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Oil Sardine Landings and Revenue Realization under a Climate Change Regime in India

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Abstract

The present study probes to assess the distributional shifts in sardine landings across the states and its impact on the revenue realisation across the country. The secondary data related to the landings across the states were obtained from the National Marine Living Resources Data Centre (NMLRDC) of the Central Marine Fisheries Research Institute, Kochi for the period 1985-2017 and the primary data on the landing centre prices were obtained from Socio-Economic Evaluation Technology and Transfer Division (SEETTD) of CMFRI. Average landings showed a sturdy decrease after 2013 elucidating the price surges and regional shifts in distribution of oil sardines off the Indian coast. The prices showed an amplified growth rate in the Northwest coast of India stating the increased demand for sardines in the region during the recent decades. The surge in mean prices and mean landing quantity between the decades was computed using the Decomposition Model. An analysis of the landing centre prices of oil sardine along India showed the highest change in mean price which means that there is a higher price effect when compared to the quantity effect. The availability of sardine in non- traditional demand areas is due to shifts in habitat distribution (towards the latitudinal stretch) and the demand for import of sardines to the domestic markets and fishmeal industries. The study advocates the need for establishing affordable prices (minimum support and maximum ceiling prices) for sardines to provide sustenance to the fishers and fish food security to the consumers in the demand-rich regions.

Keywords: Sardine; fishery; Revenue; Price; Climate change; India

Introduction

The Indian oil sardine, Sardinella longiceps, is a major commercially important epipelagic fishery which accounts for 17-20% of the total marine fish landings in India. Sardine fishery productions are fluctuating from year to year and it is considered to be an important factor that determines the trends in total fish production of the country. Several studies relating the sardine catch variability to environmental conditions such as sea surface temperature, salinity, rainfall, upwelling and food availability were carried out along the southern coast of India. In addition, more recently notable contributions on the oil sardine fishery and its relationship to habitat loss and climate drivers was studied by . This clupeid fish spawns during the summer monsoon season (June to September) and the intensity in spawning is rapid in July and August months, which correlate with the upwelling months in the southwest coast of India. Oil sardine grows to about 15 cm (>1 year) attaining an early maturity stage within the life span of about 2.5 years. Oil sardinesare planktivores feeds both on phytoplankton and zo oplankton. Madhupratap et al., 1994 reported the correlation between t he phenology of blooms of colonial diatom Fragilaria oceanica and the abundance of oil sardine.

Materials and methods

Globally, average production of oil sardine production among the other sardine producing countries, India tend to be high with 65% (376,189 t) followed by Oman, Yemen, Iran, and Pakistan (FAO 2016). Oil sardine landings constitute to about 66-96% of the total global catch. Over the years, oil sardine catches of India collapsed eventually since 2012. The sardine famine was noted in the year 2013 with a decline of 0.39 million tons (2012) to 0.21 million tons in the year 2013. It further waned to about 0.15 million tons to 0.068 million tons in the years 2014 and 2015. This indicates a percentage variation of drop in sardine catch to about 46% to 82% since 2012. The southwest region, comprising the states of Kerala, Karnataka and Goa where oil sardine was abundant, experienced a major setback resulting in the overall reduction of oil sardine landings in the country with a maximum loss of nearly 3 lakh tonnes. Oil sardine catch along Kerala coast dropped drastically to 68431 t registering a sharp decline from an estimated 1.55 lakh t recorded in the previous year and a record of 3.92 lakh t during 2012.

However, these falloffs in the landings are not unusual, as the oil sardine stock has collapsed in a similar way in 1929, 1943, 1963, 1986 and as recently as 1994. These small pelagic fishes are highly influenced by the environmental conditions in the sea, the temperature, salinity, oxygen levels etc. There have been serious disruptions in the climatic conditions inducing variations in environmental events such as upwelling in the Arabian Sea. Besides, 2015 was a strong El Niño year with reduced rainfall and increased sea surface temperatures. These factors, coupled with excessive fishing on the stock beyond the maximum sustainable yield, and

excessive capture of juveniles during 2010-2012, has led to a famine in the oil sardine stock in the Indian coast.

Sardines bolster the fisher folk's economic state through their significance for increased consumption rate, strong demand and supply paradigm in marketing of the fish. Among the Indian maritime states, Kerala is the maximum fish consuming state leading to a recognized market demand. In addition, the supply pattern is met from the fish arrivals from the neighbouring states of Tamil Nadu, Karnataka, Maharashtra, and Goa. The southwest region, comprising the states of Kerala, Karnataka and Goa where oil sardine was abundant, experienced a major setback resulting in the overall reduction of oil sardine landings in the country with a maximum loss of nearly 3 lakh tonnes. Oil sardine is experiencing a surge in the price these years, probably due to its high demand and low supply. At the same time, there has been an increase in the share of the landings along southeast coast where there is less demand for oil sardine.

In this context, we investigate the economic factors influencing variability in a 33-year time-series of oil sardine landings across all the coastal states of India. This study will address the climate change driven fluctuations in the revenue dynamics of the sardine fishery. We made use of sardine landing data, landing centre value and landing centre price of each coastal state to ascertain the observed economic variability among each other. The study will elucidate the potential effects of an economic surge in sardine fishery with potential inputs for facilitating sustainable fishery management.

Oil sardine distribution extends along both the east and west coast of India. Distribution off the west coast of India is confined to the 40 m isobaths with temperature ranging from 22-28ºC. Landing datasets for nine coastal states and one union territory was used for the present study. Figure 1 represents the coastal states and union territory of India used for the study.

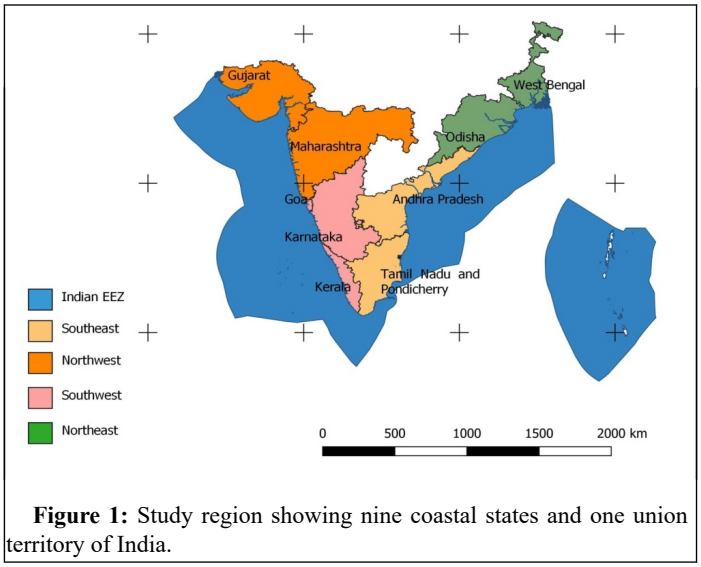

Figure 1: Study region showing nine coastal states and one union territory of India.

Annual sardine landing datasets of all the coastal states from 1985 to 2017 (33 years) were collected from the National Marine Living Resources Data Centre (NMLRDC) of Central Marine Fisheries Research Institute, Kochi. CMFRI was involved in the estimation of marine fish landings since 1920s' and in the latter years, the landing datasets were estimated using stratified multi-stage sampling method. We studied the annual landings of the oil sardines over a period of 33 years obtained from the more reliable source of information on the fishery. The Landing Centre Price (LCP) and Landing Centre Value (LCV) were collected from the Socio-Economic Extension and Technology Transfer Division (SEETTD), CMFRI. The price values were deflated using the Wholesale Price Index (WPI) from the WPI source release for the year 2011. The interannual/decadal variability within the landings and landing price value across all the coastal states were done using the Decomposition analysis. The coastal states were categorized into four regions: Southwest Southeast, Northwest and Northeast zones. This regional zonation was classified based on the dominance in the geographical distribution of major finfish groups in the Indian coast. Increase in landings and LCP of oil sardine along Southwest Southeast, Northwest and Northeast coasts of India during the two decades: Period 1(1985-2000) and Period 2(2001-2017) were studied.

The description of the variable considered for calculating component of change in average landing centre value and component of change in variance of landing centre value are given in Table 1.

Results and Discussion

Inter-Annual Variability of Oil Sardine

In the present study, Oil sardine landings of the Indian coast for the period of 1985-2017 (33 years) were examined. Highest landing was recorded in the year 2012 to 7.3 million tonnes and lowest landing was from the year 1994 to 0.5 million tons. Oil sardine landings over the years showed an upward trend till the year 2012 and have started declining since 2013 till now. The total landings decline was 6 million tons in 2013 from the peak of 7.2 million tons in 2012. It further waned to 5.4 million tons in 2014, and continued to drop to about 2.9 million tons in 2015 and 1.7 million tons in 2016. Kerala stands as a major contributor with 51% of oil sardine landings over the years followed by Tamil Nadu (19%) and Karnataka (16%). The landing contribution from the states such as West Bengal, Gujarat and Orissa tend to be meagre in comparison to the other coastal states of India represents the percentage variations of total landings over the years from each state.

Regional variability of Oil Sardine Landings

To understand the fluctuations and variability in landings of oil sardine off the Indian coast more in detail, the spatio-temporal scale was divided into four regions and two decades respectively. The first decade covers the first 16 years of the time-series and the second decade includes the next 17 years. Nine coastal states and one union territory were classified into four regions such as: Southeast (Tamil Nadu, Pondicherry and Andhra Pradesh), Northeast (Odisha and West Bengal), Southwest (Kerala, Karnataka and Goa), and Northwest (Maharashtra and Gujarat). From examining the results on landings and percentage variations regionally and decadal-wise, it is evident that the Southwest coast immensely contributes to the overall oil sardine landings and it has drastically increased from 18.5 million tons (in the first decade) to 54.5 million tons in the second decade represents the region-wise and decadal-wise landings of Oil Sardine in the Indian coast. Among the coastal states of the Southwest coast, Kerala registered to be the major contributor with 14 million tonnes and 35.85 million tonnes in the first and second decade, respectively. The next regional contributor is the Southeast coast, which showed a twofold increase in the second decade. The Northeast and Northwest coastal regions are the minimum contributors to the landing. However, the significant fact to be noted is the increase over the second decade

in these regions. Both the coastal regions have shown a subsequent progress in landings during the second decade. In comparison, among the Northwest and Northeast region, the Northwest coastal regions have shown a greater increase from 0.4 in the first decade to 2.2 million tons in the second decade. Percentage contribution has increased from 71 to 75% in the Southwest coast and 2 to 3% in the Northwest coast. The fall in percentage variability was noted in the Southeast coast from 27 to 22%. towards the higher latitudes (off Maharashtra and Gujarat) substantiates that the sardines are extending their habitat towards the Northwest coast of India due to feeble oceanographic conditions and climate change impacts on 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. On the other side, two significant interventions during the study period was noted, trawl bans (since 1989) and introduction of outboard crafts (since 2010) was also described to be the cause of increase and waning sardine landings. Pre-ban periods (past 1988) and Post-ban (subsequent increase), since 2010 introduction of outboard crafts (ref, technical report – trawl ban). Though there are two significant interventions almost in the same period, namely the seasonal ban and introduction of outboard crafts, the resource mainly targeted by the second intervention is oil sardine and hence the impact on the series on total landings excluding oil sardine can be attributed to the effect of seasonal fishing ban.

Conclusion

The present study indicates that Oil Sardines play a vital role in coastal economy of the fisher folks of India. However, Oil Sardine fishery is known to be a fluctuating fishery resource affected by both the physical and biological interactions of the marine environment. The historical records of depletion and decline of sardine fisheries were reported off the Konkan and Malabar regions (Southwest coast) in the year 1943. Climate change persuaded environmental changes and unfavourable niche alterations have created huge impacts on the abundance of oil sardines and thus a distributional shift of sardines towards the higher latitudes were observed and reported post 2014. With backdrop of these instances, we developed an interest in studying the impact of climate induced deviations on oil sardine landings and their effect on disparities in economic values with orientation to landing centre price and landing centre values over 33-years. The study indicates that in the viciousness of different climate change induced factors; the economy of sardine fisheries is tremendously driven by the landings. The climate change shifts have created an impact over the landings which have taken over on the demand-supply transferals since 2014. Growth rates among the landings and LCV was noted to be significant in the LCVs' among the two decades and the less significant relationships were noted in the landings especially constricted to the Northwest and Southwest coast of India. The decomposition analysis also supplements that economic realisation of sardine fishery is bound to the landings. This is an initial study in understanding the time-series of sardine landings and the economic values. Future works will flag a way to arrive at meticulous conclusions on the impact of climate change on the economics of the major fishery resources.

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