Research Note

Ice Utilization in the Fisheries Sector of Kerala

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India is one of the top fish producing countries in the world, with its current fish production at 11.42 million mt (Fig. 1). The 1990's saw a boost in aquaculture production from India (Fig. 2) increasing the total fish production manifold from a mere 75,000 MT in the 1950-51 to 4.87 lakh and presently the country stands third in fish production and second in aquaculture production in the world.

Fish is a highly perishable commodity. On a national average, 75% of the fish is marketed fresh, 13.8% is frozen mainly for export, and about 5 to 11% is utilized for drying, curing and other purposes (Anon, 2020). Considering that the largest proportion of fish produced is marketed and consumed fresh, ice is a crucial input in the sector for its preservation and it is extensively used as a reliable coolant. The fishing sector also utilizes ice for the preservation of fish catch onboard and it is used during its onward transportation to the various channels of distribution.

Kerala has an impressive fishing fleet of 39,546 mechanised fishing vessels, 5979 motorised crafts, 30,881 motorised non-mechanical boats and 2676 non-motorised boats which caters to the fisheries industry (Anon, 2021). The marine fish production in the state was 6.42 lakh tonnes during 2018 (www.cmfri.org/kerala). Apart from marine fish, Kerala also produces freshwater fish from vast inland waters, lakes and reservoirs which gets distributed for domestic consumption. The state is also a hub for seafood processing with 112 fish processing plants with an installed capacity of 4493.86 tons of seafood per day. The industry is equipped with state-of-art infrastructure for processing, storage, packing and transport of fish which are processed into frozen, chilled and value added products.

Spoilage starts setting in fish soon after its death due to act of enzymes (Graham et al., 1992). Icing is the most common method used to preserve the catch onboard owing to its portability and cost effectiveness. At all stages right from harvesting to transportation, processing and marketing, ice is extensively used for preservation. During the fishing operations, especially in the case of multi-day fishing, fishermen store catch onboard in iced condition till it is landed. Fish reaches the consumer through a wide network of wholesale, retail and roadside fish markets where ice is again extensively used by the stakeholders in the supply chain.

Ice factories play a major role in supplying ice to the fisheries sector (Anon, 2005). Though advancements in ice manufacturing like production of slurry ice, flake ice, tube ice *etc.*, to suit the requirements of fisheries has revolutionized fish quality management (Thomas et al., 2015), the dependence on block ice continues. Very few studies are available in the literature which have assessed the ice utilization by fisheries (Jadhav et al., 2015), though the importance of the input is well accepted in maintaining quality and safety of the raw material or product. Therefore, the present study was taken up to estimate the ice production in the state with particular reference to the fisheries sector. The study was conducted in 2015 by undertaking a sample survey covering three fisheries intensive districts namely Ernakulam, Kollam and Kozhikode districts of Kerala. The main objective was to analyse the ice utilization pattern by the Kerala fisheries sector and to provide a short term projection for total ice requirement for Kerala fisheries. The production capacity vis-à-vis the actual production of ice by the ice factories and extent of utilization of ice by fishers, auctioneers,
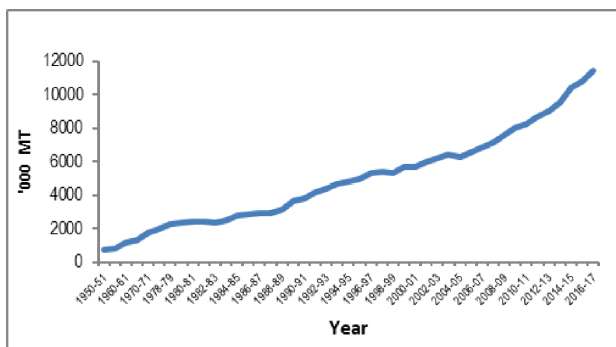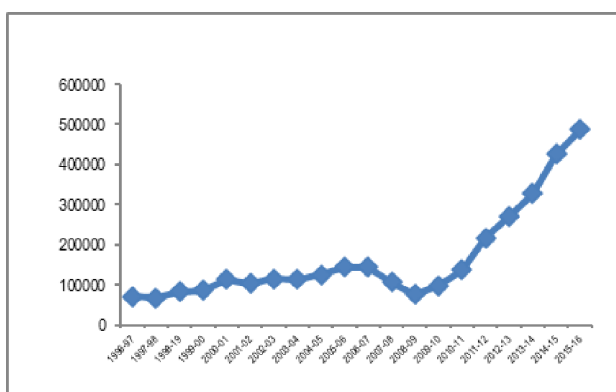
Fig. 1. Trend in fish production from India

Fig. 2. Aquaculture production from India

wholesalers, commission agents, retailer and roadside vendors in Kerala was collected both from secondary and primary data sources. The study was conducted from the supply side- ice factories producing ice for preservation; and utilization side - fishing, fish processing, marketing and transportation sub-sectors.

For estimation of quantity of ice manufactured during the study period, stratified random sample of ice manufacturing factories from Ernakulam, Kozhikode and Kollam was taken, with installed capacity of ice production as criteria for stratification. The production capacity of ice manufacturing factories varied from 5 to 50 mt per day which primarily depended on the location and demand. 35 ice factories drawn from the four strata (5-50 mt per day (TPD), 51-100 TPD, 101-150 TPD, and above 150 TPD) was covered.

In the fishing sector, mechanised fishing boats utilize ice predominantly for the multi-day fishing trips. Stratified random sampling was followed to collect data from 120 fishing crafts were selected so as to cover 75 mechanised trawlers, 15 mechanised

gillnetters, 5 purseiners, 25 ringseine fishing boats for one whole fishing season from Munambam, Cochin, Puthiyappa, Beypore, Neendakara and Sakthikulangara fishing harbours.

For estimating the ice utilised in fish processing and marketing sector, around 30 fish processing plants (6, 12, 8, 3 and 1 seafood factories with installed capacity of < 20 TPD, 20 to 39 TPD, 40 to 59 TPD, 60 to 79 TPD and 80 TPD), 50 pre-processing units, 12 wholesale fresh fish agents, 30 retail fresh fish vendors and 20 roadside fish vendors from Ernakulam, Kollam and Kozhikode were covered.

Data collection on ice utilization was carried out using pre-tested questionnaires on per fishing trip basis from fishing vessels and per day basis from the other type of sampling units. One whole fishing season was covered by recording weekly data from sampling units so as to assess the ice requirement during lean and peak seasons. During the study, the constraints faced by ice manufacturing industry was collected from ice factory owners through personal interviews.

There are 29 registered ice factories in the state under Marine Products Export Development Authority (MPEDA) with a total installed capacity of 606.35 MT per day. Apart from these, around 361 ice factories function in coastal districts which are registered as micro-enterprises under respective District Industries Council. Together these ice factories cater to the ice requirement of the Kerala fisheries and it was evident that Ernakulam, Alleppey and Kozhikode are the top three ice manufacturing hubs accounting for 25.19, 23.51 and 14.76% of the total installed capacity for ice (Fig. 3).

Ice gets manufactured in blocks of 45 to 55 kg by manufacturing units located along the coastal belt, mostly in proximity to fish landing centres and fish
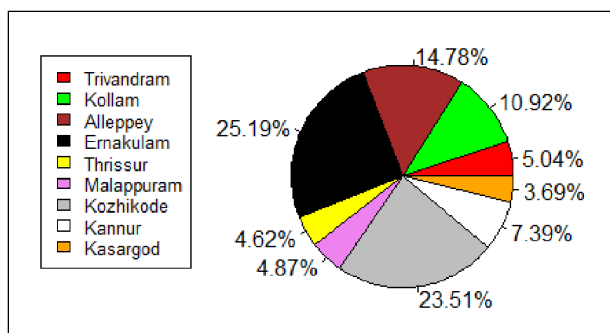

Fig. 3. Distribution of Ice plant capacity in Kerala

Table 1. Annual average ice utilization by fishing vessels in Kerala

Season	Trawlers (lakh tonnes)			Gillnetters (lakh tonnes)	Other multi-day fishing crafts (lakh tonnes)
	< 13 m	13 – 18 m	> 18 m		
Pre-monsoon	0.648 (0.0023)	1.900 (0.101)	1.070 (0.116)	0.250 (0.056)	0.084 (0.007)
Post-monsoon	1.492 (0.098)	4.480 (0.129)	2.830 (0.376)	0.583 (0.085)	0.036 (0.0063)
Total	2.140	6.380	3.900	0.833	0.120

Figures in parantheses indicate standard error of estimate

processing hubs in the state. These manufacturing units are registered as micro-enterprises under District Industries Council. In most of the ice factories surveyed, it was found that the source of water for ice production was a borewell. Some factories also procure freshwater for ice preparation. Ice production units are run by electricity and production is carried out throughout the year. The annual average ice production from the state was estimated at 29.51 lakh tonnes.

The mechanization of fishing industry has led to the fishing boats to undertake longer fishing trips exploring the deeper waters. The mechanised fishing fleet of the state has also increased in size and number manifold during the recent years. Ice is carried onboard these fishing boats undertaking multi-day fishing to preserve the fish catch till it is auctioned for sale. Ice utilisation depends on the duration of the fishing trip, fish catch during the trip, the season and the species composition of the catch. From the study it was estimated that on an average, 0.75 MT of ice gets utilized for 2 to 5 days fishing and 10.5 MT for a 6 to 10 days fishing trip.

It was estimated that, among the mechanised fishing boats, on an average the trawl sector utilizes 12.43 lakh tonnes of ice, gillnet fishing units use 0.83 lakh tonnes of ice and other fishing crafts which undertake multiday fishing use 0.12 lakh tonnes of ice annually (Table 1). An examination of seasonal use pattern of ice revealed that around 70 to 72% of total ice utilized by the fishing industry is after the closed season (monsoon) during which the fish catch is observed to be maximum.

In the processing sector, a few of the processing factories have their own ice making units. Prior to processing, fish is handled at the pre-processing/ peeling units which utilize ice at various stages of handling and processing. From the study it was estimated that, on an average, the Kerala fish processing industry utilizes around 6.10 lakh tonnes of ice and the pre-processing units or peeling sheds utilize around 2.42 lakh tonnes of ice annually (Table 2).

The fish distribution network of Kerala is vast and complex, and the fish markets cater to the coastal districts as well as to the interior areas of the state. A huge volume of ice is required to preserve the fish during long distance transportation. An estimated annual average of 4.07 lakh tonnes was utilized by the fish marketing network in the state which is organized into wholesale, retail and roadside fresh

Table 2. Ice utilization from post-harvest sector

Stage	Estimate of ice utilized (MT)	SE of estimate
Pre-processing	242000	0.0053
Processing		
< 20 TPD	13188	12.35
20 to 39 TPD	189208.8	45.13
40 to 59 TPD	246551.4	19.00
60 to 79 TPD	78972.3	42.71
80 TPD and above	82620	95.23
Marketing		
Wholesale markets	96875	23.12
Retail markets	262500	11.78
Roadside markets	48613	101.03
Transportation	214500	33.56
TOTAL	1475028.5	

fish markets. Ice is also extensively used for transportation of fresh fish from the landing centres to processing units, fish markets and outside states and the annual average was estimated as 2.14 lakh tonnes (Table 2).

The trend in fish production from the state was analysed along with the ice requirements in the fishing sector in the state. The analysis points out that the estimated average annual ice production from state was just sufficient to cater to the requirements of the fisheries sector as the estimated average annual utilisation of ice for fisheries was computed as 28.12 lakh tonnes. The fish production from the state is having an upward trend, if the same trend continues, it is anticipated that ice requirement will also increase to maintain the fish value chain. It is projected that the minimum ice requirement for Kerala's fishing sector for 2025 will be 30 lakh MT and the ice industry should be ready to meet this demand. Therefore there is an urgent need to take stock of the infrastructure for ice production in the state to gear up for supply of ice in the coming years.

The main constraint faced by ice manufactures, was under utilized capacity during certain months as fluctuations in fish landings affects demand for ice. Also once ice gets manufactured as blocks, it cannot be stored in the factory as storage facilities are minimal or absent. Therefore the manufacturers are forced to sell the ice blocks. The ice manufacturing process requires continuous power supply and power outages lead to imperfect ice blocks which reduces the price realization. Majority of the ice factories used borewell water for ice manufacture, leading to conflicts with local population as it affects water availability in the neighbourhood. During the trawl ban period, the ice making units have high idle capacity but are forced to retain the labour increasing cost of production. Also the immediate post-trawl ban period has a surge in demand which cannot be met. As most of the factories use borewell water for ice manufacture, the quality of water varies from season to season. Testing the quality of water utilized for manufacturing ice should be made mandatory. To avoid water scarcity problems faced by the coastal area population, a desalination unit which is centralised for the ice manufacturing industry can be planned. The demand-supply of ice to the fisheries sector can be stabilised by establishing a centralised cold storage facility.

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