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# 7 STRUCTURAL CHANGE IN THE FISHING PATTERN- A NATURAL RESOURCE STUDY IN TAMIL NADU

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## Abstract

Indian marine fishery sector has transformed from a subsistence traditional avocation to that of an industry through State support and technological innovations leading to increased fish landings. However, there is a fear that these developments have led to depletion of certain fishery resources. In this context, an attempt was made to study the structural changes in the mode and pattern of fishing in Tamil Nadu State and to ascertain whether the current level of exploitation is sustainable.

The study shows that the share of traditional crafts in the total marine fish landings of Tamil Nadu declined during the period 1969-1997, while that of the mechanised crafts increased. The transition probability matrix estimated to study the structural changes in the fishing pattern showed that the mechanised crafts have been able to retain 36 per cent of their previous year's catch, while traditional and motorised crafts could retain 68 per cent and 100 per cent of their previous year's share of landings, respectively. However, the mechanised crafts could seek 31 per cent of traditional crafts' share, apart from garnering 92 per cent of the additional landings. The changes in demersal and pelagic fish landings by different crafts also showed a similar trend. The maximum sustainable yield (MSY) estimated using the Schaefer's model indicated that the current level of exploitation is closer to MSY.

## Introduction

Fishery sector has earned a prominent place in the Indian economy by serving as sources of income, employment and foreign exchange. India has an Exclusive Economic Zone of 2.02 Million Sq. km. With an annual harvest potential of fishery resources of 3.92 million tonnes (Anon., 1991). The total fish catch has increased phenomenally from 0.53 mt. in 1950-51 to 2.71 mt. in 1996-97, which is made possible largely through the introduction of mechanised crafts, changes in craft-gear technologies and related developments. These developments have certainly lead to increased quantum of landings, but at the same time these are perceived to have led to depletion of certain fishery resources. Besides, it has affected the share of the traditional crafts to the total marine fish landings, which was significant till sixties. These changes have

resulted in a structural change in the fishing pattern, which is assumed to have an impact on the craft-wise, species-wise marine fish landings and the level of exploitation of the different fishery resources. In this context, an attempt has been made in this paper to study the structural changes in fishing pattern in Tamil Nadu State.

### Data and Methodology

The data on total annual marine fish landings, annual fishing effort, craft-wise and species-wise marine fish landings were collected from the Central Marine Fisheries Research Institute, Cochin. The data collected covered a period of 29 years from 1969 onwards. However, the craft and species-wise landings of different types of crafts were collected from 1985 only as the data for the previous years were not available.

#### *Structural Change*

The structural changes in fishing pattern refers to any perceptible change observed in the craft and gear technologies and related aspects of fishing. This will have long lasting impact on quantum of landings and species composition of landings of different types of crafts, which will ultimately reflect on the relative cost-return structure of different crafts.

The structural changes in the fishing pattern was studied with the help of Markov Chain Analysis (MCA) which helps to estimate the Transition Probability Matrix (TPM) which indicates the structural changes in the fishing pattern that had taken place over time. The transition probability matrix was estimated in the linear programming framework by minimisation of Mean Absolute Deviation (MAD) method as suggested by Lee *et al* (1965).

The model is formulated as

$$\text{Minimise } O'P^* + Ie \quad (1)$$

Subject to

$$XP^* + Y \quad (2)$$

$$GP^* = 1 \quad (3)$$

$$P^* \geq 0 \quad (4)$$

Where

$P^*$  is a vector of probabilities  $P_{ij}$

$O$  is a vector of Zeros

$I$  is an identity matrix

$e$  is the vector of absolute errors (101)

$y$  is the vector of landings by each craft in the current year

$x$  is the block of diagonal matrix of lagged values of  $y$

$v$  is a vector of errors and

$G$  is a grouping matrix to add the row elements of  $P$  arranged in  $P^*$  to unity.

For this analysis, the annual landings by the three types of crafts (three states) namely mechanised, motorised and traditional, have been considered. The additional landings over the previous year have been included as the fourth state to find out as to how much of the additional landings in each year are appropriated by each of these three types of crafts.

### Results

The analysis of craft-wise marine fish landings of the state during 1979-1997 (Table 1) (Fig 1 and Fig 2) indicated that the share of the traditional crafts in the total fish landings of the State has declined from 76.53 per cent to 20.5 per cent, though the landings in quantity terms have not declined substantially. The share of the mechanised crafts has increased from 23.7 per cent to 64.8 per cent during the same period. This is due to the phased introduction of mechanised crafts and

the subsequent increase in their strength besides the intrinsic characteristics of these crafts in exploring the deeper zones.

**Table: 1 Craft-wise marine fish landings in Tamil Nadu during 1970-1997**

Year	Traditional Craft		Motorised Craft		Mechanised Craft		Total
	Landings	Percent Share	Landings	Percent Share	Landings	Percent Share	Landings
1970	118733	76.3	0	0.0	36783	23.7	155516
1980	123263	56.7	0	0.0	94131	43.3	217397
1990	115510	38.1	10513	3.5	177252	58.4	303275
1997	96989	20.5	69369	14.7	306155	64.8	472513

The share of the motorised crafts has been between 10 and 15 per cent of the total landings during 1990-1997. Murthy and Rao (1996) also observed that the popularisation of mechanised crafts during the seventies along with motorization of indigenous crafts during the late Eighties have led to the decline in the share of the traditional crafts which was significant during the fifties and sixties. These observations indicate that there has been a shift in the fishing pattern as also increased fish yield over the years.

#### ***Structural changes in the craft-wise marine fish landings***

The estimated TPM to study the structural changes in the fishing pattern) indicated that the mechanised crafts retained 36 per cent of the previous year's share of whereas they cornered 92 per cent of the additional landings (Table 2). The traditional crafts have retained 68 per cent of the previous year's share while giving away 31 per cent to mechanised crafts. The motorised crafts retained the full share of the previous year.

**Table 2. Structural changes in craft-wise marine fish landing in Tamil Nadu (1969-1997) – Transition Probability Matrix**

Crafts	Mechanised crafts	Traditional crafts	Motorised crafts	Additional landings
Mechanised crafts	0.36	0.12	0.01	0.51
Traditional crafts	0.31	0.68	0.00	0.01
Motorised crafts	0.00	0.00	1.00	0.00
Additional landings	0.92	0.00	0.08	0.00

All the three operate in the inshore region (0-50 m) and the mechanised are capable of operating even beyond 50 m depth. The increase in the mechanised craft's share in the additional landings may be associated with their increase in strength from 2627 in 1980 to 8991 in 1996-97 (Anon., 1997). Similarly, the reduction in share of the traditional craft landings may be due to its reduction in strength from 43,343 in (1980 to 29,021 in 1997). Also due to the competition from mechanised and motorised crafts, the share of traditional crafts has declined. The encouragement given for mechanisation and motorization through financial subsidies and other technical supports might have inspired the fishermen to go in for such crafts. This has ultimately resulted in the shift of the catch from traditional crafts to the mechanised and motorised crafts.

***Structural changes in the craft-wise species-wise composition of marine fish landings***

The species composition of craft-wise marine fish landings differ depending upon the depth of fishing, distance travelled,

duration of fishing, gears used and other related, parameters. Because of these factors, the same species get harvested at different levels by different crafts, which will give an idea of the structural changes in the composition of landings by various crafts. To assess this change the triennium average of the craft-wise landings of important species have been worked out for the periods 1985-1987 and 1995-97 and the results are presented in Table 3.

It could be seen from the Table 3 that, the percentage share of all the selected species harvested by traditional craft has declined between the two periods. In case of landings of mechanised crafts, the share of lesser sardines, mackerels, prawns and *carangids* have increased between the two triennia, while that of perches has declined from 80.33 per cent to 73.97 per cent. The decline in catch of the *silverbellies* by mechanised crafts is negligible between the two periods. These changes indicate that the species composition of landings by different crafts has changed over the years leading to a structural change. To quantify this structural change, the TPM was estimated. For this purpose, the entire marine fish landings has been grouped into demersal and pelagic adopting the classification made by Jones and Banerjee (1973). During 1985-1997, the demersal varieties have been contributing to about 55 per cent of the total marine fish landings of the State and the rest by pelagic group.

**Table 3: Craft-wise landings in tonnes of selected species in Tamil Nadu (1985-87, 1995-97)**

(in tonnes)

Species	1985-87				1995-97			
	Traditional Crafts	Motorised Crafts	Mechanised Craft	Total	Traditional Crafts	Motorised Crafts	Mechanised Crafts	Total
Silver bellies	2298 (5.38)	0	40435 (94.62)	42733 (100.00)	1452 (3.05)	1175 (2.47)	45017 (94.48)	47644 (100.00)
Other sardines	21593 (66.41)	0	10924 (33.59)	32517 (100.00)	14710 (25.08)	13244 (22.58)	30694 (52.34)	58648 (100.00)
Perches	6472 (19.67)	0	8059 (80.33)	10031 (100.00)	4957 (13.40)	4673 (12.63)	27367 (73.97)	36997 (100.00)
Carangids	8081 (69.42)	0	3560 (30.58)	11641 (100.00)	4581 (19.54)	3973 (16.94)	14893 (63.52)	23447 (100.00)
Prawns	3226 (21.45)	0	11817 (78.55)	15043 (100.00)	921 (3.33)	667 (2.42)	26029 (94.25)	27617 (100.00)
Mackerels	9399 (95.16)	0	478 (4.84)	9877 (100.00)	5631 (28.23)	6832 (34.25)	7485 (37.52)	19948 (100.00)

Note: Figures in parentheses indicate percentages to the respective row total.



*Structural changes in the craft-wise demersal marine fish landings:*

The mechanised crafts have retained 84 per cent of the previous year's share of demersal varieties, while giving away 12 per cent to the traditional crafts (Table 4). Besides, all the additional landings has been appropriated by the mechanised crafts. This fishing is supported by the statistic that the share of the demersal group harvested by the mechanised crafts increased for 68 per cent in 1985 to 82 per cent in 1997. This may be due to the fact that the demersal varieties are available in the deeper zones, which are easily harvested by the mechanised crafts as compared to the other two. Among the different species, silverbellies and prawns are caught in large proportions by the mechanised crafts.

**Table 4. Structural change in the craft-wise, demersal marine fish landing in Tamil Nadu (1985-1987)- TPM**

Crafts	Mechanised crafts	Traditional crafts	Motorised crafts	Additional landings
Mechanised crafts	0.84	0.12	0.04	0.00
Traditional crafts	0.00	0.22	0.00	0.78
Motorised crafts	1.00	0.00	0.00	0.00
Additional landings	1.00	0.00	0.00	0.00

*Structural change in the craft-wise pelagic marine fishery resources*

The traditional and mechanised crafts have retained 73 per cent of the previous year's landings (Table 5), while motorised crafts retained their full share. The traditional crafts could retain 73 per cent by virtue of their fishing in the 0 - 20 m. depth and the use of different types of gill nets. The mechanised crafts could retain 73 per cent of their share, which may be due to the use of large mesh size fish trawl net, which is dragged even in shallow waters. The

motorised crafts retained their full share which may be attributed to different types of gillnets operated by them with suitable adjustments to harvest big sized pelagic fish. Luther *et al.* (1997) also made similar observations while analysing the gillnet fisheries of India.

**Table 5. Structural change in craft-wise, pelagic marine fish landings in Tamil Nadu (1985-1987) – TPM**

Crafts	Mechanised crafts	Traditional crafts	Motorised crafts	Additional landings
Mechanised crafts	0.73	0.00	0.27	0.00
Traditional crafts	0.00	0.73	0.00	0.27
Motorised crafts	0.00	0.00	1.00	0.00
Additional landings	1.00	0.00	0.00	0.00

### Conclusion and Policy Implications

Fishery is a renewable natural resource but not inexhaustible. Various developments programme for fishery aimed at increasing the production from the sea. The mechanisation of fishing in India which is a landmark in Indian fishing, increased the catch from the seas. The landing of the mechanised crafts has increased over the years and the structural change indicated that they have cornered 92 percent of the additional landings. Since the inshore fishery is nearly over exploited, the possibility of deploying the mechanised crafts in the offshore region and diversification of fishing can be explored. These will not only facilitate the conservation of resources but also reduce the competition among the different craft owners. As motorised crafts also accounted for 8 per cent of the additional landings besides retaining their full share, of the previous year, the motorization of traditional crafts may be encouraged to sustain their share of these crafts and thus sustained the livelihood of the large traditional fishermen community.

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