

TOTAL FACTOR PRODUCTIVITY GROWTH IN LIVESTOCK SECTOR OF TAMIL NADU

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ABSTRACT

An attempt was made to work out the factor shares and value shares of output in livestock sector over last 19 years and to examine in the Total Factor Productivity (TFP) growth of livestock production i.e. livestock production growth over and above the input growth in Tamil Nadu using secondary data for the period from 1999-2000 to 2017-18 from various reports on state-wise estimates of value of outputs from Central Statistics Office, Government of India and Department of Economics and Statistics, Government of Tamil Nadu. The share of milk to total value of output in Tamil Nadu decreased from 68 per cent to 27 per cent from the year 1999-2000 to 2017-18, whereas product shares of meat increased from 18.45 per cent to 64.77 per cent during the same period. During the same period, the factor shares of feed (47.65 per cent to 38.06 per cent) and dry fodder (36 per cent to 20 per cent) was decreased, in contrast to the share of green fodder (10 to 19 per cent). The value of TFP was found to be increasing gradually from the year 2000-01 to 2002-03 and drastically declined during the year 2003-04 (0.95), thereafter it increased gradually from the period 2003-04 to 2016-17, with drastic dip during 2011-12 and minor dip during 2007-08, 2013-14, 2015-16 and 2017-18. From the year 1999-2000, the cumulative TFP index increased to 6.17 during 2004-05, 12.79 during 2010-11 and 20.38 during 2017-18 with increase of one unit per annum, which indicated good sign of livestock development in Tamil Nadu. It could be concluded that the technological interventions in livestock sector (output growth over and above the input growth) in Tamil Nadu shared about 72 per cent in the growth of livestock sector for the past 19 years.

Key words: Livestock; input; output; technology; total factor productivity (TFP); Chain index

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INTRODUCTION

There is significant growth in livestock sector development in Tamil Nadu in terms of milk, meat and egg production over last four decades. The milk production has significantly increased from 1.68 million tonnes to 8.36 million tonnes; egg production from 682 million numbers to 18842 million numbers and livestock meat (excluding poultry) production from 32 million kgs to 178 million kgs from the year 1977-78 to 2018-19, respectively and poultry meat production has increased from 362 million kgs to 456 million kgs from the year 2000-01 to 2018-19 (Basic Animal Husbandry Statistics, 2019). The Annual Compound Growth Rate (ACGR) of milk, egg and meat production over last four decades was calculated to be 3.83, 8.23 and 4.61 per cent, respectively. Although there is a hypothesis that technology has contributed to the growth of livestock sector in Tamil Nadu, there is no empirical evidence to support this statement. This paper attempts to measure the contribution of technology to the growth of the livestock sector in Tamil Nadu. It should be ascertained whether the livestock sector growth in Tamil Nadu over the years is due to increase in input use or due to technological interventions (research and extension). Various indicators are used to measure and analyse the output and productivity changes in agriculture and livestock at disaggregated level (Pandey *et al.*, 1985; Pandey *et al.*, 1994, Elumalai and Pandey, 2004). In this context, the present study was carried out to work out the factor shares and value shares of output

in livestock sector over last 19 years and to examine the impact of technology in the growth livestock sector of Tamil Nadu.

MATERIALS AND METHODS

Secondary data on various factors and products of livestock sector in Tamil Nadu, Southern State of India for the period from 1999-2000 to 2017-18 were collected in the focussed manner from the publication on state-wise estimates of value of outputs from agriculture and allied activities over years from Central Statistics Office, Ministry of Statistics and Programme Implementation, Government of India, Directorate of Animal Husbandry and Department of Economics and Statistics, Government of Tamil Nadu and other reliable sources. Further, assumptions were also made based on methodology for compilation of Gross State Value Added - GSVA (Central Statistical Office, 2019) and past literatures if the particular data is not available. The value of draught power was estimated based on draught animal population projections and assumptions from past studies on cultivable land covered by draught animals (Singh, 2002) and cost of draught animal power (Singh, 2006). From the state-wise estimates of value of outputs from agriculture and allied activities over various years of Government of India, the total value of crops were considered and the conversion factors adopted by various studies (Prabu, 2008; Raju, 2012; and Reddy *et al.*, 2018) were used to estimate the value of animal feed. The estimates of value of green fodder from grazing land were made based on

previous studies (Sankaran, 2007; Prabu, 2008; Reddy *et al.*, 2018; and Thirunavukkarasu *et al.*, 2012). The value of expenditure towards labour utilized in livestock sector was estimated based on the assumptions on agricultural labourers (Elumalai and Pandey 2004; and Prabu, 2008) and wage rates (Das and Usami, 2017; Pocket book of agricultural statistics, 2017). The value shares of individual products (outputs) and factors (inputs) to the total value of livestock outputs and livestock inputs were worked out, respectively.

Total Factor Productivity (TFP)

A concept closely related to the notion of technological change is that of productivity growth. There is a strong link between research investments / innovations and productivity growth (Fuglie and Heisey, 2007). The technical progress shifts the production function upward. As partial productivity approach has its own limitations, Total Factor Productivity (TFP) approach is highly applicable and it measures the increase in total output, which is not accounted for by increase in total inputs. Thus, the TFP index was computed as the ratio of the index of aggregate output to the index of aggregate inputs (Elumalai and Pandey, 2004; and Kumar *et al.*, 2005). The method used to measure TFP does not by itself suggest what determines changes in TFP. Nor does it suggest an underlying TFP production process that might make it possible to derive functional form restrictions that can be used in statistical specifications. TFP growth in its simplest sense is a residual. That is, it is the difference between an actual change in production and

a change in production predicted by weighted factor changes (Evenson, 1999).

Among the parametric (models the state of technology by including a time trend in the production or cost functions and the partial differentiation with respect to time to get estimates of technological changes), accounting (Christensen 1975) and non-parametric (Cox and Chavas, 1980; Chavas and Cox, 1988; and Coelli and Rao, 2003) approaches for TFP measurement, the accounting approach is popular because it is easy to implement requiring no econometric estimation (Kumar *et al.*, 2004). The use of TFP indices gained prominence since studies (Diewert, 1976 and Diewert, 1978) proved that the Theil-Tornqvist discrete approximation to the Divisia index and was consistent in aggregation (Kumar *et al.*, 2008). As the Divisia index in its original integral form are expounded (Hulten, 1973), Tornqvist-Theil index, which is an approximation to Divisia index, is widely used for construct the aggregate output index and aggregate input index (Kannan, 2011 and Senthil *et al.*, 2017). In this method, the residual productivity is considered as a measure of technical change, which indicates a shift in the production function.

In the present study, the TFP index was calculated using Tornqvist Theil index as adopted in previous studies (Prabu, 2008; and Kannan, 2011). The formulae for calculating the Livestock Output Index (LOI), Livestock Input Index (LII) and Total Factor Productivity (TFP) Index is furnished below;

$$LOI = \frac{LOI_t}{LOI_{t-1}} = \sum_{j=1}^7 \left[\frac{Y_{jt}}{Y_{jt-1}} \right]^{(R_{jt} + R_{jt-1})^{\frac{1}{2}}}$$

$$LOI = \frac{LOI_t}{LOI_{t-1}} = \sum_{j=1}^7 \left[\frac{Y_{jt}}{Y_{jt-1}} \right]^{(R_{jt} + R_{jt-1})^{\frac{1}{2}}}$$

... (2)

$$TFP \text{ index} = \frac{TFP_t}{TFP_{t-1}} = \frac{LOI}{LII}$$

... (3)

Where, Y_{jt} is value of j^{th} output in the period t ; R_{jt} , share of j^{th} output in the total value of livestock products in period t ; X_{it} , value of i^{th} input in the period t and S_{it} , share of i^{th} input in the total value of livestock input in period t .

Cumulative indices and chain index

By specifying TOI, TII and TFP equals to 1 in the initial year 1999-2000, the annual TFP indices were estimated for the various periods up to 2017-18. Further, cumulative TOI, cumulative TII and cumulative TFP indices were also worked out. In addition to construction of TFP indices over fixed base index, chain index (Coelli *et al.*, 2005 and Kannan, 2011) was also calculated. Chain index combines annual changes in productivity to measure changes in productivity over a

period of time. Formally, let $I(t+1, t)$ be an index for the period $t+1$ with the base period t . This index is applied to time series $t=0$ to t . A comparison between period t and fixed base 0 is made by following chain indexing of successive periods.

$$I(0, t) = I(0, 1) \times I(1, 2) \times I(2, 3) \dots \dots \dots \times I(t-1, t)$$

... (4)

Share of output in TFP index

The Annual Compound Growth Rate (ACGR) of the following form Z_t for the period 't' for LOI, LII and TFP were worked out as in studies (Prabu, 2008) for four periods viz., 1999-2000 to 2004-05, 2005-06 to 2010-11, 2011-12 to 2016-17 and 1999-2000 to 2016-17.

$$ACGR = \left(\frac{1}{Z_t} \right) \times \left(\frac{dZ}{dt} \right) \times 100$$

... (5)

The share of TFP to Livestock output growth for the above mentioned periods were calculated as indicated by Kannan (2011) and is mentioned below;

Share of TFP to Livestock output growth

$$= \left(\frac{ACGR_{TFP_t}}{ACGR_{LOI_t}} \right) \times 100$$

... (6)

RESULTS AND DISCUSSION

The growth of Total Factor Productivity indices of livestock sector of Tamil Nadu was estimated by calculating the Livestock Output Indices and Livestock Input Indices.

Livestock Output Index (LOI)

The shares of milk in total value of livestock outputs in Tamil Nadu was decreased continuously from 67.85 per cent in the year 1999-2000 to 26.94 per cent in 2017-18 (Table -1). In contrast, the share of value of meat in total value of livestock output in Tamil Nadu was very low at 18.45 per cent during the year 1999-2000 and gradually increased to 64.77 per cent in the year 2017-18. The share of egg in total value of livestock outputs in Tamil Nadu was ranged between 5 to 9 per cent during 1999-2000 to 2009-10 and 3 to 5 per cent during 2010-11 to 2017-18. Similarly, the share of dung in total value of livestock outputs in Tamil Nadu was ranged between 4 to 8 per cent during the entire period. The share of value of draught power in Total value of livestock output was meagre (1.64 per cent) in the year 1999-2000 and it was decreased to almost nil till the period 2017-18. It might be due to the reason of drastic reduction in work animal population (Senthilkumar *et al.*, 2015) and mechanical and electrical power sources contributing about 90 per cent of the total farm power (Tiwari *et al.*, 2019). The share of value of hide and skin in total value of livestock output was less than one per cent throughout the period. The share of increment of livestock to total value of output was ranged from 4.55 to 5.99 per cent during the period 2004-05 to 2010-11 and later it was around one per cent.

The output indices of all the livestock products in Tamil Nadu for the period from 2000-01 to 2017-18 worked out and presented in the Table 2. Based on this, overall Livestock

Output Index (LOI) was also measured and it implied that LOI was above 1.00 for all the years except during the period 2002-03, where it was 0.9485. The results indicated that the growth rate of livestock outputs was increased over period year which is the beneficial for the economy of Tamil Nadu state. Further, it is evident the LOI was ranged between 1.20 to 1.28 during the periods 2004-05, 2007-08 to 2010-11, 2013-14 to 2014-15 and 2017-18. The highest LOI growth index (1.3439) was observed during the period 2010-11, which might be due to significant increase in value of meat from Rs.6358 crores in 2009-10 to Rs.11654 crores in 2010-11. The lowest LOI growth index was noticed during the period 2002-03 (0.9485). The probable reasons for the lowest LOI might be due to drastic reduction in the value of milk (Rs. 5341 crores to Rs.4897 crores) and egg (Rs.413 crores to Rs.370 crores) from the year 2001-02 to 2002-03. The growth of output indices of livestock sector in Tamil Nadu was positive and almost stagnant (LOI growth index of 1.0501), as all the components of livestock sector output increased by meagre level during the year 2017-18. As a whole, it could be concluded that LOI growth indices over the study period was found be advantageous to the Tamil Nadu state economy.

Livestock Input Index (LII)

As shown in the Table 3, the factors shares *viz.*, feed, green fodder, dry fodder, veterinary expenses, labour, marketing and Financial Information Services (FIS) expenses in value of livestock inputs in per cent were

observed to be 47.65, 9.68, 35.68, 3.60, 1.94 and 1.45, respectively in the year 1999-2000. However, these factor shares in per cent were noticed as 37.33, 20.71, 32.35, 5.79, 2.11 and 1.70 per cent, respectively in the year 2004-05. However, these shares became 49.50, 17.81, 21.66, 6.24, 1.73 and 3.06 per cent, respectively in the year 2010-11. The per cent share of feed, green fodder, dry fodder and veterinary expenses in total value of livestock inputs in the year 2017-18 were 38.06, 19.44, 20.44 and 14.92 per cent, respectively. The value of feed and fodder occupied almost 90 per cent of the value of inputs up to the year 2010-11 and thereafter, their share decreased to about 78 per cent in the year 2017-18. It might be due to the significant increase in value of veterinary expenses, which has increased its share from 6 per cent in the year 2010-11 to 15 per cent in the year 2017-18. This clearly indicated that the major thrust and emphasis has been given in animal health care and extension activities implemented by the Department of Animal Husbandry, Government of Tamil Nadu during the last decade. The estimated share value of labour on livestock inputs was observed to be ranged between 1 to 2 per cent during the entire study period and that the marketing, maintenance and Financial Intermediation Services (FIS) were estimated as one to three per cent up to the year 2015-16 and 5 per cent later.

The input indices of all the livestock inputs are presented in the Table 4. Livestock Input Index (LII) was found to be above 1.00 for all the years except during the period 2002-

03 (0.7927) and 2016-17 (0.8311). There was a sharp decline in LII during 2012-13 and increase during 2013-14 and thereafter it decreased continuously till 2016-17. However, LII was estimated to be stagnant with index value of 1.0489 in the year 2017-18. The reasons for sharp decline during the year 2002-03 might be due to decrease in value of inputs viz., feed (Rs.1093 crores to Rs. 740 crores), dry fodder (Rs.950 crores to Rs. 760 crores), labour (Rs.56 crores to Rs. 52 crores) and marketing expenses (Rs.38 crores to Rs. 36 crores). The decline in LII during the year 2016-17 might be due to decrease in value of feed (Rs.4433 crores to Rs. 3056 crores) and dry fodder (Rs.1817 crores to Rs.1276 crores). The growth of input indices of livestock sector in Tamil Nadu was positive and meagre with the value of 1.0489, as value of feed component was decreased to Rs.2963 crores with concurrent increase in value of green (Rs.1513 crores) and dry fodder (Rs.1591 crores) leading to overall meagre growth of LII during the year 2017-18. As a whole, it could be concluded that LII growth indices over the study period followed a mixed trend.

Total Factor Productivity (TFP), Cumulative TFP and Chain Indices

The TFP and chain indices of livestock production in Tamil Nadu over years is presented in the Table 5 and Figure 1. The TFP indices was found to be less than 1 during the years 2000-01 (0.9975), 2003-04 (0.9467) and 2011-12 (0.8549). It implied that the value of LII was greater than LOI during these years. The value of TFP index was found to be the

maximum during the period 2016-17 (1.4750), which indicated the substantial difference between TOI and TII, which is a good sign of development. Further, it is peculiar to note that although the values of LOI (0.9485) and LII (0.7927) were less than one, the value of TFP was found to be 1.1964 during the year 2002-03 and observed to be beneficial in terms of development.

The value of TFP was found to be increasing gradually from the year 2000-01 to 2002-03 and drastically declined during the year 2003-04 (0.95), thereafter it increased gradually from the period 2003-04 to 2016-17, with drastic dip during 2011-12 and minor dip during 2007-08, 2013-14, 2015-16 and 2017-18. The output growth rate were comparatively lower than the input growth rate of livestock sector during the years 2003-04 and 2011-12. In other words, there was no substantial increase in value of various outputs of livestock sector over previous periods, when compared to increase in value of inputs over previous periods. National level evidence showed that output as well as TFP growth of the livestock sector picked up in the eighties when output growth touched nearly 4 per cent per year and TFP growth jumped to nearly 1.8 per cent contributing about 45 per cent to total output growth (Joshi *et al.*, 2005). The growth in TFP revealed the increase in residual productivity or shift in the production function which showed the presence of technical change.

The cumulative TFP index was 1.00 during 1999-2000, and it increased to 6.17 during 2004-05, 12.79 during 2010-11 and

20.38 during 2017-18 with increase of one unit per annum, which indicated good sign of livestock development. The chain index for the year 2000-01 was estimated to be 0.9975 and slowly increased as 1.2273 in 2002-03 and 1.1619 in 2003-04 and thereafter increased considerably. It is evident from the table that it took 12 years for doubling in the chain index (2013-14) and tripled in 19 years (2016-17), when compared to base year 1999-2000. The chain index of 3.3880 during the year 2017-18 was not only due to the effect of previous year but also the effect of output growth over input growth during the entire study period.

The efforts of the government, particularly the department of animal husbandry have played a vital role in improving the livestock productivity. Further, dairy cooperatives have contributed in creation of markets and supported farmers with technical inputs and veterinary services. Development programmes like Operation Flood provided an impetus to the growth of dairy sector. Better feeding and technology and modern marketing (along the Amul model) and determined measures for the protection of health and breed improvement contributed higher TFP growth in livestock sector (Kumar *et al.*, 2005). Thus, technological interventions comprising crossbreeding technology, improved animal health through diagnostics, vaccines, balanced rations composition for better FCR, improved fodder varieties, improved labour efficiency through low cost implements, efficient outreach programmes for better technological adoption might have resulted in improved livestock productivity.

Table 1. Product shares in total value of livestock outputs in Tamil Nadu (in per cent)

Year	Milk	Meat	Eggs	Dung	Increment in livestock	Draught power	Wool & hair
1999-2000	67.85	18.45	5.72	6.18	0.11	1.64	0.05
2000-01	66.90	17.68	5.52	8.24	0.21	1.40	0.05
2001-02	68.33	18.24	5.29	6.45	0.41	1.24	0.04
2002-03	66.06	19.24	4.99	7.68	0.78	1.20	0.05
2003-04	65.40	20.35	5.35	6.59	1.18	1.08	0.05
2004-05	60.12	20.33	8.30	5.72	4.55	0.83	0.15
2005-06	62.18	19.44	6.63	5.89	4.88	0.83	0.15
2006-07	59.92	20.90	8.20	5.83	4.46	0.63	0.05
2007-08	57.90	23.60	8.42	5.17	4.52	0.39	0.00
2008-09	54.30	26.17	8.32	5.15	5.75	0.21	0.10
2009-10	49.91	28.62	9.92	5.39	5.91	0.17	0.08
2010-11	43.21	39.05	7.02	4.59	5.99	0.09	0.06
2011-12	42.85	45.37	6.95	3.76	0.98	0.06	0.04
2012-13	37.70	48.77	7.08	5.32	1.06	0.04	0.03
2013-14	31.78	55.47	6.84	4.88	0.98	0.03	0.03
2014-15	35.03	52.80	5.63	5.56	0.94	0.01	0.02
2015-16	32.78	56.44	5.12	4.64	0.99	0.01	0.02
2016-17	27.38	64.75	3.59	3.40	0.87	0.00	0.02
2017-18	26.94	64.77	3.73	3.58	0.96	0.00	0.02

Table 2. Livestock Output Indices (LOI) in Tamil Nadu over years

Year	Milk	Meat	Eggs	Dung	Increment in livestock	Draught power	Wool & hair	Total Output	LOI
2000-01	0.0369	0.0048	0.0018	0.0257	0.0011	-0.0013	0.0000	0.0691	1.0716
2001-02	0.0414	0.0128	-0.0001	-0.0150	0.0022	-0.0011	0.0000	0.0400	1.0409
2002-03	-0.0584	0.0001	-0.0056	0.0086	0.0035	-0.0010	0.0000	-0.0529	0.9485
2003-04	0.0032	0.0140	0.0043	-0.0099	0.0043	-0.0010	0.0000	0.0149	1.0150
2004-05	0.0608	0.0367	0.0423	0.0024	0.0438	-0.0008	0.0014	0.1865	1.2051
2005-06	0.0620	0.0046	-0.0117	0.0056	0.0065	0.0005	0.0001	0.0675	1.0699
2006-07	0.0851	0.0502	0.0288	0.0098	0.0040	-0.0007	-0.0009	0.1764	1.1929
2007-08	0.0990	0.0720	0.0190	0.0045	0.0096	-0.0014	-0.0010	0.2019	1.2237
2008-09	0.0769	0.0759	0.0159	0.0102	0.0227	-0.0013	0.0024	0.2028	1.2248
2009-10	0.0884	0.0941	0.0392	0.0158	0.0164	0.0000	0.0001	0.2539	1.2890
2010-11	0.0703	0.2050	-0.0043	0.0066	0.0184	-0.0004	0.0000	0.2955	1.3439
2011-12	0.0399	0.1061	0.0064	-0.0041	-0.0596	-0.0003	-0.0002	0.0881	1.0921
2012-13	0.0004	0.0948	0.0104	0.0216	0.0022	-0.0001	0.0000	0.1292	1.1379
2013-14	0.0126	0.1750	0.0120	0.0062	0.0013	-0.0001	0.0000	0.2070	1.2300
2014-15	0.0987	0.0804	0.0001	0.0172	0.0015	-0.0001	0.0000	0.1979	1.2188
2015-16	0.0039	0.0792	-0.0008	-0.0053	0.0013	0.0000	0.0000	0.0782	1.0814
2016-17	0.0079	0.2082	-0.0065	-0.0042	0.0007	0.0000	0.0000	0.2060	1.2287
2017-18	0.0089	0.0318	0.0032	0.0035	0.0014	0.0000	0.0000	0.0489	1.0501

Share of TFP in Output Growth

The share of TFP in output growth was also ascertained and shown in the Table 6. The annual compound growth rate of LOI and LII indices for the period 1999-2000 to 2004-05 was 1.95 and 1.89 per cent, respectively. The Annual Compound Growth Rate (ACGR) of TFP in Tamil Nadu was found to be gradually increased from 0.0537 per cent in period I (1999-2000 to 2004-05) to 3.9055 in period III (2011-12 to 2017-18). Thus it could be concluded that the TFP growth of livestock sector in Tamil Nadu has performed better

than the national performance during the period of 1980s and 1990s (Kumar *et al.*, 2005) and that of Haryana state during the periods of 1970-71 to 1998-99 (Elumalai and Pandey, 2004).

The share of TFP in output growth was found to be meagre 2.75 per cent during the period 1999-2000 to 2004-05. However, the share of TFP in output growth was higher (65.84 per cent) during the period 2005-06 to 2010-11 and was the maximum (317.84 per cent) during the period 2011-12 to 2017-18. The negative growth of LII (decrease in cost

Table 3. Factor shares in value of livestock inputs in Tamil Nadu (in per cent)

Year	Feed	Green fodder	Dry fodder	Department of Animal Husbandry	Labour	Marketing, Maintenance and FIS
1999-2000	47.65	9.68	35.68	3.60	1.94	1.45
2000-01	45.35	9.01	38.23	3.76	2.19	1.45
2001-02	42.38	12.90	36.84	4.17	2.20	1.50
2002-03	36.24	16.28	37.21	5.91	2.57	1.79
2003-04	36.88	15.19	37.60	6.19	2.45	1.70
2004-05	37.33	20.71	32.35	5.79	2.11	1.70
2005-06	41.63	19.59	28.79	6.12	2.09	1.77
2006-07	46.63	17.01	24.49	7.99	1.99	1.90
2007-08	47.39	17.58	24.03	7.17	1.85	1.99
2008-09	48.01	16.42	24.42	7.00	1.89	2.26
2009-10	50.11	16.52	22.28	6.64	1.83	2.62
2010-11	49.50	17.81	21.66	6.24	1.73	3.06
2011-12	50.94	15.40	18.52	10.89	1.60	2.66
2012-13	42.67	16.93	22.85	12.90	1.68	2.98
2013-14	45.45	13.23	24.01	12.79	1.54	2.98
2014-15	45.74	13.24	23.88	12.37	1.51	3.26
2015-16	49.71	12.67	20.38	12.31	1.52	3.41
2016-17	41.18	18.56	17.20	16.02	2.01	5.04
2017-18	38.06	19.44	20.44	14.92	2.10	5.05

of production) and positive growth of LOI (increase in value of production) together with extensive livestock research and extension activities in Tamil Nadu might be reasons for greater share of TFP to output growth. Various technologies developed by the University and

implementation of Hon'ble Chief Minister's Special Schemes viz., Free distribution of Milch Cows and Free distribution of Goats/ Sheep. State Fodder Development Schemes, Infrastructure Development Schemes, Livestock disease control schemes, National

Table 4. Livestock Input Indices (LII) in Tamil Nadu over years

Year	Feed	Green fodder	Dry fodder	Department of Animal Husbandry	Labour	Marketing, Maintenance, FIS and others	Total Inputs	Livestock Input Indices
2000-01	0.0103	0.0000	0.0520	0.0043	0.0040	0.0010	0.0716	1.0742
2001-02	-0.0245	0.0406	-0.0095	0.0046	0.0004	0.0006	0.0121	1.0122
2002-03	-0.1529	0.0000	-0.0824	0.0058	-0.0019	-0.0009	-0.2323	0.7927
2003-04	0.0318	0.0000	0.0301	0.0070	0.0005	0.0003	0.0697	1.0722
2004-05	0.0718	0.0882	0.0108	0.0069	0.0008	0.0031	0.1817	1.1992
2005-06	0.0552	-0.0049	-0.0262	0.0051	0.0005	0.0012	0.0308	1.0313
2006-07	0.0959	-0.0069	-0.0154	0.0262	0.0011	0.0033	0.1041	1.1097
2007-08	0.0834	0.0336	0.0345	0.0040	0.0017	0.0040	0.1611	1.1748
2008-09	0.0425	0.0014	0.0224	0.0037	0.0018	0.0043	0.0761	1.0790
2009-10	0.0726	0.0182	0.0031	0.0036	0.0013	0.0062	0.1051	1.1108
2010-11	0.0635	0.0369	0.0245	0.0050	0.0015	0.0084	0.1399	1.1501
2011-12	0.1369	0.0163	0.0175	0.0685	0.0027	0.0029	0.2449	1.2775
2012-13	-0.0758	0.0178	0.0467	0.0220	0.0010	0.0036	0.0153	1.0155
2013-14	0.1181	-0.0062	0.0596	0.0252	0.0019	0.0062	0.2048	1.2273
2014-15	0.0529	0.0146	0.0249	0.0096	0.0014	0.0062	0.1096	1.1158
2015-16	0.0547	-0.0016	-0.0281	0.0032	0.0005	0.0026	0.0312	1.0317
2016-17	-0.1690	0.0309	-0.0664	0.0113	0.0017	0.0087	-0.1827	0.8330
2017-18	-0.0123	0.0178	0.0415	-0.0037	0.0018	0.0025	0.0477	1.0489

Table 5. TFP, cumulative TFP and Chain indices of livestock sector in Tamil Nadu

Year	TFP Index	Cumulative TFP Index	Chain Index
1999-2000	1.0000	1.0000	1.0000
2000-01	0.9975	1.9975	0.9975
2001-02	1.0283	3.0259	1.0258
2002-03	1.1964	4.2223	1.2273
2003-04	0.9467	5.1690	1.1619
2004-05	1.0049	6.1739	1.1675
2005-06	1.0374	7.2113	1.2112
2006-07	1.0750	8.2862	1.3020
2007-08	1.0416	9.3278	1.3562
2008-09	1.1351	10.4629	1.5394
2009-10	1.1604	11.6234	1.7863
2010-11	1.1685	12.7918	2.0872
2011-12	0.8549	13.6467	1.7843
2012-13	1.1206	14.7673	1.9995
2013-14	1.0022	15.7695	2.0039
2014-15	1.0924	16.8618	2.1890
2015-16	1.0481	17.9100	2.2943
2016-17	1.4750	19.3850	3.3842
2017-18	1.0011	20.3861	3.3880

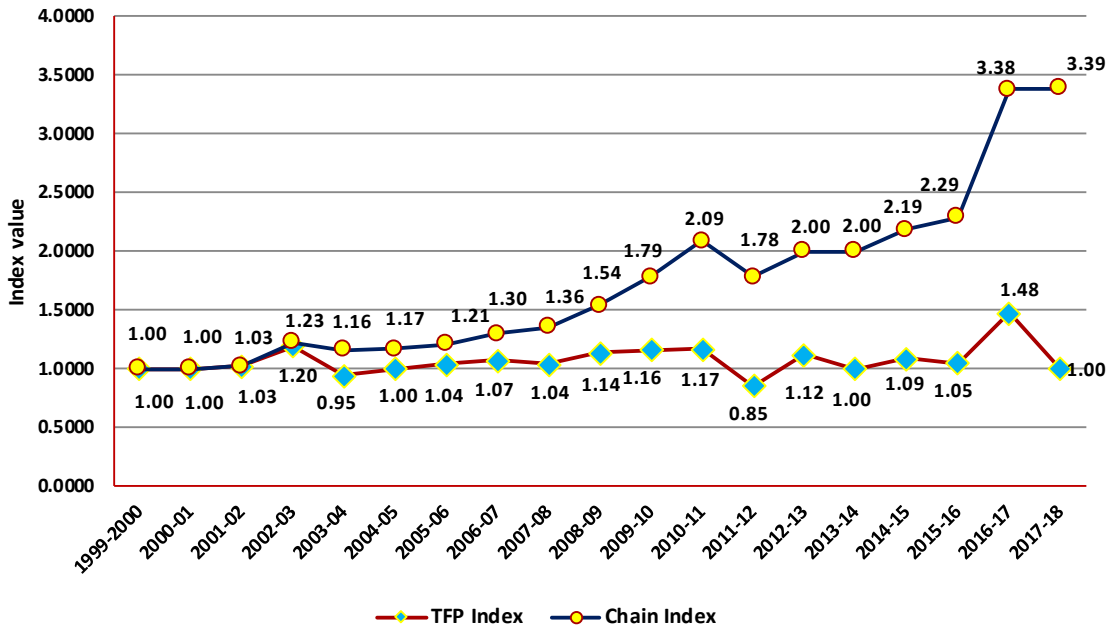


Fig. 1. TFP and chain index of livestock sector in Tamil Nadu

Table 6. Share of TFP in output growth

Period	Annual Compound Growth Rate (ACGR %)			Share of TFP in output growth
	LOI	LII	TFP	
1999-2000 to 2004-05	1.9533	1.8986	0.0537	2.75
2005-06 to 2010-11	4.0021	1.3322	2.6348	65.84
2011-12 to 2017-18	1.2288	-4.0776	3.9055	317.84
1999-2000 to 2017-18	0.7732	0.2161	0.5559	71.90

Livestock Mission implemented by the Government might have contributed to the TFP growth. The budget outlay for research and development activities for the livestock by the Government of Tamil Nadu increased from Rs.85 crores in the year 1999-2000 to Rs.1161 crores in the year 2017-18, which might have improved the research, infrastructure development, health and extension services. As a whole, it could be concluded that the technological interventions i.e. research and extension activities in livestock sector of Tamil Nadu shared about 72 per cent in the growth of livestock output index for the past 19 years.

CONCLUSIONS

The annual compound growth rate (ACGR) of milk, meat and egg production was observed to 3.18, 10.21 and 9.58 per cent, respectively for the period from 1999-2000 to 2017-18. Further, it was further explored that the ACGR of the productivity of indigenous cow, crossbred milk, buffalo milk, desi egg and improved hen egg was calculated to be 2.37, 2.11, 1.53, 0.49 and 1.85 per cent, respectively. Thus the productivity and production of livestock in Tamil Nadu was found to be positive during the study period. Further, estimated values of Chain index, ACGR of TFP growth and share of TFP in output growth of livestock sector in Tamil Nadu during the study period indicated that 72 per cent of livestock sector growth during the study period was not due to the inputs i.e due to the technological factors, which implied good sign of development. Further, there is the scope for further improvement in TFP growth

of livestock sector of Tamil Nadu through innovative high yielding technologies and vigorous extension programmes.

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