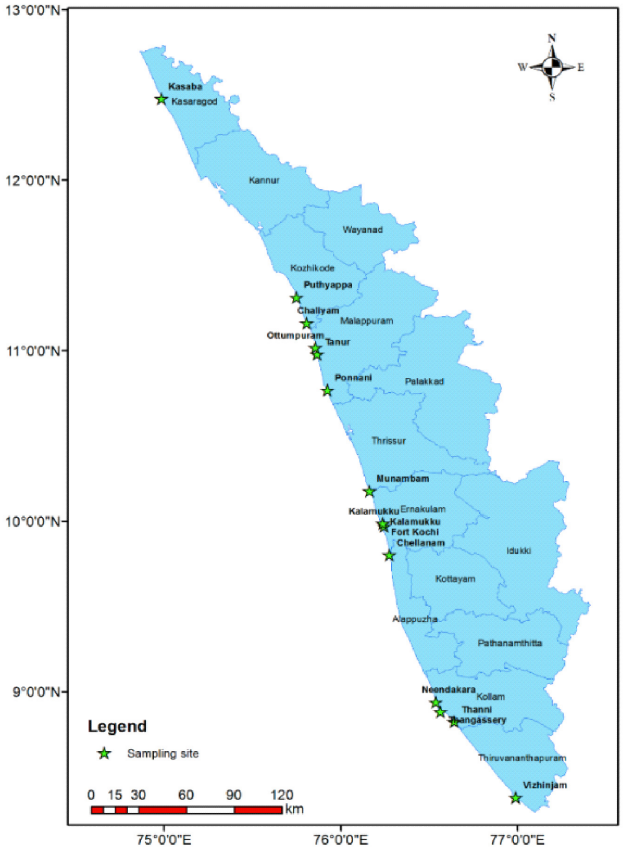


Fig. 1. Study locale: Selected districts of Kerala, India

## Results and Discussion

The current financial position of the fishers were analyzed and presented in Table 2. The analysis showed that fishing is the major source of income in fisher families and fishers earns a moderate level of an average annual income of ₹ 1,20,340 which is less than the per capita income of Kerala ₹ 1,49,563 but higher than the national average of ₹ 96,152 in 2019-20 Economic Review (2020). The monthly

income levels of the fishers vary from ₹ 8,100 to ₹ 23,456 across the mechanized, motorized, and non-motorized fishing systems. And the average monthly income from fishing for almost 46 % of the total respondents was less than ₹ 10,000, with 44.3 % earning between ₹ 10,001 and ₹ 15,000. Around 66 % of non-motorized fisher respondent's income falls between ₹ 8,000 and ₹ 10,000, implying that they make less money via non-motorized fishing. Mechanized, motorized and non-motorized fishermen earn an average of ₹ 13,258, ₹ 11,619.5 and ₹ 9,400 per month respectively. The study indicates that the income earned by fishers through fishing is relatively low. Approximately 79 % of all fishers surveyed shared this opinion, with percentages ranging from 85.4 % among non-motorized fishers to 70 % among mechanized fishers.

In this section, the analysis is done to assess the economic changes which occurred post implemen-

Table 2. Monthly net income of fishers

| Fishing Income (₹) | Mechanized (n=68) | Motorized (n=92) | Non-motorized (n=50) | Total (N=210) |
|---|---|---|---|---|
| <10000 | 18 (26.5) | 44 (47.8) | 33 (66.0) | 95 (45.2) |
| 10001-15000 | 36 (52.9) | 40 (43.5) | 17 (34.0) | 93 (44.3) |
| 15001-20000 | 9 (13.2) | 8 (8.7) | 0 (0.0) | 17 (8.1) |
| 20001-25000 | 5 (7.4) | 0 (0.0) | 0 (0.0) | 5 (2.4) |

(Figures in parenthesis designates percentage to the total)

Table 3. Changes in attributes after MLS Implementation

| Sectors | Attributes | Complier ($n_1$) | Non-complier ($n_2$) | % change | Paired t-test Sig. |
|---|---|---|---|---|---|
| Mechanized purse and ring seiners ($n_1$=25, $n_2$=12) | Net income of fisher/month (₹) | 14,324.87 | 14,928.34 | -4.04 | 0.007 |
| | Hours spent/trip | 8.60 | 8.29 | 3.60 | 0.315 |
| | Catch/trip (Kg) | 861.28 | 892.13 | -3.46 | 0.032 |
| | Revenue/trip (₹) | 65142.80 | 70078.20 | -7.04 | 0.002 |
| | Fuel (litres) | 369.38 | 341.25 | 7.62 | 0.284 |
| Mechanized single day trawlers ($n_1$=21, $n_2$=10) | Income of fisher/month (₹) | 13,880.49 | 14,207.99 | -2.31 | 0.035 |
| | Hours spent/trip | 9.84 | 9.34 | 5.08 | 0.021 |
| | Catch/trip (Kg) | 771.44 | 798.74 | -3.42 | 0.253 |
| | Revenue/trip (₹) | 41,235.70 | 43,459.20 | -5.12 | 0.007 |
| | Fuel (litres) | 372.95 | 351.95 | 5.63 | 0.005 |
| Motorized crafts ($n_1$=61, $n_2$=31) | Income of fisher/month (₹) | 11,090.91 | 11,333.33 | -2.14 | 0.003 |
| | Hours spent/trip | 6.72 | 6.50 | 3.18 | 0.005 |
| | Catch/trip (Kg) | 257.50 | 251.30 | 2.41 | 0.003 |
| | Revenue/trip (₹) | 28,545.20 | 29,120.00 | -1.63 | 0.386 |
| | Fuel (litres) | 335.58 | 338.50 | -0.86 | 0.425 |
| Non-motorized crafts ($n_1$=26, $n_2$=24) | Income of fisher/month (₹) | 9,897.66 | 10,046.15 | -1.48 | 0.047 |
| | Hours spent/trip | 3.93 | 3.75 | 4.80 | 0.235 |
| | Catch/trip (Kg) | 16.02 | 16.22 | -1.23 | 0.263 |
| | Revenue/trip (₹) | 795 | 808 | -1.60 | 0.007 |

tation of MLS to the compliers and non-compliers of MLS. From the Table 3, it is evident that there is a decrease in fishers' income, catch per trip and revenue per trip by 4.04 %, 3.46 % and 7.04 % respectively for the purse and ring seiners and 2.31 %, 3.42 % and 5.12 % respectively in the case of single day trawlers after MLS adoption similarly in case of motorized sector the fishers' income, catch per trip and revenue per trip is decreased by 2.14 %, 2.41 % and 1.63 % respectively. In case of non-motorized sector there is decrease in fishers' income, catch per trip and revenue per trip by 1.48 %, 1.23 % and 1.60 % respectively. The income of purse and ring seiners have considerably reduced compared to other fishing practices. According to fishers' those who comply with MLS, the majority (71.9 %) of them did not see any change in revenue because of the MLS adoption. The main reason for the drop in income, according to the fishers', is that they used to catch significant amounts of juvenile fishes along with the other catch and sell the juvenile fishes to the fish meal plants for ₹ 20 per kg and thus earn additional income. The exploitation of juveniles of commercially important species causes a relatively significant economic loss when compared to the benefits gained by fishermen from allowing the juvenile fish to grow in size and weight before catching them (Suja & Mohamed, 2014). According to the fishers, if they have a poor catch during a fishing trip, they will often resort to targeting immature fish in order to cover their operational costs. However, the fishers also opined that they are getting good prices for their catches due to catch of larger sized fish and hence with higher price realization the effect of reduction in revenue is negated. Majority of the fishers are aware about the negative impacts of the over exploitation of the juvenile fishes, the same has been reported in the study of Suja & Mohamed (2014) and raising awareness among all fishers will help in tackling the menace of juvenile fishing.

To analyze the effect of MLS compliance in different fishing systems, cost-benefit analysis was carried out and the results are furnished in Table 4, 5, 6, 7 and Fig. 2. In case of mechanized fishing vessels, the MLS compliers among single day trawlers have a benefit-cost ratio of 1.09, whereas non-compliers have a benefit-cost ratio of 1.10 which is slightly more than compliers. And there is only slight difference in operating ratio of both the compliers and non-compliers with 0.89 and 0.88 respectively. However, both groups the MLS compliers and non-compliers, have economic viability in fishing, but the strict implementation of MLS regulations can promote sustainable fishing practices. While in purse and ring seiners the compliers and non-compliers were having a BC ratio of 1.30 and 1.34 with operating ratio 0.69 and 0.67 respectively. In case of the motorized sectors, both the compliers and non-compliers are having a benefit-cost ratio of 1.06 and there is no difference in operating ratio of both the compliers and non-compliers. The economic analysis of non-motorized sector with compliers and non-compliers reveals that even though both are economically viable with a benefit-cost ratio of 1.21 and 1.23 respectively, the non-compliers of MLS are benefitted compared to compliers. The data explains that the income of MLS compliers has significantly been affected with MLS adoption, but with the increase in fishing hours due to scouting and catching big sized fishes which fetches more price in the market, the compliers are getting a decent income. Despite the technological advancements made by fishers to enhance their fishing efficiency, they have not been able to attain economic efficiency (Najmudeen & Sathiadhas, 2008). This is because a considerable amount of potential future income, represented by a large number of juvenile fish, is being lost each year due to overfishing. So, MLS adoption could be strictly monitored and implemented for all fishing practices to attain long-term positive impacts. Hancock (1990)

Table 4. General characteristics of mechanized, motorized and non-motorized fishing systems

| Items | Mechanized PRS† (n=37) | Mechanized SDT§ (n=31) | Motorized (n=92) | Non-motorized (n=50) |
|---|---|---|---|---|
| Average crew size (no.s) | 40 | 9 | 5 | 3 |
| Annual fishing days | 230 | 213 | 248 | 264 |
| Craft life (yrs.) | 20 | 20 | 20 | 15 |
| Gear life (yrs.) | 10 | 10 | 10 | 10 |

†PRS: Purse and Ring Seiner§SDT: Single Day Trawler

conducted a review of the impact of setting legal sizes in Australia and found that it has yielded positive results by protecting immature and juvenile fishes and allowing them to spawn at least once. Graham et al. (2007) also arrived at a conclusion that MLS is a positive measure that can help to reduce the number of juveniles caught as bycatch. When comparing the income of MLS compliers and non-compliers, the analysis reveals a decrease in income for fishers across all sectors. However, there is significant difference in income between the two groups. But the cost-benefit analysis of compliers and non-compliers in these three sectors shows that, fishing is profitable even after MLS implementation. The fuel costs were the significant cost component in the operating costs which comes between 50-57 % in mechanized and 79.07 % in motorized crafts respectively. So, increase in fuel cost will have a significant impact on the profitability of fishing which is one of the major constraints in the sector (Shyam et al., 2019). And looking at the broader perspective by analyzing the result of cost-benefit scenario and considering the time spent by the non-compliers to catch the juveniles which in turn increases the fuel usage and thereby reduces the catch per unit effort (CPUE) which may leads to less economic productivity. As the species that fishermen target, the level of exploitation, and the gear that they employ are all impacted by the benefits they obtain as fishing is an economic activity (Pascoe, 2006). The income is the multiplier of the price and catch, albeit the catch has got reduced, the compliers opined that they are able to fetch good price in the market which may negate the significant economic impact of MLS adoption. Implementing robust monitoring and imposing heavy fines and penalties on those who do not comply could have a substantial impact on the economic returns of non-compliant fishers. This, in turn, is likely to encourage better compliance with MLS regulations across the industry. With this, it can be concluded that MLS adoption won't be economically affecting the fishers much in accordance with the sustainability viewpoint. Since post MLS adoption, compliers are fetching good prices in the market for their big sized fishes while the juvenile fishes fetch very less price, thus MLS as an output control tool seems to be a potential management measure to control juvenile exploitation and sustain the stock. And with the compliance of MLS by all the fishers, fishes will be able to grow up to marketable size and this will have a significant positive effect on the income of fishermen. The MLS implementation will be highly effective when the fishermen shift the fishing grounds where high percentage of juvenile fishes will be there along with the use of large square meshed gears. Thus, the gear become selective and the juvenile fishes could be able to escape from the gear and larger fishes will get caught (Mohamed et al., 2014).

The economic conditions of the fishers indicate that the adoption of MLS has not affected the fishers significantly considering the long-term positive effects on the sustainability of marine fisheries resources. The revenue per trip, fishers' income and catch per trip have shown a slight decrease for the compliers of MLS by adopting minimum legal size

Table 5. Annual fixed costs of mechanized, motorized and non-motorized fishing systems

| Items | Mechanized PRS (n=37) | | Mechanized SDT (n=31) | | Motorized (n=92) | | Non-motorized (n=50) | |
|---|---|---|---|---|---|---|---|---|
| | Cost | Depreciation | Cost | Depreciation | Cost | Depreciation | Cost | Depreciation |
| Craft | 4,875,433.00 | 243,771.65 | 1,104,545.45 | 55,227.27 | 239,226.40 | 11,961.32 | 35,194.40 | 2,346.29 |
| Gear | 1,731,300.00 | 173,130.00 | 210,416.66 | 21,041.67 | 88,584.90 | 8,858.49 | 50,277.70 | 5,027.77 |
| Accessories | 93,600.00 | 46,800.00 | 76,400.00 | 25,466.67 | 20,781.00 | 6,927.00 | 2,815 | 938.33 |
| Total | 6,700,333.00 | 463,701.65 | 1,391,362.11 | 101,735.61 | 348,592.30 | 27,746.81 | 88,287.10 | 8,312.40 |
| Interest on investment (11.3 % p.a) | | 757,137.63 | | 157,223.92 | | 39,390.93 | | 9,976.44 |
| Total annual fixed cost | | 1,220,839.28 | | 258,959.52 | | 67,137.74 | | 18,288.84 |

(All the values in ₹)

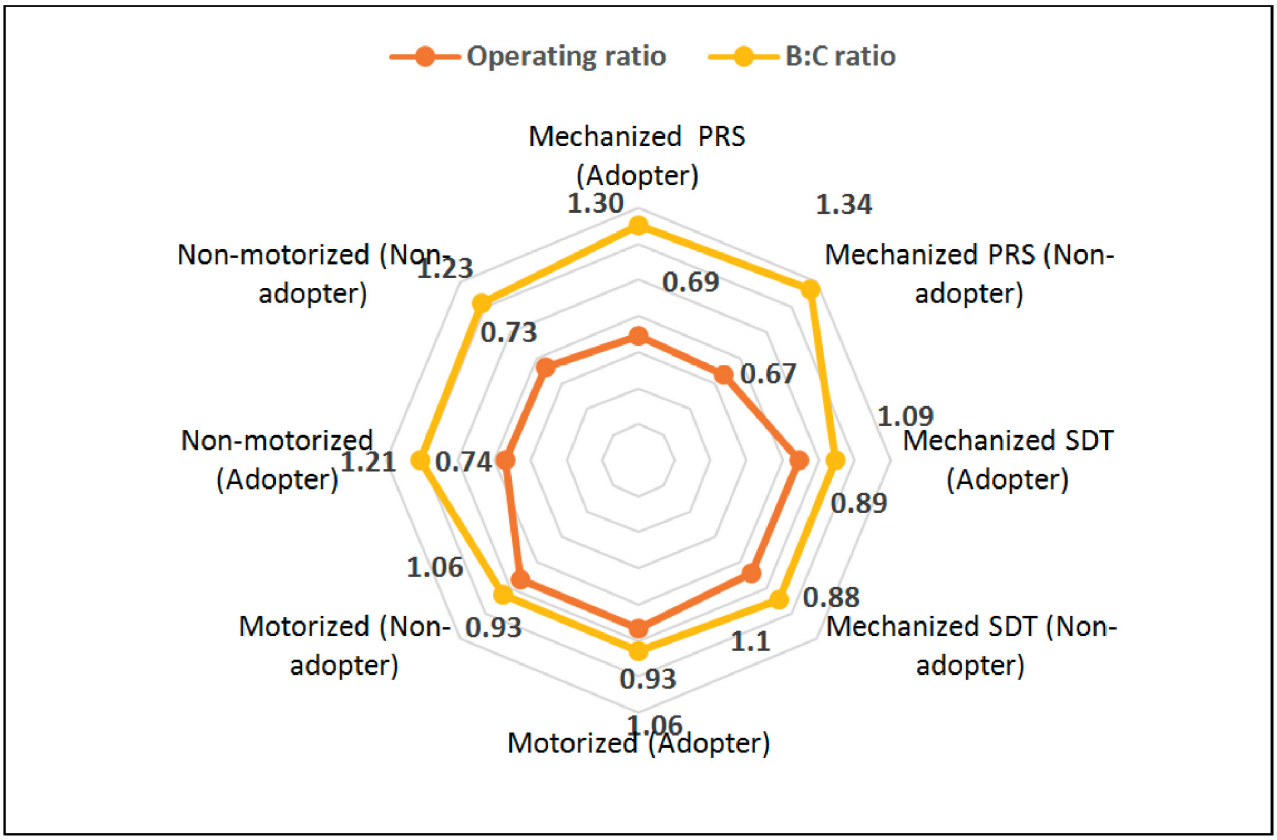


Fig. 2. Financial feasibility indicators of different fishing methods

Table 6. Annual operating cost of mechanized, motorized and non-motorized fishing systems

| Items | Mechanized PRS Complier ($n_1$=25) | Mechanized PRS Non-complier ($n_2$=12) | Mechanized SDT Complier ($n_1$=21) | Mechanized SDT Non-complier ($n_2$=10) | Motorized Complier ($n_1$=61) | Motorized Non-complier ($n_2$=31) | Non-motorized Complier ($n_1$=26) | Non-motorized Non-complier ($n_2$=24) |
|---|---|---|---|---|---|---|---|---|
| Fuel & Oil | 5,198,200.00 | 5,646,700.00 | 5,301,532.92 | 5,715,336.54 | 5,405,187.06 | 5,456,620.00 | 0.00 | 0.00 |
| Food & Daily Bata | 530,150.00 | 530,150.00 | 498,115.20 | 506,510.40 | 77,115.36 | 77,115.36 | 55,400.00 | 55,400.00 |
| Wages | 3,680,000.00 | 3,680,000.00 | 1,408,158.00 | 1,463,167.80 | 651,000.00 | 651,000.00 | 79,200.00 | 79,200.00 |
| Repair and maintenance | 120,000.00 | 133,400.00 | 31,495.00 | 34,000.00 | 28,540.00 | 28,540.00 | 9,314.00 | 9,438.00 |
| Total working capital | 95,283,50.00 | 9,990,250.00 | 7,239,301.12 | 7,719,014.74 | 6,166,267.00 | 6,213,275.36 | 143,954.00 | 144,078.20 |
| Interest on working capital (8.1 % p.a) | 771,796.35 | 809,210.25 | 586,383.39 | 625,240.19 | 499,468.00 | 503,275.30 | 11,660.27 | 11,670.32 |
| Annual operating cost | 10,300,146.35 | 10799460.25 | 7,825,684.51 | 8,344,254.93 | 6,665,734.84 | 6,716,550.66 | 155,614.27 | 155,748.32 |

(All the values in ₹)

Table 7. Annual cost and returns of mechanized, motorized and non-motorized fishing systems of Kerala

| Components | Mechanized PRS Complier ($n_1$=25) | Mechanized PRS Non-complier ($n_2$=12) | Mechanized SDT Complier ($n_1$=21) | Mechanized SDT Non-complier ($n_2$=10) | Motorized Complier ($n_1$=61) | Motorized Non-complier ($n_2$=31) | Non-motorized Complier ($n_1$=26) | Non-motorized Non-complier ($n_2$=24) |
|---|---|---|---|---|---|---|---|---|
| Annual fixed cost | 1,220,839.28 | 1,220,839.28 | 258,959.52 | 258,959.52 | 67,137.74 | 67,137.74 | 18,288.84 | 18,288.84 |
| Annual operating cost | 10,300,146.35 | 10,799,460.25 | 7,825,684.51 | 8,344,254.93 | 6,665,734.84 | 6,716,550.66 | 155,614.27 | 155,748.32 |
| Annual total cost | 11,520,985.63 | 12,020,299.53 | 8,084,644.03 | 8,603,214.46 | 6,732,872.58 | 6,783,688.40 | 173,903.11 | 174,037.16 |
| Annual gross revenue | 14,982,844.00 | 16,117,940.00 | 8,807,945.52 | 9,439,338.24 | 7,153,609.60 | 7,221,760.00 | 209,880.00 | 213,312.00 |
| Annual net operating income (5-2) | 4,682,697.65 | 5,318,479.75 | 982,261.01 | 1,095,083.31 | 487,874.76 | 505,209.34 | 54,265.73 | 57,563.68 |
| Annual net income (5-3) | 3,461,858.37 | 4,097,640.47 | 723,301.49 | 836,123.78 | 420,737.02 | 438,071.60 | 35,976.89 | 39,274.84 |
| Operating ratio | 0.69 | 0.67 | 0.89 | 0.88 | 0.93 | 0.93 | 0.74 | 0.73 |
| B:C ratio | 1.30 | 1.34 | 1.09 | 1.10 | 1.06 | 1.06 | 1.21 | 1.23 |

(All the values in ₹)

of target species, as the fishers require more scouting time and fishing time in the sea to target large sized fishes which can be reduced by arranging training and awareness programmes of potential fishing zone advisories and usage of such technologies. The economic loss caused due to the exploitation of juveniles of commercially important species is relatively significant when compared to the catch gained by the fishermen leaving juvenile fishes to grow and attain weight. The major reasons for fishermen to catch juveniles is the price they can get from the fish meal industry and juvenile sardines have a strong consumer preference due to their superior taste, which must be prevented by raising awareness among both fishermen and customers. Also, the minimum support price system like in agriculture and the online marketing system can be implemented in capture fisheries that reduces the middlemen exploitation and eventually fishers get high returns for their catch (Salim et al., 2018). It is concerning that fishers who are hesitant to comply with MLS regulations are gaining an unfair advantage over responsible fishers, which is unacceptable. The competent authorities, such as the marine enforcement wing in Kerala, must monitor the management measures strictly and organize awareness programs and training to enhance the understanding and adoption of these control measures, ultimately leading to sustainable marine fish production. It can be concluded that the MLS as a management measure is a good initiative and it is visible that the catch has increased in the following years after the implementation of MLS and the adoption by the fishers (CMFRI, 2018 & 2019). Also, the low value bycatch (LVB) landings have significantly reduced, along with a decrease in the percentage of juveniles in the LVB, in the Kerala coast (Dineshbabu et al., 2022). Albeit the existence of legal pluralism in the country for marine fisheries management, this type of measures is necessary and to be implemented in all the maritime states of India. By taking such measures, the marine capture fisheries of India can gradually be managed in a better way, providing sufficient space for the fishery resources to regenerate and sustain for the long term.

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