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Shyam Salim S
Socio Economic Evaluation and Technology Transfer Division Central Marine Fisheries Research Institute, Kochi 682018, India.

Manjusha U
Socio Economic Evaluation and Technology Transfer Division Central Marine Fisheries Research Institute, Kochi 682018, India.

Pushkaran KN
Socio Economic Evaluation and Technology Transfer Division Central Marine Fisheries Research Institute, Kochi 682018, India.

Suresh VK
Socio Economic Evaluation and Technology Transfer Division Central Marine Fisheries Research Institute, Kochi 682018, India.

Sunil PV
Socio Economic Evaluation and Technology Transfer Division Central Marine Fisheries Research Institute, Kochi 682018, India.

Correspondence
Shyam Salim S
Socio Economic Evaluation and Technology Transfer Division Central Marine Fisheries Research Institute, Kochi 682018, India.

Assessment of socio-economic impact of mud bank fisheries along Punnapra, Kerala

Shyam Salim S, Manjusha U, Pushkaran KN, Suresh VK, Sunil PV

Abstract
Mud banks are unique formations which are characteristic to the south west coast of India and it commensurates with the fishing holidays or closed season in fisheries. The fishermen who are devoid of fishing activities during the monsoon ban period gets to huge amount of shoals finds this as an opportunity to gain the sole income. The fishing operations in the mudbank area are done at a lower depth, and hence the fishing costs tend to remain significantly low leading to huge profitability and increased returns. A cost benefit study related to mudbank fisheries was conducted in Punnapra of Alappuzha district, Kerala during 2014 and 2015 among non-motorized, motorized and mechanised sector. In spite of a slight increase in the fisheries landings during 2015 compared to 2014 it did not reflect in the income gained by the fishermen. The difference in income was mainly due to the changes in fish composition during these periods. Many fisheries operations face economic difficulties as a result of high fuel prices and low income.

Keywords: Mudbank, fisheries, operations, catch composition, profitability, cost and earnings.

1. Introduction
The fisheries sector is a vital component in Kerala's economy. It is an important source of food and protein and a major avenue for employment which has also become a major export industry in recent years. The fish consumption of Kerala is four times the national average and is inelastic in the case of both price and income [1]. Previously abundant species used for consumption has declined in the recent years there by aggravating the issue of food security. This issue of food security aggravated due to the current employment pattern of fishermen. Marine fish landings in Kerala during 2014 is estimated at 5.76 lakh tonnes registering a decline of 95000 tonnes i.e., 15% compared to 6.71 lakh tonnes landed during 2013. Marine fish production in Kerala has shown a decline over last two years, mainly because of decline in the landings of oilsardine. In Kerala, Alappuzha district contributed to about 0.81 lakh tonnes to the total Kerala marine fisheries landings during 2014, of which the trawl ban period contributed to about 28.2% [2]. The reduction in fish catch directly affects the employment patterns of the fishing community. Fishing labourers, who share one third of the total revenue of the catch, suffered heavily with substantial wage losses due to decrease in catch over the years and many were not willing to make a temporary shift from their traditional employment even during the lean period. Livelihood outcomes and fish abundance may also affect the vessel investment, as people regularly evaluate whether it is sensible to harvest fish-both in terms of the fleet size required to obtain the necessary catch and whether selling this catch will meet financial needs [3].
Maritime states along the west and east coast of India are implementing closed season for mechanized vessels as a corollary to their marine fishing regulation. During the ban period, the mechanised fishing boats, trawlers, including traditional boats are banned from carrying out fishing activities in the waters. The ban on bottom-trawling, imposed between June and August, contribute to an increase in income for the traditional fishermen.
The south west monsoon period is generally an off-season for the fisherfolk on the west coast of India. In this period of general idling, the calm areas created by the mud banks attract fishermen from far and wide. These calm areas varying in extent from 10-25 km provide safe harbourage to the country crafts. Launching and landing of canoes are very easy in the mud bank areas. Taking advantage of this facility, large numbers of canoes are brought to the mud bank areas, even from far off places [4]

Mud banks are distinctive creations which are characteristic to the south west coast of India between Mangalore and Kollam, documented for more than 350 years or more. Nevertheless the sequential occurrence over space and time isn't documented full proof. Mud bank formation in Kerala coast is unique and typically occurs between Neendakara in Kollam district to Ponnani in Malappuram district. Often this phenomenon is known as "Chaakara", "Large shoals" or "Shaanthakkara" which could be a quiet shore.

Mudbanks of Kerala can be defined as those areas of the sea adjoining the coast, which have a special property of dampening the waves resulting in clearly demarcated areas of calm water even during the roughest monsoon conditions of the sea. These areas become distinct from the other areas which may have a muddy bottom, and the tranquillity is caused as a result of dissipation of wave energy in the large quantity of mud kept in suspension [5]. Mud banks, as they appear and disappear in the sea, have been considered as unique formations and seem to occur nowhere else except along the Kerala coast, SW coast of India.

The formation of mud bank plays a major role in moulding the social and economic set up of the coastal people of that region by providing a stable fishing ground during the monsoon season. The mud banks which are known to exist from time imemorial have always been a matter of puzzle for the common man as well as the scientific world. These mud banks are boon to marginal fishermen of Kerala. The calm condition facilities marginal fishermen to venture into the sea during peak monsoon season and operate the available gears to catch the maximum fish wealth. Mud banks are often rich in penaeid prawns, oil sardine, mackerel, Stolephorous and various other soles. Around fifty species of fish and six species of prawns have been identified from the mud bank areas [6].

The importance of Chaakara results from the fact that the fishermen during the monsoon ban gets huge amount of shoals in the depth region of 20 to 50 metres and the fishing cost remain significantly low leading to huge profitability and returns during the season. The fishermen who are devoid of fishing activities and who solely depends upon the meager welfare measures initiated by the government in terms of ration and allowances finds this as an unique opportunity to gain the sole income during this particular period.

There are various studies related to many aspects of mudbank like its formation, physico-chemical properties, hydrography, phyto plankton productivity, benthos, fish and fisheries etc however there aren't many works reported regarding the cost benefit study related to mudbank fisheries. The overall objective of the study is to assess the economics of fishing operations in the month of monsoon ban commensuration with the mud bank in Kerala coast there by assessing the contribution of various fishery in the gross mudbank fisheries and the cost and earnings of the fishing operations. The study was conducted in Punnapra region of Alappuzha district (Figure.1) during the July 2014 and 2015.

2. Materials and methods

A cost benefit survey was conducted during 2014 and 2015 among 30 non motorised (Thermocol), 30 motorized and 5 mechanised crafts of the mudbank region to collect data on species composition, price, information related to craft and gear, operational cost, fixed cost, gross revenue, in the mud bank of Punnapra region of Alappuzha district. Percentage analysis and profitability ratios were worked out. The following computations were done to assess the cost and earnings of mud bank fishery

a) Total cost: Fixed cost + operating cost
b) Net operating income: Gross revenue-Total operating cost
c) Rate of return: Net profit /Total cost
d) Profitability Ratio : Net profit /operating cost
e) Net profit: Gross revenue- Total cost
f) Net profit ratio: Net profit / Gross revenue
g) Operating ratio: $\frac{\text{Total operating cost}}{\text{Total cost}}$

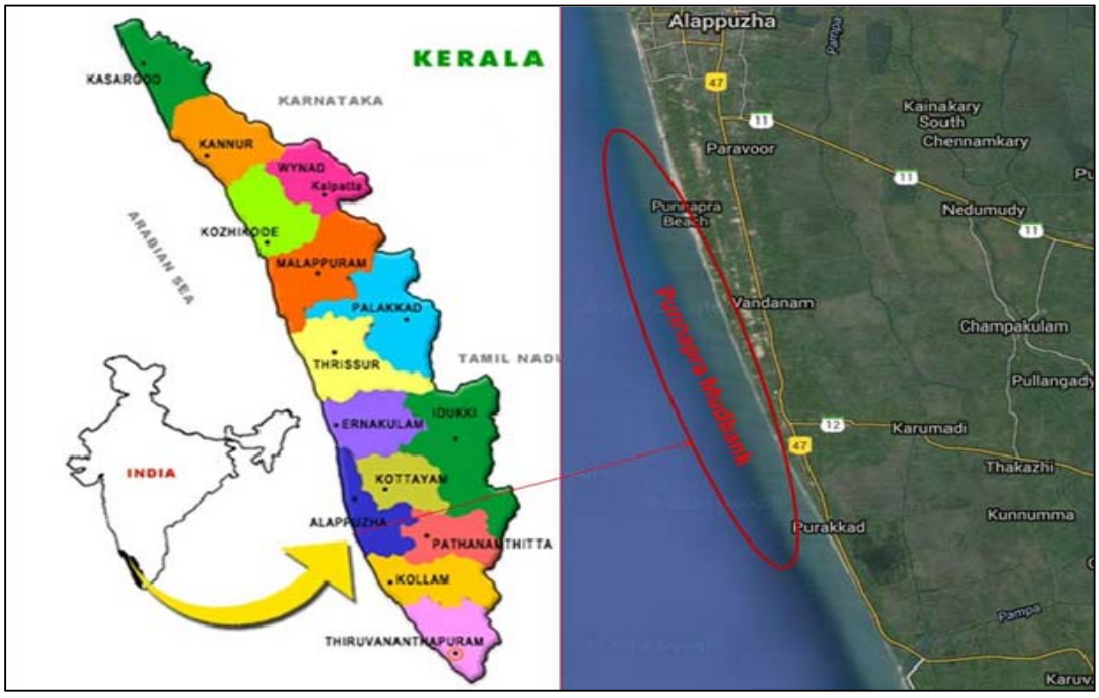

Fig1: Study Area

3. Results and Discussions

3.1. Operations

The study analyzed the cost of fishing operations amongst the different craft and gear in Punnapra region of Alappuzha district. It was found that the fishing operation was done mostly by non-motorized followed by motorized and mechanised sector (Figure.2). The average number of crafts operating in the region during the mudbank period is given below (Table 1).

Table1: Average number of crafts operated in mud bank region

S. No.	Crafts	Number
1.	Non-motorised (Thermocol)	125-175
2.	Motorised -Ring siene and gillnet	50-100
3.	Inboard	15-25
4.	Carrier boat	20

Fishing is done from the early hours of the day till noon normally in the mud bank region. But fishing continues throughout the day during heavy fishing days. The fishing is generally restrained to the peripheral region of the mud bank. When catches are heavy the boats have been observed to come to the shore to unload their catches and return to the same area to continue the fishing operations. On days of rough weather, fishing operations are carried out very close to the shore, within the mud bank. Majority of the fishermen who are engaged in fishing at the mud bank area are not permanent dwellers of this region; but have come from far off places for the sake of fishing during monsoon season. They come with owned or hired crafts and gears.

3.1.1. Non motorised (Thermocol)

The non-motorized craft include Thermocol boat, also called 'ponth' in local parlance for drag net operation. The fisherman use thermocol boats to venture into the sea by themselves, rowing with a single oar. The boat is about five feet long and less than two feet wide. Usually one or maximum two people go for fishing in thermocol boat which has enough space to seat them and balance their catch. The body of the thermocol boat is lined with plastic sheet. The boat along with the gear costs around Rs. 12,000-15,000 and sometimes the ownership is shared by 2 people. There are about 125-175 thermocol boats operating in the mud bank region.

3.1.2. Motorised

Outboard ring seiners and driftnet/gillnet operations are the major gears operating in the mudbank region.

Fig 2: Fishing operations in mudbank area

3.1.3. Mechanised

Inboard ring seiners are operating in the mudbank region. The ring seines goes inside chaakaras and operates upto 2 hauls per day. Every inboard ring seine employed in fishing operations needs carrier boats to transfer the catch from off shore to on shore. The number of carrier boats employed per ring seine is a director indicator of the financial capacity of the boat owners. In general 2 to 5 people go in carrier boats, a rope is used for anchoring the ring seine. After anchoring, the motor is motor is switched off and the catch from ring seine and is transferred to carrier boat. Around 15 to 25 numbers of ring seiners are employed in the locality of mudbank. Cost of ring seiner ranges from around 20 lakh to 30 lakh where as the cost of carrier boat falls within Rs. 2 to 2.5 lakh.

3.2. Catch composition

The different species which landed during 2014 mudbank include Oil Sardine - *Sardinella longiceps*, Croaker- *Otolithes cuivre*, Malabar Anchovy -*Thryssa malabarica*, Mustached anchovy - *Thryssa mystax*, Flower shrimp- *Metapenaeus dobsoni*, Hilsa Shad -*Tenualosa ilisha*, Indian White Prawn - *Fenneropenaeus indicus*, Silver bellies species, Indian Anchovy -*Stolephorus commersoni*, White sardine- *Escualosa thoracata* and Indian Mackerel - *Rastrelliger kanagurta.*

There is a vast difference in the species landed during 2015 mudbank compared to 2014 mudbank. The species include Indian Anchovy -*Stolephorus commersoni*, Flower shrimp- *Metapenaeus dobsoni*, Indian Mackerel - *Rastrelliger kanagurta*, White sardine- *Escualosa thoracata*, Indian White Prawn -*Fenneropenaeus indicus*, Silver bellies species, Big-jawed jumper- *Lactarius lactarius*, Malabar Anchovy - *Thryssa malabarica*, Hilsa Shad -*Tenualosa ilisha* (Figure. 3). The pattern of fish distribution in the mudbanks has been observed to change very frequently even ranging from day to day to seasonal. The phenomenon is not only for the mud bank area but also for other region of the coast during the other months.

Fig 3: Mudbank fisheries

The catch composition of 2014 and 2015 mudbank across the different crafts is indicated below

3.2.1. Non motorised (Thermocol)

During 2014 mudbank oil sardine accounted for 40% of the dominant catch in non-motorised landing, followed by Malabar anchovy (20%), mustached anchovy (10%), croaker (10%), hilsa shad (6%), silver bellies (6%), flower shrimp (4%), and other miscellaneous items constitute 4% of the landings (Figure. 4).

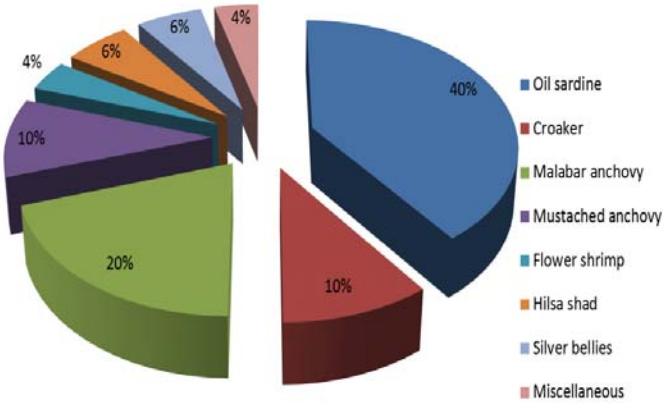

Fig 4: Non-motorized landings during 2014

The major species landed by thermocol boats during 2015 include White sardine- *Escualosa thoracata* and Flower shrimp- *Metapenaeus dobsoni* and the white sardine contributes 86% of the landings followed by flower shrimp (14%) (Figure. 5). Oil sardine and Thryssa species which were dominant during 2014 mudbank were not present in 2015 non-motorised landings.

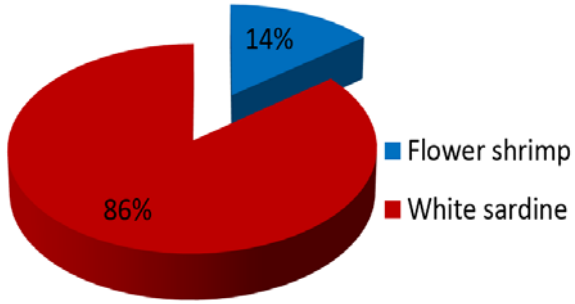

Fig 5: Non-motorized landings during 2015

3.2.2. Motorised

During 2014 mudbank, Stolephorus formed the major proportion of landings in motorised sector and accounted for 44% of the total landings followed by flower shrimp 28%, Oil sardine 13%, white sardine 6%, white prawn 6%, Indian Mackerel 2% and other miscellaneous items 1% (Figure. 6).

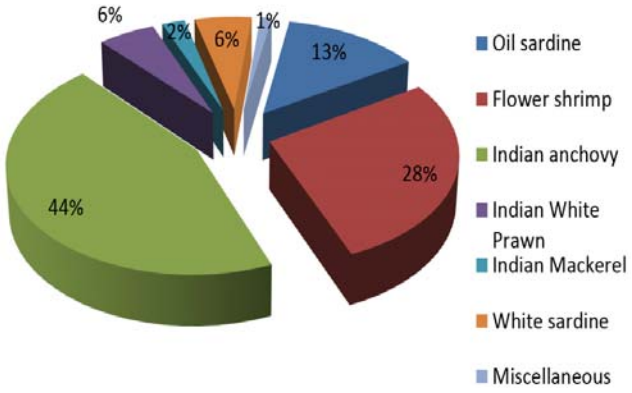

Fig 6: Motorized landings during 2014

Compared to 2014 mudbank, Stolephorus yet again accounted for 73% the major landings followed by Indian Mackerel 10%, Thryssa 5%, Horse mackerel 3%, Flower shrimp 3%, Big jawed jumper 2%, silver belly 2% and scad 2% during 2015 (Figure. 7).

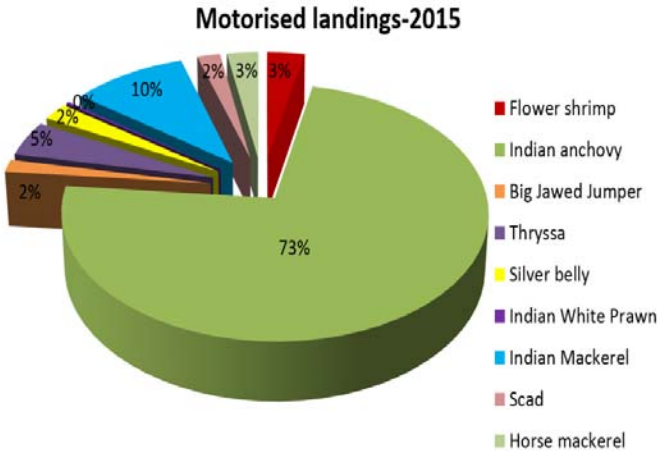

Fig 7: Motorized landings during 2015

3.2.3. Mechanised

During 2014 mudbank, flower shrimp contributed majorly to the catch with a percentage composition of 34% just followed by Stolephorus 32%, oil sardine 27%,white sardine 5%, Indian white prawn 2% and Indian mackerel constituted less than one percentage of the total landings (Figure. 8).

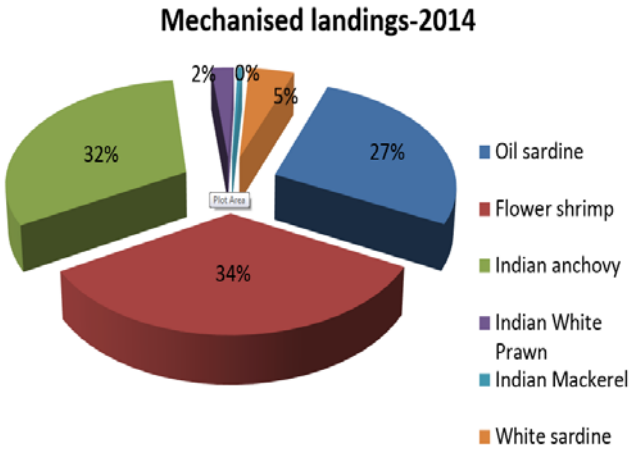

Fig 8: Mechanised landings during 2014

Compared to 2014 mudbank fisheries, 89% of the catch was contributed by Stolephorus landings, Thryssa 4%, Flower shrimp *M.dobsoni* 3%, big jawed jumper and silver belly 2% each throughout 2015 (Figure. 9).

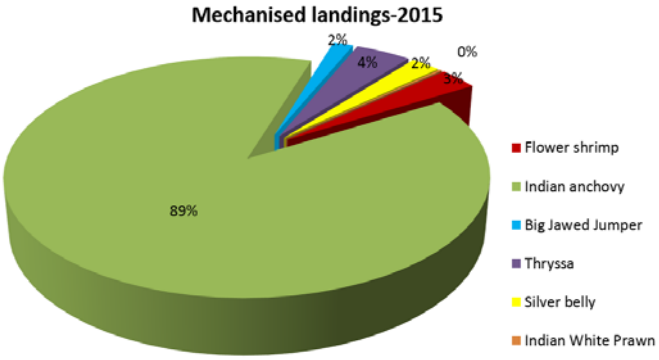

Fig 9: Mechanised landings during 2015

3.3. Cost and earnings

The economic performance of fishing operations is affected by several factors including fluctuations in revenue, diminishing catch per unit of effort, unforeseen increases in the cost of key inputs as well as catch and effort restrictions. Revenues and costs mainly determine the economics of fishing operations. Revenues depend on species and quantities caught and prices obtained, which again depend on marketing channels and markets, seasonal fluctuations and other factors. The main cost factors are capital investment and operation costs, which can be divided in labour costs, running costs and vessel costs. The major components of labour costs are wages and other labour charges such as insurance and employer's contributions to pension funds. Running costs are principally composed of fuel, lubricants, cost of selling fish, harbour dues, cost of ice, food and supplies for the crew [7].

3.3.1. Non Motorised fishing

An average quantity of 50 Kg fish and average revenue of Rs.1535 per trip was obtained from thermocol boats during 2014 however an average quantity of 7 Kg of fish and average revenue of Rs.660 per trip was only obtained from thermocol boats during 2015.

Compared to 2014 the net operating income was low during 2015. Net operating income is obtained by subtracting the operating costs from gross income which is the major element in decision making in day to day operations of marine fishing involving heavy risk and uncertainty. However for thermocol boats there is no cost of fuel, crew wages and other expenses so the rate of return and profitability ratio is high compared to other crafts, with the net profit (deducting fixed cost from operating income) for thermocol boats working out to be Rs. 1174.1 (Table. 2). Due to rough weather, fishing operations are carried out very close to the shore inside the mud bank. Owing to the extreme weather condition during the event of 2015 mudbank, fishing operations using thermocol boats were difficult and hence it reflected in the fish catch which was found to be nominal compared to the previous year.

Table 2: Cost and earnings

Profitability	Non motorised		Motorised		Mechanised	
	2014	2015	2014	2015	2014	2015
Average Quantity (Kg)	50	7	450	455	2250	2642
Average Revenue (Rs)	1535	660	43325	28063	210750	100000
Total Cost	360.95	360.95	27614	22494	137025	73560
Total Operating Cost	142.1	142.1	25448	21091	126487	68560
Net Operating Income	1392.90	570.40	17877	6972	84263	31440
Net Profit	1174.05	537.40	15711	5569	73725	26440

3.3.2. Motorised fishing

Outboard ring seine and gillnet together constituted an average quantity of 450 kg fish with an average revenue of Rs.43325 per trip during 2014 however an average quantity of 455 kg of fish and an average revenue of Rs.28063 per trip only was obtained during 2015.

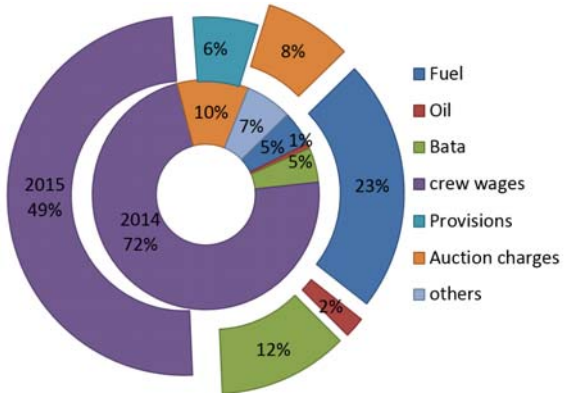

Fig 10: Operational cost of motorized fishing during 2014 and 2015

Usually the fuel expenses, auction commission, bata for food expenses of crew and other day to day operating expenditure except the repairing work of craft and gear are considered the common expenses of the unit. The main components of operating cost such as fuel, crew wages, auction charges, crew bata, other provisions, and their percentage of contribution is given in figure 10. The total operational cost indicated that crew wages was the maximal component accounting for 72% during 2014 and 49% during 2015. Usually fuel costs accounts for higher percentage during motorized operations, but during the mudbank fishing the boats are generally confined to the peripheral region of the mud bank so the cost of fuel was less compared to other motorized operations

The average operating cost per trip of the motorized fishing operations during 2014 was worked out to Rs. 25,448/- per trip with a gross revenue of Rs. 43,325/-,from 450kg of catch thus earning a net operating income of Rs. 17,877/-(Figure. 11)

During 2015 the average operating cost per trip of the motorized fishing operations was worked out to Rs. 21091/- per trip with a gross revenue of Rs. 28063/-, from 455 kg of catch thus earning a net operating income of Rs. 6972/-. Wages accounted for 49.59% of the total operating cost since the operation is more labour intensive, followed by the cost of fuel (23%). The net returns derived after meeting this common expenditure from the gross revenue is shared between the owner and crew members.

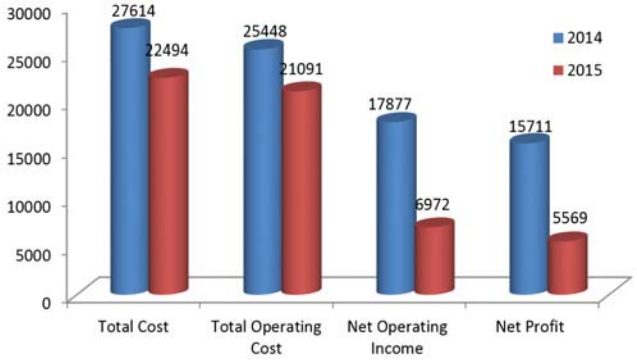

Fig 11: Operational efficiency of motorized fishing operations during 2014 and 2015

3.3.3. Mechanised fishing

During 2014 an average quantity of 2250 kg fish and average revenue of Rs.210750 per day was obtained from inboard ring seiners whereas an average quantity of 2642 kg fish and average revenue of Rs.1, 00,000 per day was obtained during 2015 mudbank.

The main components of operating cost such as fuel, crew wages, auction charges, crew bata, other provisions, and their percentage of contribution are given in Figure 12. In both the years crew wages accounted for 70% of the operational cost followed by the cost of fuel, auction charges, crew bata etc.

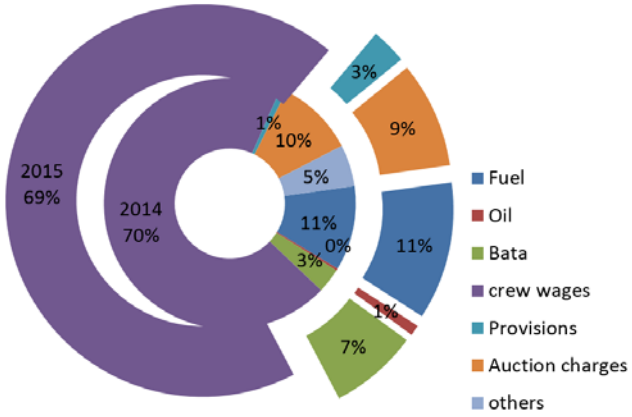

Fig 12: Operational cost of mechanised fishing during 2014 and 2015

The average operational costs for inboard ring seiners during 2014 was Rs. 126487 and the net operating income was Rs. 84263 per day and a net profit of Rs.73725 was obtained from the mechanized operations, whereas during 2015, the average operating costs and net operating income were Rs. 68560 and Rs. 31440 respectively. Only a net profit of Rs. 26440 could be gained during 2015 (Figure 13).

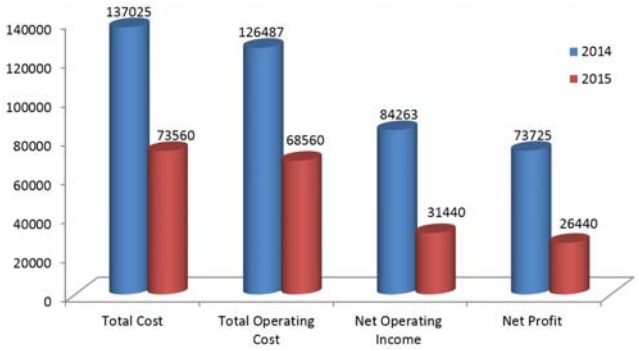

Fig 13: Operational efficiency of mechanized fishing operations during 2014 and 2015

There is a vast difference in the species landed during 2015 mudbank compared to 2014 mudbank. Even though there was a slight increase in the fisheries landings during 2015 compared to 2014, it was not reflected in the income gained by the fishermen. The difference in income was mainly due to the changes in fish composition during these periods. The share of income from flower shrimp (34%), stolephorus (32%)oil sardine (27%)and remaining share from white sardine, Indian white prawn and mackerel during 2014 was replaced by (stolephorus 89%, thryssa 4%) which are low value fish and flower shrimp and big jawed jumper were encountered only in small quantities. Whenever the gross earnings from the fish

catch is not sufficient to meet even the common expenses, the loss is temporarily shared by all crew members and adjusted later when the catches are high. Many fisheries operations face economic difficulties as a result of high fuel prices and low income. Though there is reduction in fish catch compared to 2015 the sale value of catches was high on account of prawns which was reflected in the average revenue acquired. The higher per day earnings of purse-seiners were due to the increase in the landings and prices of prawns, oil sardines and mackerels during 2014. The non-availability of fish in the domestic fish market will lead to a situation wherein the domestic consumers are devoid of fish in the market at affordable prices [8]. In fishing operations, the increased cost of fishing per trip, the reduced catch and subsequent decline in the returns per trip have become important constraints affecting the economic returns from different fishing crafts [9].

3.4. Profitability Ratio

Compared to three fishing operation, non-motorized sector has high rate of return and profitability ratio. The result of the profitability ratio varied from 0.26 in motorized landing during 2015 to 8.26 in non-motorized landings during 2014 (Table 3). The operating ratio worked out to be in the range of 0.09 to 0.75 for the various crafts across the sectors. Except operating ratio, rate of return, profitability ratio and net profit ratio was higher during 2014 in the motorized and mechanized fishing operations of the mudbank region.

Table 3: Profitability ratios of different fishing operations during 2014 and 2015

Profitability Ratios	Non-motorized		Motorized		Mechanized	
	2014	2015	2014	2015	2014	2015
Rate of return	3.25	4.38	0.57	0.25	0.54	0.36
Profitability ratio	8.26	6.00	0.62	0.26	0.58	0.39
Net Profit Ratio	0.76	0.81	0.36	0.25	0.35	0.36
Operating ratios	0.09	0.14	0.59	0.75	0.60	0.69

3.5. Marketing

The marine fishes in mudbank are disposed by auctioning, fish travels long distances from coastal areas to the interior parts of the state as well as the country. Generally the auctioning is done by traditional auctioneer or middlemen on commission basis who take up the responsibility of realizing the sale proceeds from the traders. The commission agent is the linkage between the fisherman and the supplier because of his dealing with local-language speaking fishermen as well as suppliers. The following marketing channels are prominently observed in the fish marketing system in mudbank (Figure. 11). For transportation of fish, trucks, tempos, motorised cycle rickshaws, mopeds and bicycles are used generally.

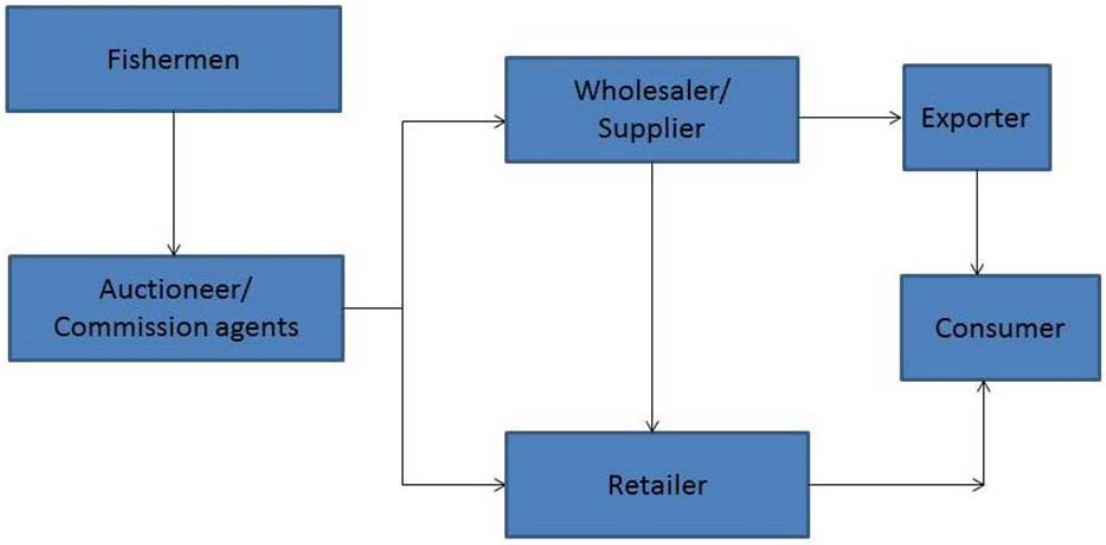

Fig 14: Marketing channel operated in mudbank region

3.6. Valuation of mudbank fisheries

The valuation of marine fish landings in India during 2014 was estimated at Rs.31750 crores at landing centre (LC) level and Rs.52360 crores at the retail centre (RC) level. Kerala accounted for the maximum share of the value of marine fish landings both at landing centre (Rs.6730 crores; 17.5%) and at retail centre (Rs.10720 crores; 15.8%) levels after Gujarat [2]. Of the total valuation of Kerala, the value of marine fish landings during the mudbank period in Punnapra accounted for the share of 1.6% and 0.88% during 2014 and 2015. Similar to Punnapra there are various places across the Kerala coast where the mudbank phenomenon is observed.

4. Conclusion

Mud bank formation commensurate with the fishing holidays or closed season in fisheries in Kerala. The fishermen who aredevoid of fishing activities finds this as an opportunity to gain the sole income during this particular period. A cost benefit survey was conducted during 2014 and 2015 among 30 non motorised (Thermocol), 30 motorized and 5 mechanised crafts of the mudbank region to collect data on species composition, price, information related to craft and gear, operational cost, fixed cost, gross revenue, in the mud bank Punnapra region of Alappuzha district.

The pattern of fish distribution in the mudbanks has been observed to change. Species which were dominant during 2014 mudbank were not present in 2015. Owing to the extreme weather condition which prevailed during the event of 2015 mudbank, fishing operations using thermocol boats was difficult and hence it reflected in the fish catch which was

found to be nominal compared to 2014 The difference in income was mainly due to the changes in fish composition during these periods.

The general trend in decrease of landings has been observed over the years, same has been reflected in the case of mudbanks. Declining catch per unit effort and increasing cost of operations have resulted in uneconomical operation of the fishing fleet during 2015 mudbank. The economic efficiency changes are difficult to access without using economic considerations, as effort changes towards species according to availability (and price). The study revealed that huge landings of stolephorus leading to steep fall in prices. Revenues and costs mainly determine the economics of fishing operations. Revenues depend on species and quantities caught and prices obtained, which again depend on marketing channels and markets, seasonal fluctuations and other factors.

5. Acknowledgement

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