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Total factor productivity growth in marine fisheries of Kerala

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ABSTRACT

Total factor productivity (TFP), which is a measure of the increase in total output not accounted by increase in total inputs is an indicator of the performance of any production system and sustainability of the growth process. The total factor productivity growth of marine fisheries in Kerala was estimated using Divisia-Tornqvist index. The total marine fish production in the state increased from 3.25 lakh t in 1985 to 6.08 lakh t in 2010. The total factor productivity showed a negative growth of -3.69% indicating economic unsustainability of production system in the short run. The study concluded that there exists excess fishing capacity above the economically optimal levels resulting in wastage of money, manpower and fuel in the fishing industry. This necessitates the need for fishery management measures and optimal use of resources in the sector.

Keywords: Divisia-Tornqvist indices, Economic sustainability, Total factor productivity (TFP)

Introduction

In the production function framework, total factor productivity (TFP) growth indicates technical progress, which represents shifts in the production function over time. The efficiency change analysis of TFP attempts to measure the increase in total output which is not accounted by increase in total inputs. TFP serves as an indicator of the performance of any production system and sustainability of the growth process. TFP is often seen as the real driver of growth within an economy. It can also be taken as a measure of economies long term technological change. Productivity measurement is very important as it is a key driver of profitability. Hence productivity growth is identified as an important indicator for fishery performance reports. The TFP growth will form a base for the policy makers for analysing the sustainability of the sector in the long run. Measurement of TFP and analysing its impact on the socio-economics of stakeholders will help the planners and policy makers to make rational resource allocation decisions and to develop a sustainable development plan for the fisheries sector in the country.

The various factors affecting TFP are technology development, infrastructural development, institutional reform, human resource development and externalities like changes in climate. In marine fisheries, stock conditions and environmental factors also influence productivity. Technology development in general is influenced by private and public investment in Research and Development. In marine fisheries, however technology development is in terms of improvements in crafts, gears and engines which can be either through indigenous or imported technologies. Productivity trends can be decomposed into various drivers of productivity, through which the contribution of various factors on productivity growth can be obtained and this will guide the investment decisions on these factors.

The marine fish production in Kerala increased from 3.25 lakh t in 1985 to 6.08 lakh t in 2010. The catch was almost stagnant at 6 lakh t during the period 2000-2010. The value of catch at landing centre level increased from ₹ 2,438 crores to ₹ 3,803 crores and at retail level from ₹ 4,272 crores to ₹ 5,520 crores during 2000-10 (Sathiadhas *et al.*, 2012). The catch of penaeid prawns declined from 56,462 t in 2000 to 35,652 t in 2010 whereas the catch of oilsardines reached 2,59,342 t in 2010. The mechanised trawlers which were undertaking single day fishing in the earlier period started undertaking multiday fishing from 2002 onwards. With the decline in the catches of shrimps, the trawlers initiated pelagic trawling also and engines with very high capacities were introduced, resulting in rise in fuel consumption in the marine fishing sector. The high fuel cost in turn increased the costs of operations of many of the fishing units. This along with reduction in catches of high value resources affected the profitability of operations of many of the fishing units.

Even though there are many studies on the TFP analysis in the crop and livestock sectors, there are no such studies in India dealing with fisheries other than that conducted by Kumar *et al.* (2004). Divisia-Tornqvist index has been used for computing TFP for the inland and marine fisheries. The TFP annual growth has been estimated to be 4% for the aquaculture sector and 2% for the marine sector. Kumar *et al*. (2005) estimated the TFP of livestock sector in India. Tornqvist-Theil TFP indices were computed at the aggregate level for the period between 1950-51 and 1995-96 and the results showed that between 1950-51 and 1995-96, the livestock sector output grew at 2.59% per year. The input index increased by 1.79% per year and TFP grew at about 0.8%. Output growth proceeded along the traditional production function and was entirely driven by growth in measured inputs.

Thorat *et al.* (2006) studied the TFP in horticultural crops in Konkan Region of Maharashtra. Divisia-Tornqvist index was used to compute the TFP indices for crops. Inputs included in the index were: human labour, manure, fertilisers and plant protection chemicals. The sub-period wise analysis has revealed that the magnitude of TFP growth varied from 1.3% per annum during the 1990s to 6.2%t per annum during the 1980s. During the entire period under study (1981-2000), TFP has been found growing at the rate of 5.4% per annum. Investment on research has been the major source in TFP growth. The returns to horticultural research were high pay-off to the tune of IRR 119%.

The present study attempted to assess the economic sustainability of the marine fish production system in Kerala by estimating the total factor productivity growth for the period 2000-2010 using Divisia-Tornqvist indexing method. Since labour and fuel costs accounted more than 80% of the total operating costs, quantities and cost shares of labour and fuel were used for constructing the input index and the quantities and revenue shares of 12 resource groups were used for developing the output index. Since the time series data on stock parameters are not available, the influence of stocks on productivity growth is not covered in the present analysis.

Materials and methods

Gear wise and species wise catch-effort data and species wise average marine fish prices in Kerala estimated by the Central Marine Fisheries Research Institute for the period 2000-2010 were used for the analysis. Data on diesel were collected from marine diesel pumps in Kerala and also from oil companies. The data on kerosene was estimated based on the total subsidised kerosine supplied by the State Civil Supplies Department and also based on the number of motorised units operated per year. Labour employed in the marine fishing industry (mechanised/motorised/non-mechanised sectors) was estimated in terms of labour days. The labour cost consisted of crew share, wages for the crew and expenses for food and bata. The crew share was worked out based on the actual share in net revenue received by the crew members for each category of fishing unit.

The total factor productivity indices in the marine fisheries sector of Kerala for the years 2000 to 2010 were developed using Divisia-Tornqvist indexing method as given below:

$$\text{TFP index} = \frac{\text{Output index}}{\text{Input index}}$$

$$\text{Input index} = \Pi_i(X_{it}/X_{it-1})^{(S_{it}+S_{it-1})1/2}$$

where X_{it} and X_{it-1} are the quantities of input i at time t and t-1; S_{it} and S_{it-1} are the shares of input i in total cost at time t and t-1

Similarly output index was worked out as follows:

$$\text{Output index} = \Pi_j(Q_{jt}/Q_{jt-1})^{(R_{jt}+R_{jt-1})1/2}$$

where Q_{jt} and Q_{jt-1} are the quantities of resource j at time t and t-1; R_{jt} and R_{jt-1} are the shares of resource j in total revenue at time t and t-1; t is the number of years.

The growth in total factor productivity was estimated from the compound annual growth rate (CGR) in TFP indices during the period 2000 to 2010.

Results and discussion

The quantities and values of 12 marine fishery resource groups (Fig. 1) consisting of elasmobranchs, clupeids, low value pelagics, perches, carangids, pomfrets, mackerels, seerfishes, tunnies, crustaceans, cephalopods and low value demersals were taken for constructing the output index. The quantities and shares of labour and fuel (diesel and kerosene) used in the fishing sector was used for constructing the input index.

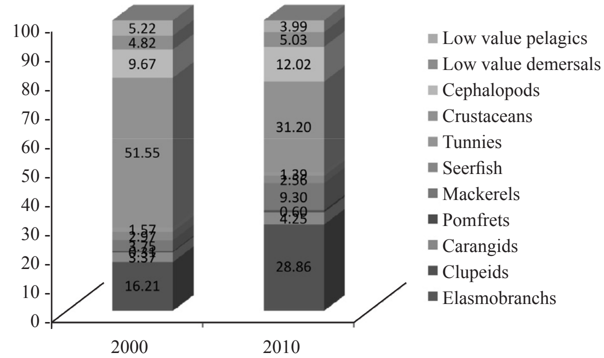

Fig. 1. Shares of various marine fishery resources in 2000 and 2010

Analysis of the shares of different resources in the gross revenue earned at landing centre level showed that the share of crustaceans in the total revenue declined from 51.55% in 2000 to 31.20% in 2010. The share of cephalopods increased from 9.67% to 12.02%. The share of clupeids increased from 16.21% to 28.86% during 2000-10. The output index showed a negative growth of - 2.65% t during 2000-10. The negative output index growth can be attributed to the decline in the catches of high value shrimps which was a major contributor to the gross revenue.

The number of motorised units operated per year declined from 14,99,050 units in 2000 to 9,82,524 units in 2010. The kerosene consumption in Kerala declined from 101 million liters in 2000 to 65 million litres in 2010. The total number of kerosene permits in the state by the Civil Supplies Department is 17,413 and the annual kerosene supply is only 30.48 million litres (2010-11). The remaining kerosene requirement is met from private dealers.

The mechanised trawler units operated per year declined from 3,84,817 in 2000 to 2,17,603 in 2010 whereas the fishing hours declined from 38 million to 35 million hours. The quantity of diesel consumed in Kerala increased from 54.08 million litres in 2004-05 to 119.31 million litres (Fig. 2) and the cost incurred for diesel increased from ₹ 90.53 crores to ₹ 376.28 crores at constant prices. The Government of Kerala is not providing any diesel subsidies, other than the excise duty reimbursement by the Government of India, which is not available to majority of the boat owners due to certain conditions imposed by the central government from 2005 onwards.

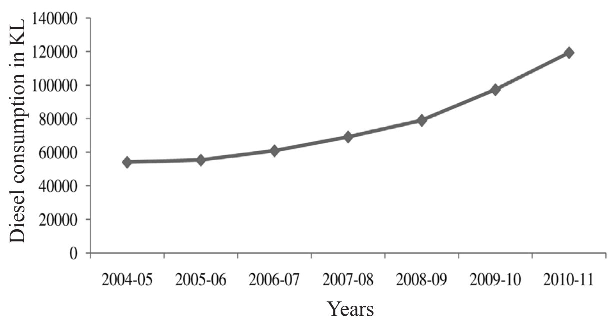

Fig. 2. Diesel consumption in marine fisheries sector of Kerala

The total labour days declined from 18 million to 15 million during 2000-10 (Table 1). In the mechanised sector the total labour days employed increased from 4.4 million to 7.7 million days. In the motorised sector, the labour days declined drastically from 11.04 million to 6.25 million days and in the non-mechanised sector, from 1.38 million to 0.7 million. The labour cost consisting of crew share, bata and food for the crew declined from ₹ 890.31 crores to ₹1239.53 crores during 2000-10.

Table 1. Category-wise labour days in Kerala

Years	Mechanised	Motorised	Non-motorised	Total
2000	4446684	11045293	1385684	16877661
2001	5057899	9101093	1157786	15316778
2002	4602926	9464527	763276	14830729
2003	4624387	10020541	1059658	15704586
2004	4763214	8652311	834906	14250431
2005	4469518	7501859	901138	12872515
2006	5954426	7990678	990116	14935220
2007	6669482	9104945	862790	16637217
2008	7783775	10469164	1121166	19374105
2009	6639601	7044513	815776	14499890
2010	7747187	6259680	739842	14746709
Average	5705373	8786782	966558	15458713

The share of diesel in the total cost increased from 5.96% in 2000 to 32.27% in 2010 whereas the share of labour declined from 74.15% to 42.61% with reduction in the crew share (Table 2).

Table 2. Share of various items in the total cost

Cost components	2000		2010	
	₹ lakhs	% in total cost	₹ lakhs	% in total cost
Diesel cost	7160	5.96	48917	23.19
Kerosene cost	4416	3.68	6840	3.24
Labour cost	89031	74.16	123953	58.76
Other costs	19453	16.20	31222	14.80
Total cost	120060	100.00	210932	100

The total factor productivity showed a negative growth of -3.69% in Kerala during 2000-10 (Table 3). The output index showed a negative growth of -2.65% and the input index showed a positive growth of 1.07%. The negative total factor productivity which could be attributed to the decline in the stocks of high value fishes in the state, is an indicator of the economic unsustainability in the short run. Management measures for conservation of the high value resources like shrimps or other resources may improve the total factor productivity situation in the state.

Negative TFP indicated economic unsustainability of the production process in the short run in the state.

Table 3. Total factor productivity growth (2000-2010)

Indices	Compound annual growth rate (CGR %)
Input index	1.07
Output index	-2.65
TFP index	-3.69

Even though there was substantial increase in marine fish prices in the past decade, reduction in catches of high value fishes like crustaceans as well as high cost of fuel and labour made the system economically unsustainable. There was considerable decline in the number of boats operated but fishing hours remained the same with multiday fishing and engines with very high capacities. Total number of trawlers is 3,982 as against the optimum fleet size of 2,829 (based on potential yield estimates by Sathiananthan *et al*., 2008). The reduction in profit levels of fishing units may lead to reduced fishing effort in the long run with the characteristic boom and buzz game of open access common property marine fishery resources. However efforts are necessary to manage the fishery based on some community based measures to improve the profitability of operations of fishing units and development and promotion of fuel efficient as well as profitable fishing methods. In addition, the impact of introduced technologies like Chinese engines on the productivity and profitability of different fishing units and also on the biological and economic sustainability of the production system needs to be analysed.

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