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Sardine economy of Kerala: Paradigms and Perspectives

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Abstract
Among the commercially important marine fish species harvested in India, oil sardine occupies the foremost position along with mackerel in terms of landings and consumption. About 85 per cent of the Keralites eat fish and hence its role in the economy is of paramount importance in the present scenario of escalating fish landings along with the fluctuating sardine landings. The primary data was collected from 600 households of the three major cities of Kerala using the simple random sampling method. The demand – supply gap of sardine in Kerala is analysed and forecasted which indicates widening demand-supply gaps. The study reveals that there is boundless sardine demand-supply gap in Kerala economy which was usually ironed up by the interstate fish business. Moreover, the study inspects the effect of bait industry upon the food security, fishing pressure, and reduced post-harvest job opportunities.

Keywords: Fishery, Sardine, Economy, Demand-Supply gap, Food security, Bait industry, Fish feed industry, Fish meal.

1. Introduction
Fisheries is one of the major sectors in the world economy, which provides livelihood for more than 200 million people around the globe, and hence must be given immense consideration in the present scenario of shrinking fish landings. The Indian marine fisheries sector provides direct employment to over one and a half million people, besides the indirect employments, and it contributes much to the food security of the country as well. India, being the second largest producer of fish in the world, contributes about 5.43 percent of the world production. Fisheries sector plays a very important role in the socio – economic development of the country by providing a source of livelihood for a massive section of the economy [1]. Eventually, there are wide-ranging variations in marine fish landings [2], which might have serious impacts on the economy of the country. Even though the quantity of landings is depreciating in thirteen major marine areas out of fifteen there is almost a fivefold increase in the case of India, since 1950 [3, 4].Among the commercially important marine fish species harvested in India, Oil sardine, a pelagic resource, occupies the foremost position along with mackerel.

The term *Sardine* was first used in English during the early 15thcentury, and may have originated from the Mediterranean island of Sardinia, around where sardines were once abundant. The oil sardine is a coastal, pelagic, tropical schooling fish, forming massive fisheries in India. The Indian Oil Sardine, *Sardinella longiceps*, is abundantly found in the northern regions of the Indian Ocean. Oil sardine has a high population, doubling time of less than 15 months and is probably the largest stock in the Indian Ocean [5]. It attains a maximum total length of about 22 cm and is a plankton feeder. The approximate life span of sardine is 2.5 years. Even though it holds the lowest position in the food web, sardine plays a vital role in the ecosystem. It acts as food for large predators and hence, any fluctuations in its abundance may have a direct reflection on the ecosystem.

1.1 Sardine and Kerala
Kerala, situated in the South West coast of India is endowed with rich fisheries resources along a coastline of 590 km. According to the estimates, 85 per cent of the Keralites eat fish, which accounts for over three quarter of the animal protein intake of an average Keralite [6]. The fish consumption of Kerala is four times the national average and is inelastic in the case of both price and income. Whatever the price is, people are ready to buy their favourite fish for

which the demand is consistent in comparison with other fishes. Along with that the consumption of fish is increasing significantly due to many reasons. The changing lifestyle due to an increase in income can be cited as one among them. The improved health consciousness of the people had also led them to choose fish instead of red meat. The increasing trend in the cost of meat had also made fish dearer [6]. The sardine is one of the favourite foods of the Keralites which is typically eaten fresh or even dried, while canned sardines are yet to gain popularity.

Sardine, the staple fish of Kerala, is stated as a low cost delicacy for Keralites in adding to the poor men's protein and is the much sought after fish for the fish food security in the state. Off late, the scenario has changed drastically with the paradox of even being the second largest producer of marine fishes in India, the fish prices in Kerala is escalating. In comparison to the previous years the price of sardine had almost quadrupled. The major reason which contributed to this alarming price rise includes the significant reduction in the availability, climatic changes, augmented purchasing power of consumers, paradigm shift in fish consumption behaviour *vis-a-vis* other protein sources, increased use of fish for non-food purposes, changes in the ecosystem. In addition, the climate change studies revealed the distributional shifts of sardines towards the Northern latitudes across the West and East coast. These shifts resulted in the availability of sardine across the non-conventional consuming states leading to the usage of sardine for non-food purposes.

Sardines assume significance in the economy of Kerala as this fish is consumed maximum in the state. There exists a very clear cut demand and supply pattern for the fish. Consumption studies indicate that sardine is the mostly consumed fish across the length and breadth of the state leading to an identified market demand. In addition, the supply pattern are met from the fish arrivals from the neighbouring states of Tamil Nadu, Karnataka, Maharashtra, and Goa. Sardine, like rice, has got a considerable demand in the state. Also, the invention of plastic crates had made the transport of sardine to and from the state much more convenient.

Thus, the present study is an attempt to analyse the sardine economy of Kerala by assessing the demand and supply pattern along with possible demand-supply gap expected for the future. The study also gauges the quantum of fish which arrives across the different states in curbing the present demand-supply deficit to minimum. In addition, the demand estimates were collected across the three districts of Kerala by using simple random sampling method and the sardine consumption vis-à-vis fish consumption data obtained.

2. Materials and Methods

The primary data of sardine consumption was collected using a structured schedule from the selected 600 urban middle income consumers of the three major cities of Kerala, *viz.*, Trivandrum, Cochin, and Kozhikode using simple random sampling method. A sample size of 120 was collected from Kozhikode whereas a size of 240 was collected each from Trivandrum and Cochin. The major parameters used in the study includes age, education, income and expenditure, fish consumption, buying behaviour, etc.

Further analysis was conducted by analysing the secondary landing data of oil sardine for the period of 1991 – 2014 along the Kerala coast, collected from Central Marine Fisheries Research Institute (CMFRI), along with the export data collected from The Marine Products Export Development Authority (MPEDA). The region-wise landings data of oil sardine, estimated by CMFRI, was also analysed and used in this study. Along with that the secondary data regarding the landings of oil sardine along the South West coast of India, including Karnataka, Tamil Nadu, and Goa were also considered for the comparative analysis.

3. Results and Discussion

Based on the data collected, the results and discussions are presented under the following heads;

3.1) Demand pattern
3.2) Supply pattern
3.3) Demand – Supply gap
3.4) Sardine into competing uses / users

3.1. Demand Pattern

The demand side of sardine comprises the household consumption, demand from the fish feed as well as bait industry within Kerala, along with the export demand. A household consumption analysis was done using primary data collected from the 600 urban middle income consumers selected from three major cities of Kerala. The major findings of the survey are depicted in Table 1.

Table 1: Socio-economic characteristics of the respondents

Age distribution (Years)		Income status (Rs 000)		Educational status		Proximity to buying sources (km)	
Age range	**Number**	**Amount (Rs 000)**	**Number**	**Grade**	**Number**	**Distance (km)**	**Number**
Less than 35	138 (23)	<25	162 (27)	Primary	24 (4)	<1	246 (41)
36 – 60	360 (60)	25-50	186 (31)	High school	144 (24)	1 – 2	174 (29)
More than 60	102 (17)	50-100	174 (29)	Secondary	228 (38)	2 – 3	114 (19)
		>100	78 (13)	College education	204 (34)	>3	66 (11)

Figures in parentheses indicates percentage to total.

. It is found out that the majority of the respondents were middle aged (36-60 years) constituting to 60 per cent of the total respondents. About 23 per cent were below 35 years old and 17 per cent were above 60 years old. While analysing the income status, 31 per cent of the respondents were having an income ranging from Rs 25,000 to Rs, 50,000 per month. About 29 per cent were having earnings ranged between Rs 50,000 to Rs 100,000 whereas 27 per cent of the respondents were having an income range below Rs.25,000 monthly. The respondents who earn above one lakh per month constitutes 13 per cent.

Among the 600 respondents, 38 per cent were possessing secondary education, 34 per cent were having college education and 24 per cent were possessing high school education Four per cent of the respondents were having primary education only . The proximity to the buying sources were also analysed, in which it is found out that 41 per cent of the respondents were having their buying sources within one km. About 29 per cent of the respondents were having it

within a range of 1 km to 2 km, and 19 per cent were having within 2 km to 3 km, whereas the buying source is more than 3 km away for the remaining 11 per cent of the respondents. The average monthly expenditure pattern of the respondents was analysed and is depicted in Table 2.

Table 2: Average monthly expenditure pattern in Kerala

Parameters	Amount (Rs)	Share (%)
Expenditure	30539.60	
Food	7160.01	23.44
Meat and meat products	1134.16	15.84
Fish and fish products	1202.90	16.80

The average monthly expenditure of the selected respondents is found to be Rs 30539.60, out of which 23.44 per cent is spent on food. Among the expenditure incurred on food the amount spent on meat and fish were more or less similar with 15.84 and 16.8 per cent respectively, indicating that fish is an important expenditure component in the food basket of Keralites.

The household survey indicated that around 85 per cent of the surveyed households consume fish. The details regarding the fish eating population of Kerala are given in Table 3.The fish consumption across the selected households were quantified and found that the average monthly fish consumption of Keralites is 0.64 lakh tonnes, of which 0.19 lakh tonnes (30%) is sardine [7].

Table 3: Fish consumption details of Keralites

Monthly fish consumption (lakh tonnes)	0.64
Monthly sardine consumption (lakh tonnes)	0.19
Average family size (Nos)	4.20
Monthly per capita sardine consumption (Kg)	0.66
Annual per capita sardine consumption (Kg)	7.92

Along with that, about 43 per cent of the total low value fishes consumed in Kerala is also found out to be sardine [8]. The average size of a family in Kerala is 4.2 and hence the monthly as well as the annual per capita consumption of sardine can be figured out to be 0.66 kg and 7.92 kg, respectively. Based upon the population growth the total demand for sardine in Kerala over the years can be interpreted from Table 4.

Table 4: Total Demand for Sardine in Kerala over the years.

Year	2011	2012	2013	2014	2015	2020	2025	2030	2035
Population (Million)	33.40	33.65	33.73	33.89	34.06	34.91	35.78	36.68	37.60
Fish eaters (Million)	28.39	28.60	28.67	28.81	28.95	29.68	30.42	31.18	31.96
Annual per capita sardine consumption (kg)	8.20	8.20	8.20	8.20	10.00	11.00	12.00	13.00	14.00
Total Demand (Lakh Tonnes)	2.27	2.29	2.30	2.31	2.90	3.26	3.65	4.05	4.47

The data indicates that the population of Kerala is rising at an average rate of 0.5 per cent annually. Similarly, the average annual growth rate of the fish eating population is also 0.5 per cent. While examining the demand details of sardine over the years from the table above, the total demand is found out to be swelling up. The annual per capita consumption of sardine is found out to be expanding at an average rate of 2 per cent. The demand for the forthcoming twenty years is also predicted in Table 2, from the data gathered. By making use of this data the population for over 20 years from now, i.e. up to 2035, is estimated. Meanwhile, from this data the demand for the coming two decades is also predicted and arrayed in Table 3, which ascertains that the demand for sardine in Kerala will be accumulating in the very next future (Figure 1).

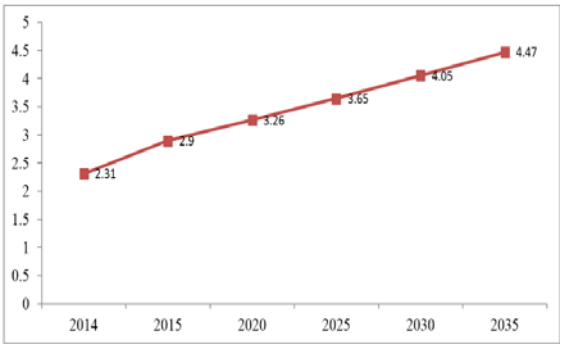

Fig 1: Total sardine demand over years

3.2. Supply Pattern

The studies show that there is a drastic decline in the availability of fishes. Even though the total marine fish landings are showing a descending trend for the past many years, the case of sardine is different. The sardine which is supposed to be accounting for 50 tonnes per square mile of Indian Ocean is highly fluctuating over the years [9]. About 55 per cent of the total sardine landings in the country is accounted by Kerala. However the sardine landings in Kerala is fluctuating over the years as indicated in the annual sardine landings. (Figure 2A, 2B). Figure 2A and 2B clearly illustrates the fluctuations in the landings of sardine in Kerala compared to other states as well as overall India.

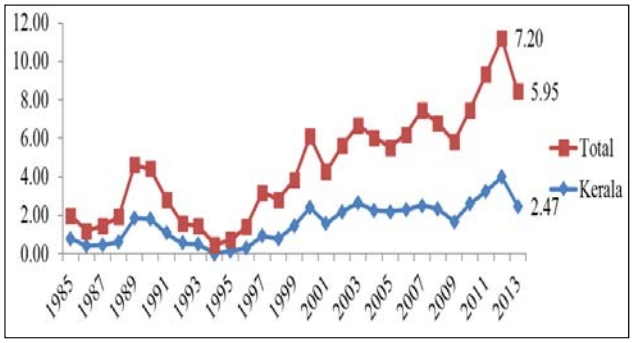

Fig 2A: Sardine supply in Kerala vis-à-vis India (lakh tonnes)

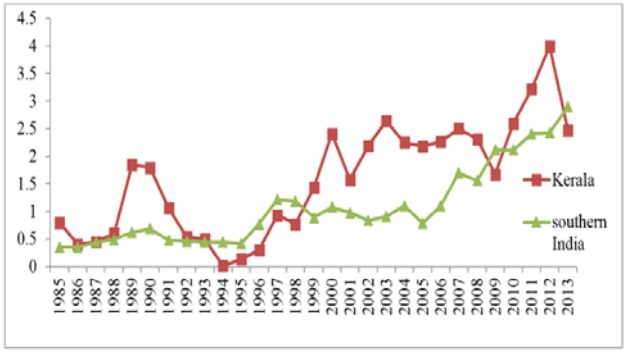

Fig 2B: Sardine supply in Kerala vis-à-vis other states (lakh tonnes)

The analysis of the landing data reveals that the total fish landing of Kerala was 8.39 lakh tonnes in 2012, out of which 3.9 lakh tonnes was sardine. The year 2012 recorded a catch of sardine constituting about 32 per cent of the total catch. But in 2013 the total catch dropped to 6.71 lakh tonnes, out of which the quantity of sardine constituted only one lakh tonnes [10]. The average decadal sardine landings in Kerala is found out to be 2.50 lakh tonnes.

The total fish landing estimates in Kerala indicates that there is fluctuations in the landings of sardine. Even though the total fish landing is following a declining trend, the sardine landings are highly fluctuating. The sardine catch has declined during 2013, from the latest available data. But, just before 2013, i.e. in 2012 and 2011, sardine catch was showing an increasing trend. This can be well explained from Table 5, in which the variations in the total landings of sardine over years are represented.

Table 5: Oil Sardine landings of Kerala (1985-2013) in lakh tonnes

Year	Quantity (LT)
1985-89	4.01
1990-94	3.91
1995-99	3.59
2000-'04	11.07
2005-'09	10.94
2010-'13	12.28

Source: CMFRI 2014 [8]

It can be clearly noted from the Table 5 that the total catch of sardine, which was 4.01 LT during the late eighties, descended to 3.91 and 3.59 lakh tonnes during the succeeding quadrennials respectively. The period 2000 – '04 witnessed a very high sardine landing throwing in a quantity of 11.07 lakh tonnes. Even though there was a small decline, the subsequent quadrennial (2005 – 2009) also witnessed a highest sardine landing putting in a quantity of 10.94 lakh tonnes. The three year period of 2010 – 2013 obtained the ever highest sardine landing of Kerala throwing in a quantity of 12.28 lakh tonnes.

But the most dualistic fact about the 2010 – 2013 landings is that even though the total landings was at its peak, there were fluctuations in the quantity of annual landings. There was a decline in 2013 (2.47 LT) compared to the landings of the previous year 2012 (3.99 LT). An approximate drop of one lakh ton occurred in the sardine landings during the year 2013, which could have led to the consequent price hike, as well as made sardine dearer to the Kerala economy. The total fish landings as well as the total sardine landings over the years are depicted in Table 6, in which the quinquennial data for the future years up to 2035 is also forecasted.

Table 6: Total fish landings and total sardine landings over the years

Year	Total fish landings (LT)	Total sardine landings (LT)
2011	4.20	2.66 (63.3)
2012	4.65	3.29 (70.8)
2013	5.78	2.04 (35.3)
2014	6.25	2.30 (36.8)
2015	6.55	2.48 (37.9)
2020	10.21	2.48 (24.3)
2025	13.88	2.48 (17.9)
2030	17.54	2.48 (14.1)
2035	21.20	2.48 (11.7)

Figures in parentheses indicates percentage to total

The table clearly points out that the total fish landing escalates over the years whereas the total sardine landings fluctuates and might lead to a state of saturation point in the future. The trend of sardine catch and the total fish catch can be made much clearer through the line graph shown in figure 3. It is quite explicable from the figure that there may be a steep increase in the fish catch.

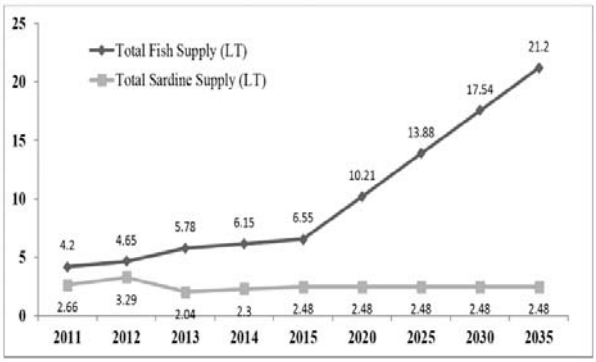

Fig 3: Total fish landings and sardine landings of Kerala over the years in lakh tonnes.

The total landing of sardine was observed to be 2.79 lakh tonnes in 2014 whereas it was 2.47 lakh tonnes in 2013. Apparently, there was a record catch of 3.99 lakh tonnes in 2012It is found out that even though the total landing of sardine was escalating from late nineties onwards, it dropped during 2013. This can be considered as one of the most important reasons for the recent price hike of sardine. The total sardine supply available for human consumption is indicated in Table 7.

Table 7: Total quantity of sardine for domestic supply over the years (Lakh tonnes).

Year	2011	2012	2013	2014	2015	2020	2025	2030	2035
Sardine landings	3.22	3.99	2.47	2.79	3.00	3.00	3.00	3.00	3.00
Export (5%)	0.16	0.20	0.12	0.14	0.15	0.15	0.15	0.15	0.15
Wastage (2.5%)	0.081	0.099	0.062	0.069	0.075	0.075	0.075	0.075	0.075
Bait Industry (10%)	0.322	0.399	0.247	0.279	0.300	0.300	0.300	0.300	0.300
Total domestic supply	2.66	3.29	2.04	2.30	2.48	2.48	2.48	2.48	2.48

According to the study, the total landings are not wholly supplied for domestic consumption. The total capture fishery production in the Asia-Pacific region is accounted as 40 million tonnes, out of which approximately 25 per cent is currently used other than for human consumption. The data illustrated in Table 7 indicates that from the total landings of Kerala about five per cent is meant for export purposes, another 10 per cent is discharged for bait industry, and two and a half per cent may be forfeited as wastage. The remaining quantity of the total landings will be used domestically. Even though the bait industry is economically beneficial as it yields high value fishes by making use of the low value fishes, it can't be considered as socially beneficial as it devoid a low value fish meant for the common man.

3.3. Demand – Supply Gap

The divergence in the quantity demanded and supplied may create demand-supply gap, which must be solved by ensuring sufficient measures. The analysis affirms that there is a wide range of demand-supply gap for sardine in Kerala. The demand-supply gap can be clarified through Table 6 in which it is illustrated that the demand-supply gap was at its peak during 2013, with a quantity of 0.26 lakh tonnes. This was mainly due to the sizable drop in the landings of sardine during 2013. The demand-supply gap for the near future can also be forecasted and is illustrated in Table 8, which is found out to be broadening over years.

Table 8: Demand – Supply Gap

Year	2011	2012	2013	2014	2015	2020	2025	2030	2035
Total Demand(LT)	2.27	2.29	2.30	2.45	2.61	2.96	3.34	3.72	4.12
Total Supply(LT)	2.66	3.29	2.04	2.34	2.39	2.36	2.24	2.12	2.00
Demand-Supply Gap(LT)	-0.39	-1.00	0.26	0.11	0.22	0.60	1.10	1.60	2.12

Usually, this exceeding demand is ironed up by the interstate fish arrivals. Generally, the fish arrivals of Kerala are from the neighbouring states of Tamil Nadu, Karnataka, Andhra Pradesh and Goa. The demand-supply gap is portrayed in Figure 4 and Figure 5.

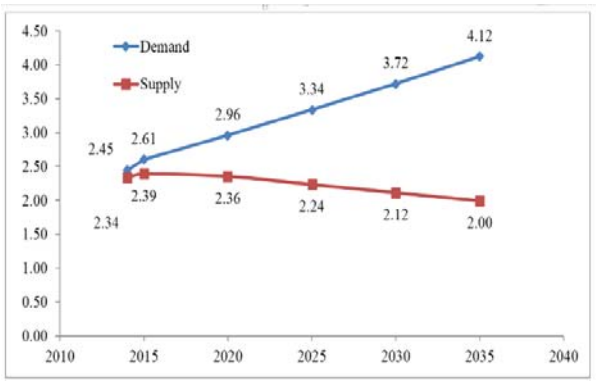

Fig 4: Demand – Supply Gap

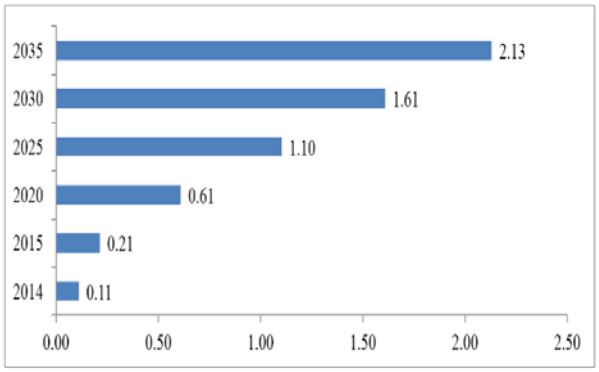

Fig 5: Demand – Supply Gap

3.4. Sardine into competing uses / users

The demand for sardine consists of the demand for various uses such as human consumption, fish feed, fish meal, live bait as well as e export demand. The multiple demand for sardine is illustrated in figure 6. The increased demand for sardine is not only arising from the domestic consumption but from the bait industry also, which is a serious matter of concern. It is revealed from the study that about 10 per cent of the total landings of sardine is procured by the bait industry. Even though this is having an advantage of value addition, it may affect the food security of the country.

Fig 6: Sardine consumption demand – Multiple uses/users

Aquaculture, being the farming of fish, can act as a fruitful solution for overfishing. But, it is beneficial in the case of farming herbivores fish only. The picture is different in the case of farming carnivores fish like tuna. The Feed Conversion Ratio (FCR) is found to be about 3-4 which means that about three to four kg of sardine feed is required for rearing one kilogram of high value fishes. While comparing the money value, the process is profitable, as only three kg of sardine which costs a lesser price than tuna is required to produce one kg of tuna. But on the other hand, this may accelerates the indiscriminate trawling of sardine from the ocean bed, which might have serious consequence over the food security of the economy. Sardine which could have been the food for poor man is thereby transferred as a high priced fish. Sardine, which is considered as the poor man's steak, will be thus drained to cultivate an overpriced carnivorous fish and thereby affects the food security of the country. Moreover the marine capture sector of this country is grappled with numerous policy hurdles in the value chain extending from resources to the consumption sector. Even though the sector is not showing a declining trend, the landings would saturate at a level of 4.5 million tonnes as per the revalidation of the potential harvestable yield from the coastal waters of India [11]. Thus the bait industry could have serious consequences upon the food security of the country.

Also, sardine fish meal is used as animal feed. On an average, 4 to 5 kg of wet fish will yield one kg of fish meal and 100 gm of fish oil. Almost 18-24 per cent of fish meal as well as 14-18 per cent of fish oil can be recovered from the fish [12]. Sardine oil is used for various purposes just as the manufacture of

paints, varnishes, linoleum, etc. approximately 25 percent (about 9.8 million tonnes) of the total capture fishery production of 40 million tonnes in the Asia – Pacific region is currently used other than directly for human consumption. The Asia – Pacific region is the largest consumer of feed fish, reduced or otherwise, as feed in aquaculture.

The extensive use of fish as feed may have various serious effects over the economy. As explained before, it may lessens the fish available as human food – particularly for the poor, reduces the quantities of low – priced fish normally accessible by the poor in port markets, and increases the fishing pressure on reduction fisheries or direct targeting in non – selective trawl fisheries. Apart from these all, it may bring a decline in the on- shore job opportunities which requires only low skilled labour. This will be affecting the poor in particular. Another major concern is regarding the reduction in the quantity of forage fish species which may affects the marine ecosystem as a whole including the dependent piscivorous fish, birds and other species. There is a possibility of disease transmission from non-endemic feed fish to local wild fish populations also.

4. Conclusion

The study very clearly points out that sardine consumption is very high in Kerala compared to other states. The consumption analysis indicated that sardine consumption contributes to around 30 per cent of the total fish consumed as well as 43 per cent of the total low value fish consumed in Kerala. Over the period of years the price of sardine has increased considerably leading to its reduced availability, affordability and accessibility leading to fish food security issues. As the demand-supply gap is widening up the study also provided guidelines on how the sardine consumption is met by interstate arrivals. The analysis indicates that as the demand – supply gap is ironed up by the imports from the neighbouring states, it will be better to employ a quality assurance check for the imports along with developing appropriate regulatory measure for exports. Since the food security issue might turn into a serious socio – economic hazard, it is recommended to undertake proper regulations for using sardine in bait industries. Even though it is a profitable process and so must be accepted, the negative impacts of the process is more, which is analysed in the study. However, it is preferable and likely that some fisheries resources currently used for fishmeal or as fresh aquaculture feed may become more valuable as human food as economic and/or technological changes make it more viable to use this fish directly. Summarizing the study, a basic know-how and consequent guidelines must be followed in the case of oil sardine in Kerala

5. Acknowledgement

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