

SPATIO-TEMPORAL ANALYSIS OF BUFFALO POPULATION AND MILK PRODUCTION IN TAMIL NADU

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ABSTRACT

Growth dynamics of buffalo population and milk production and productivity in Tamil Nadu was analysed. Point to point annual compound growth rate (ACGR) was calculated to assess the trend in buffalo population and continuous annual compound growth rate (ACGR) for milk production and productivity. The share of Tamil Nadu to National buffalo population decreased from 5.29 to 0.72 % (1951 to 2012) and the buffalo milk production reduced from 4.01 to 0.46% (2001-02 to 2015-16). The ACGR of buffalo population in Tamil Nadu was -17.23% during the last inter-census period (2007-12). North Eastern and Cauvery Delta agro-climatic zones of Tamil Nadu registered high negative growth. The annual compound growth rate of buffalo milk production during 2011-12 to 2015-16 in Southern zone was -27.37% and it was - 21.72% in North Eastern and -20.93 % in Cauvery Delta zone with overall ACGR of -16.85%. The ACGR of buffalo milk productivity was 0.61% (2001-02 to 2015-16) in Tamil Nadu, while the rate was 1.58% in India. Hence, rigorous implementation of buffalo development programmes is a prime requisite and need of the hour for improving buffalo population and milk production in Tamil Nadu.

Key words: Buffalo; Population; Production; Productivity; Growth rate

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INTRODUCTION

India possesses the largest livestock wealth in the world accounting for 12.80

% of cattle and 54.38 % of buffalo in the world as of 2019 (BAHS, 2021) and India is the largest producer of milk in the world, contributing 23% of global milk production (Press Information Bureau, 2022). The buffalo population in India was 109.85 million (in 2019) and India ranks first in the world for total milk production (209.96 million tonnes) during 2020-21 and about half of which (95.39 million tonnes) was contributed by

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buffaloes. In Tamil Nadu, buffalo population was 0.52 millions (in 2019), which yielded 0.251 million tonnes of milk (2020-21), while the productivity (average daily milk yield) of buffalo in the state was 4.08 kg per day and was reduced to 3.54 kg per day in 2020-21. Hence, the present study was conducted to assess the region-wise and district-wise growth trend in buffalo population, production and productivity in Tamil Nadu.

MATERIALS AND METHODS

Secondary data regarding district-wise population, production and productivity of buffalo in Tamil Nadu for the period from 1997 to 2012, 2001-02 to 2015-16 and 2016-17 to 2020-21 respectively were collected from the Department of Economics and Statistics, Integrated Sample Survey and Directorate of Animal Husbandry and Veterinary Services, Tamil Nadu Government (Report 2019-20 and Report 2016). Annual compound growth rate (ACGR) of buffalo population in districts of Tamil Nadu for last three inter-census period (1997 to 2012) were estimated by using the formula of point to point growth rate as used by Meganathan *et al.* (2004) and Senthil Kumar *et al.* (2015).

$$G_{pp} = \{ e^{[\ln(Y_t / Y_o)] / t} - 1 \} \times 100$$

where, G_{pp} = Annual compound growth rate between two periods

Y_o = Population of livestock species in base year

Y_t = Population in the t^{th} year (current year)

t = Number of years (current year - base year)

The annual compound growth rate of buffalo milk production in districts of Tamil Nadu (2001-02 to 2015-2016) were estimated by the using the formula of continuous growth rate as used by Selvakumar *et al.* (2012).

$$G_c = \left\{ \frac{1}{Y_t} \right\} \times \left\{ \frac{dY_t}{dt} \right\} \times 100$$

where, G_c = Annual compound growth rate for continuous data

Y_t = Estimated production / productivity of buffalo milk

t = Number of years (1,2,3,...n)

RESULTS AND DISCUSSION

Population: The buffalo population in India and Tamil Nadu over different census periods (Table 1 and Figure 1) showed that the buffalo population in India had increased from 43.4 million in 1951 to 108.7 million in 2012. In contrast, buffaloes in Tamil Nadu reduced from 2.30 million (in 1951) to 0.78 million (in 2012). The buffalo population initially decreased to 2.04 million in 1956 and during the subsequent censuses in 1961, 1966, 1974, 1977 and 1982, there was a gradual increase in the population as 2.59, 2.72, 2.85, 3.08 and 3.21 million, respectively. After that the buffalo population declined gradually as 3.13, 2.93, 2.74 and 1.66 million in 1989, 1994, 1997 and 2004, respectively. In the year 2007, it increased to 2.01 million and decreased later on to 0.78 million in 2012. The share of Tamil

Nadu buffalo population to India was 5.29 % in the year 1951 and it decreased to 4.55 % in the year 1956. During the years 1961 and 1966, it increased to 5.07 and 5.14 % respectively. In the subsequent censuses in 1974, 1977, 1982, 1989, 1994, 1997, 2004 and 2012, it gradually declined to 4.97, 4.96, 4.60, 4.12, 3.48, 3.05, 1.69 and 0.72 % respectively, except in the census of 2007, where there was a marginal increase (1.91 %) in the contribution.

The annual compound growth rate of buffalo population in India was found to be positive during all the inter-census period. The growth was found to be highest during the period 1956-61 (2.66 %) and the lowest during the period 2007-12 (0.63 %). During 1951-56, the annual compound growth rate of buffalo population in Tamil Nadu was recorded negatively as 2.34 %, which subsequently showed a positive growth by 4.91, 0.98, 0.58, 2.56 and 0.86 % during the periods, 1956-61, 1961-66, 1966-74, 1974-77 and 1977-82, respectively. Then it showed a negative growth by 0.38, 1.29, 2.21 and 6.93 % during the periods, 1982-89, 1989-94, 1994-97 and 1997-2004, respectively. A positive growth rate of 6.60 % was found in 2004-07 and then it showed a negative growth rate of 17.23 % and 5.67 per cent during the period 2007-12 and 2012-2019, respectively. The annual compound growth rate of buffalo population in India was positive throughout the period from 1951 to 2019, whereas in Tamil Nadu annual compound growth rate of buffalo population had mixed trend of both positive and negative. However in the recent three decades, negative

annual compound growth rate in buffalo population were observed with a maximum negative ACGR (-17.23 %) registered during inter-census period 2007-12. Thus, the drastic reduction in recent years necessitates further research to explore the reasons for decrease in buffalo population. The results were also emphasized by the studies of Prabu *et al.* (2012) and Selvakumar *et al.* (2012). Similar findings were observed by Chitra *et al.* (2016) in West Bengal.

The buffalo population trends in various agro climatic zones of Tamil Nadu were worked out for the last four inter-census periods, 1997-2004, 2004-07, 2007-12 and 2012-19 and the results were presented in Table 2. The buffalo population has registered a negative growth rate in all the agro-climatic zones of Tamil Nadu during the inter-census period of 1997-2004, 2004-2007 and 2007-12, except in North Eastern zone (7.61%), Western (0.98%) and Southern (30.51%) during the period 2004-07 and in High Rainfall (3.31%) and High altitude (30.10%) zone during the period 2007-12. During the inter-census period 2007-12, the highest negative growth (-17.24 %) was found in North Eastern zone.

The annual compound growth rate of buffalo population in different districts of Tamil Nadu were worked out for the inter-census periods, 1997-2004, 2004-07, 2007-12 and 2012-19 were presented in Table 3. Negative trend was observed in all the districts except Salem (4.07 %) and Virudhunagar (1.41%) during the period, 1997-2004. During 2004-07, districts of Tamil Nadu,

viz., Thoothukudi, Pudukottai, Thiruvallur, Tirunelveli, Kancheepuram, Namakkal, Dindigul, Vellore, Chennai and Erode districts had registered a positive annual compound growth rate. During inter-census period 2007-12, all the districts of Tamil Nadu has recorded a negative growth except Coimbatore and Tiruppur combined (7.99%), Kanyakumari (3.31%) and The Nilgiris (30.10%). Chennai (29.47%) and Dindigul (7.52%) district had showed a positive annual growth of buffalo population for the inter-census period 2012-19. The results were similar to the studies of Prabu *et al.* (2012) and Soju and Meena (2017).

Various constraints prevailing in buffalo farming as indicated in recent studies like existence of higher number of crossbred cattle over buffaloes, difficulty in breeding management due to existence of silent heat and more success of cross breeding in cows inhibited the dairy farmers to go for rearing the buffaloes. The lack of wallowing facilities, non-remunerative price for milk, lack of potable water, improper feed and fodder management, lack of grazing and cultivating land, increasing urbanization and non-availability of timely artificial insemination service were also reported to be the other major constraints perceived by the buffalo farmers.

Milk production: Buffalo milk production in India and Tamil Nadu (2001-02 to 2020-21) was shown in Table 4 and Figure 2. The milk production of India increased from 45.40 to 95.39 million tonnes, while the buffalo milk production in Tamil Nadu had decreased from 1.82 to 0.251 million tonnes

mainly due to declining buffalo population. The State's share of buffalo milk production to the Nation (Table 4) implied a decreasing share of 4.01 to 0.26 %.

The annual compound growth rate of buffalo milk production in various agro-climatic zones of Tamil Nadu were worked out for the period from 2001-02 to 2021-22 and the results were depicted in Table 5. The composition of buffalo milk production among various agro-climatic zones of Tamil Nadu in last three decades was shown in Figure 3. All the agro-climatic zones of Tamil Nadu showed a negative growth in the periods, 2001-02 to 2015-16 (15 years), 2006-07 to 2015-16 (10 years) and 2011-12 to 2015-16 (5 years). During the period, 2011-12 to 2015-16, the growth rate was highly negative in Southern zone (-27.37 %), followed by North Eastern (-21.72 %) and Cauvery Delta (-20.93 %) zone. However, the ten years ACGR (2006-07 to 2015-16) revealed the high negative growth in Southern (-8.35 %), Cauvery Delta (-8.24 %), North Western (-6.91 %) and North Eastern (-6.32 %) zones. Southern zone (-11.22 %), Cauvery Delta (-10.87 %) and North Eastern (-10.67 %) zones also showed a high negative growth based on 15 year ACGR. During last six years (2016-17 to 2021-22), negative growth rate was the maximum in high rainfall zone (-78.33 %), followed by Cauvery Delta zone (-14.47 %), North-Western zone (-9.22 %) and Southern zone (-8.25 %). Though, a high negative growth rate was observed in high rainfall zone, it is concluded that the contribution of this zone to buffalo milk

production is very low. Although high altitude zone registered positive annual compound growth rate in buffalo milk production during the period 2016-17 to 2021-22, it need not be considered significantly as their share in total buffalo milk production of the state is very meagre.

The annual compound growth rate of buffalo milk production in different districts of Tamil Nadu were worked out for period from 2001-02 to 2015-16 and the results are presented in Table 6. In Tamil Nadu, the buffalo milk production was decreased at the growth rate of -8.44, -6.47 and -16.85% and 8.58% during the periods, 2001-02 to 2015-16 (15 years), 2006-07 to 2015-16 (10 years), 2011-12 to 2015-16 (5 years) and 2016-17 to 2021-22 (recent 6 years), respectively. Among 30 districts studied, negative growth was found in all the districts in Tamil Nadu during the period from 2001-02 to 2015-16. Analysis of five year ACGR revealed that the high declining distributions in buffalo milk production were found in Perambalur (-50.80 %), Ramanathapuram (-47.75 %), Thiruvavur (-44.56 %) and Nagapattinam (-42.52 %), respectively. The remarkable declining trend was also observed in Perambalur (-33.32 %), Ramanathapuram (-29.47 %) and Thiruvavur (-25.29 %) districts based on 10 year ACGR, while Ramanathapuram (-25.24 %), Theni (-24.02 %) and Thiruvavur (-22.50 %) districts showed a high declining trend based on 15 year ACGR. During recent 6 years, there was drastic negative ACGR in Thiruvavur (-85.15

%). Kanyakumari (-78.33 %) and Sivagangai (-76.65 %) districts, which requires necessary interventions.

Milk productivity: Milk productivity of buffalo in India and Tamil Nadu was shown in Table 7 and Fig 4. In India, milk productivity increased from 4.09 to 5.65 kg per day from the year 2001-02 to 2020-21. The productivity of buffalo milk in Tamil Nadu was found to the highest (4.42 kg) during 2013-14 and the lowest in 3.54 kg during 2020-21. Borah and Halim (2014) reported similar findings that productivity of buffalo milk was low in Assam (2.05 litres per day) when compared with India.

The annual compound growth rate (ACGR) in milk productivity of buffaloes (in milk and in milch) in different districts of Tamil Nadu was worked out for the period from 2001-02 to 2015-16 (15 years), 2006-07 to 2015-16 (10 years), 2011-12 to 2015-16 (5 years), 2016-17 to 2019-20 and was presented in Table 8 and Table 9. The annual compound growth rate of milk productivity of buffaloes (in milk) in Tamil Nadu had registered at the rate of 0.61% during the period 2001-02 to 2015-16 and the ACGR was 0.97 and 2.51 % respectively for the period 2006-07 to 2015-16 and 2011-12 to 2015-16. The ACGR for respective periods was -0.15, 0.89 and -0.97 % for buffalo milk productivity (in milch). During 2001-02 to 2015-16, the high negative annual compound growth rate observed for buffalo milk productivity (in milk and milch) in Ramanathapuram (-3.29 and -3.72 %) and Cuddalore (-2.38 and -3.51 %) districts.

The per day milk productivity of indigenous and non-descript buffaloes were estimated to be 4.71 kgs and 3.081 kgs respectively in the year 2019-20. Further, the annual compound growth rate of milk productivity of indigenous buffaloes and non-descript buffaloes (in milk) in Tamil Nadu had registered at the rate of 2.14 % and 3.26 %, respectively during the period 2016-17 to 2019-20. During this period, the ACGR of milk productivity of indigenous buffaloes in Perambalur district showed significant negative rate of -11.47% which needs to be addressed. Similarly for the ACGR of milk productivity of non-descript buffaloes in Kanyakumari (-98.22 %) and Dindigul (-19.56 %) districts showed significant negative rate. The reasons might be due to increased urbanization which resulted in declined agricultural working to take force buffaloes for grazing, lower number of high yielding buffaloes such as Murrah, lack of grazing land and reduction in the supplementation of concentrate feeding, as reported by Kathiravan and Selvam (2011).

CONCLUSION

The State's share of buffalo milk production to the Nations had decreased considerably during the 15 years (2001-02 to 2015-16). A reasonable decline was noticed in the buffalo population and production among all the agro-climatic zones and districts of Tamil Nadu. The reasons might be due to farmer's preference to rear crossbred cattle over buffaloes, difficulty in the breeding management due to existence of silent heat, low number of high yielding buffaloes such

as Murrah, non-availability of timely artificial insemination service for buffaloes, lack of wallowing facilities and water resources, non-remunerative price for buffalo milk, non-availability of adequate grazing land and fodder, inadequate labour and high wages, inadequate supplementation of concentrate feed and other nutrients. Necessary steps such as implementation of buffalo development programmes, provision of door step artificial insemination facilities and timely veterinary health care services, improved good quality feed and fodder availability, conservation of grazing land, wallowing facilities and water resources and creation of awareness on scientific management practices among the farmers have to be taken to counteract the dwindling in buffalo population and milk production in the State. Vigorous thrust should be given by the Government to conserve the native buffalo germplasm and to implement schemes like "Priceless buffalo and buffalo calf distribution" across the districts in the State to visualize buffalo improvement.

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Table 1. Comparative scenario of buffalo population in Tamil Nadu and India (1951 to 2019)

Year	India (million)	Tamil Nadu (million)	Tamil Nadu share in India's total (%)	ACGR (%)	
				India	Tamil Nadu
1951	43.40	2.30	5.29	-	-
1956	44.90	2.04	4.55	0.68	-2.34
1961	51.20	2.59	5.07	2.66	4.91
1966	53.00	2.72	5.14	0.69	0.98
1974	57.40	2.85	4.97	1.61	0.58
1977	62.00	3.08	4.96	1.55	2.56
1982	69.78	3.21	4.60	2.39	0.86
1989	75.97	3.13	4.12	1.71	-0.38
1994	84.21	2.93	3.48	2.08	-1.29
1997	89.92	2.74	3.05	1.32	-2.21
2004	97.92	1.66	1.69	1.43	-6.93
2007	105.34	2.01	1.91	1.84	6.60
2012	108.70	0.78	0.72	0.63	-17.23
2019	109.85	0.52	0.47	0.15	-5.67

Source: Basic Animal Husbandry Statistics (various years), Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture. Government of India

Table 2. Growth of Buffalo population in different agro-climatic zones of Tamil Nadu (1997-2019)

S. No	Agro-climatic zones	ACGR (%)			
		1997-2004	2004-2007	2007-2012	2012-2019
1	North Eastern zone	-9.56	7.61	-17.24	-3.20
2	North Western zone	-3.31	-3.36	-10.59	-7.14
3	Western zone	-4.12	0.98	-10.92	-3.98
4	Cauvery Delta zone	-9.31	-0.42	-15.89	-10.47
5	Southern zone	-1.08	30.51	-1.33	-3.39
6	High Rainfall zone	-11.61	-25.54	3.31	-10.03
7	High Altitude zone	-3.08	-30.49	30.10	-7.40
	Tamil Nadu	-6.93	6.60	-17.23	-5.67

Table 3. Growth of Buffalo population in different districts of Tamil Nadu (1997-2019)

S. No	District	ACGR (%)			
		1997-2004	2004-2007	2007-2012	2012-2019
1	Ariyalur	NA	NA	-18.20	-15.39
2	Chennai	-28.81	2.03	-15.16	29.47
3	Coimbatore+Tiruppur	-11.54	-3.75	7.99	-7.82
4	Cuddalore	-9.06	-19.84	-6.12	-11.72
5	Dharmapuri+Krishnagiri	-5.43	-18.37	-1.43	-7.49
6	Dindigul	-7.12	5.83	-27.39	7.52
7	Erode	-2.12	1.77	-15.76	-2.29
8	Kancheepuram	-5.17	10.12	-17.94	-4.40
9	Kanyakumari	-11.61	-25.54	3.31	-10.03
10	Karur	-4.14	-5.32	-4.79	-6.66
11	Madurai	-19.14	-20.57	-2.21	-5.01
12	Nagapattinam	-4.23	-17.48	-17.62	-7.32
13	Namakkal	-6.66	6.47	-13.28	-7.32
14	Perambalur	-16.46	-39.10	-24.93	-2.22
15	Pudukottai	-14.16	37.98	-26.79	-20.57
16	Ramanathapuram	-23.35	-2.90	-18.31	-12.85
17	Salem	4.07	-6.01	-11.80	-6.63
18	Sivagangai	-7.31	-19.79	-8.27	-22.11
19	Thanjavur	-7.08	-6.53	-16.12	-14.99
20	The Nilgiris	-3.08	-30.49	30.10	-7.40
21	Theni	-15.74	-23.51	-14.58	-7.38
22	Thiruvallur	-3.91	20.25	-21.94	-1.36
23	Thiruvarur	-17.65	-25.16	-23.04	-7.36
24	Thoothukudi	-10.83	147.97	-53.13	-5.78
25	Thiruchirapalli	-7.76	-1.78	-14.20	-12.19
26	Tirunelveli	-4.78	13.36	-24.51	-8.98
27	Thiruvannamalai	-13.78	-0.79	-7.31	-14.67
28	Vellore	-16.43	5.01	-13.68	-0.16
29	Villupuram	-15.52	-12.30	-11.73	-9.30
30	Virudhunagar	1.41	-19.49	-14.67	-5.82
	Tamil Nadu	- 6.93	6.60	-17.23	-5.67

NA – Data not available

**Table 4. Comparative scenario of buffalo milk production in Tamil Nadu and India
(2001-02 to 2020-21)**

Year	India (million tonnes)	Tamil Nadu (million tonnes)	Tamil Nadu Share in India's total (%)
2001-02	45.40	1.82	4.01
2002-03	46.51	1.47	3.15
2003-04	47.98	1.43	2.98
2004-05	50.18	1.42	2.82
2005-06	52.07	0.77	1.48
2006-07	54.38	0.77	1.41
2007-08	56.63	0.79	1.40
2008-09	57.89	0.79	1.36
2009-10	59.76	0.79	1.32
2010-11	62.35	0.81	1.30
2011-12	65.35	0.78	1.19
2012-13	67.68	0.71	1.04
2013-14	70.44	0.60	0.86
2014-15	74.71	0.480	0.64
2015-16	76.46	0.375	0.49
2016-17	81.27	0.364	0.45
2017-18	86.26	0.361	0.42
2018-19	91.82	0.383	0.42
2019-20	95.94	0.395	0.41
2020-21	95.39	0.251	0.26

Table 5. Annual compound growth rate of Buffalo milk production in different agro-climatic zones of Tamil Nadu (2001-02 to 2021-22)

S. No	Agro-climatic zones	ACGR (%)			
		2011-12 to 2015-16 (5 years)	2006-07 to 2015-16 (10 years)	2001-02 to 2015-16 (15 years)	2016-17 to 2021-22 (6 years)
1	North Eastern zone	-21.72	-6.32	-10.67	-7.60
2	North Western zone	-11.33	-6.91	-4.003	-9.22
3	Western zone	-9.04	-3.46	-5.59	-4.73
4	Cauvery Delta zone	-20.93	-8.24	-10.87	-14.47
5	Southern zone	-27.37	-8.35	-11.22	-8.25
6	High Rainfall zone	-12.98	-17.49	-14.703	-78.33
7	High Altitude	-9.54	-7.19	NA	8.89
Tamil Nadu		-16.85	-6.47	-8.44	-8.58

NA – Data not available

Table 6. Annual compound growth rate of Buffalo milk production in different districts of Tamil Nadu (2001-02 to 2021-22)

S. No	District	ACGR (%)			
		2001-12 to 2015-16 (5 years)	2006-07 to 2015-16 (10 years)	2001-02 to 2015-16 (15 years)	2016-17 to 2021-22 (6 years)
1	Ariyalur	NA	NA	NA	-24.21
2	Chennai	NA	NA	NA	30.43
3	Coimbatore+ Tiruppur	-10.82	7.20	-6.77	-5.48
4	Cuddalore	-17.56	-11.81	-14.71	-25.20
5	Dharmapuri+ Krishnagiri	-9.58	-10.21	-6.43	-14.17
6	Dindigul	-19.31	-1.51	-8.17	-4.96

7	Erode	-8.17	-6.08	-4.78	-4.44
8	Kancheepuram	-26.19	-3.21	-6.25	-11.53
9	Kanyakumari	-12.98	-17.49	-14.70	-78.33
10	Karur	0.17	-3.39	-5.39	-9.30
11	Madurai	-32.04	-19.56	-19.76	-7.53
12	Nagapattinam	-42.52	-19.02	-16.09	-3.02
13	Namakkal	-12.54	-5.03	-3.50	-6.81
14	Perambalur	-50.80	-33.31	NA	-13.13
15	Pudukottai	-37.01	-4.19	-9.11	-34.82
16	Ramanathapuram	-47.75	-29.47	-25.24	-16.33
17	Salem	-10.84	-7.02	-2.99	-9.19
18	Sivagangai	-15.51	-10.99	-13.66	-76.65
19	Thanjavur	-24.16	-11.56	-13.14	-21.20
20	The Nilgiris	-9.54	-7.19	NA	8.89
21	Theni	-35.88	-24.80	-24.02	-19.54
22	Thiruvallur	-20.58	-6.31	-8.06	-7.12
23	Thiruvavur	-44.56	-25.29	-22.50	-85.15
24	Thoothukudi	-35.94	-10.81	-11.56	-0.04
25	Thiruchirapalli	-21.39	-8.12	-10.64	-14.25
26	Tirunelveli	-32.15	-7.46	-7.83	-14.81
27	Thiruvannamalai	-8.63	-6.33	-14.07	-11.41
28	Vellore	-22.63	-10.56	-15.08	-9.91
29	Villupuram	-22.18	-8.67	-14.39	-7.18
30	Virudhunagar	-27.67	-12.06	-11.52	-3.29
	Tamil Nadu	-16.85	-6.47	-8.44	-8.58

NA – Data not available

Table 7. Comparative scenario of buffalo milk productivity in Tamil Nadu and India (2001-02 to 2020-21)

Year	India (kg per day)	Tamil Nadu (kg per day)
2001-02	4.09	4.08
2002-03	4.12	4.11
2003-04	4.24	4.13
2004-05	4.29	4.20
2005-06	4.30	4.16
2006-07	4.36	4.22
2007-08	4.41	4.15
2008-09	3.94	4.22
2009-10	4.53	4.25
2010-11	4.44	4.04
2011-12	4.71	4.10
2012-13	4.80	4.40
2013-14	4.91	4.42
2014-15	5.15	4.39
2015-16	5.09	3.89
2016-17	5.23	3.78
2017-18	5.47	3.87
2018-19	5.62	4.04
2019-20	5.75	4.10
2020-21	5.65	3.54
2001-02 to 2015-16 (15 year growth rate)	1.58	0.61
2006-07 to 2015-16 (10 year growth rate)	2.34	0.97
2011-12 to 2015-16 (5 year growth rate)	2.28	2.51
2016-17 to 2020-21 (5 year growth rate)	2.07	-0.73

Table 8. Annual compound growth rate of Buffalo milk productivity in different districts of Tamil Nadu (2001-02 to 2015-16)

S. No	Districts	ACGR (%) (in milk)			ACGR (%) (in milch)		
		2011-12 to 2015-16	2006-07 to 2015-16	2001-02 to 2015-16	2011-12 to 2015-16	2006-07 to 2015-16	2001-02 to 2015-16
1	Ariyalur	NA	NA	NA	NA	NA	NA
2	Chennai	NA	NA	NA	NA	NA	NA
3	Coimbatore+						
	Tiruppur	3.08	1.49	-1.24	-3.29	1.63	-1.50
4	Cuddalore	3.27	1.30	-2.38	-1.95	0.78	-3.51
5	Dharmapuri+						
	Krishnagiri	-1.25	-1.04	0.10	-3.91	-0.78	0.08
6	Dindigul	6.93	2.38	-0.54	1.16	2.28	-1.29
7	Erode	3.67	3.16	2.31	-4.16	1.54	1.52
8	Kancheepuram	-0.32	1.56	0.87	-1.57	3.24	0.41
9	Kanyakumari	-1.75	-2.12	0.84	-1.89	-3.99	1.83
10	Karur	5.94	1.14	0.14	4.09	0.63	-0.76
11	Madurai	-4.17	-0.55	-1.55	0.53	-0.02	-0.65
12	Nagapattinam	-9.09	-1.18	-0.46	-12.96	0.93	-1.74
13	Namakkal	1.27	0.98	3.06	-1.34	1.23	2.75
14	Perambalur	-0.75	-0.72	-	-6.88	-0.36	-
15	Pudukottai	-2.76	-1.10	0.84	-6.57	-1.44	-0.32
16	Ramanathapuram	-11.10	-6.18	-3.29	0.58	-5.67	-3.72
17	Salem	0.23	2.17	3.00	0.47	1.28	0.96
18	Sivagangai	-6.44	2.24	1.33	0.07	2.96	-0.43
19	Thanjavur	-4.29	-0.65	-1.15	-8.23	-0.99	-2.22
20	The Nilgiris	0.40	-4.36	-	-10.57	-2.75	-
21	Theni	-1.86	-0.84	-1.33	-2.71	-3.36	-1.96
22	Thiruvallur	0.98	-0.91	-0.33	5.61	1.68	-1.13
23	Thiruvavarur	-3.89	-2.72	0.10	-2.35	-0.11	0.21
24	Thoothukudi	1.99	-0.17	0.00	1.59	-0.72	-0.24
25	Thiruchirapalli	-0.97	-0.43	-0.17	-7.86	-0.93	-0.99
26	Tirunelveli	3.26	0.64	0.89	-1.09	0.46	0.32
27	Thiruvannamalai	5.67	-0.29	-1.17	0.62	-1.34	-2.43
28	Vellore	-2.68	-3.88	-1.41	-9.57	-4.57	-2.77
29	Villupuram	0.05	-0.60	-0.48	-6.91	0.58	-1.13
30	Virudhunagar	-0.32	1.66	-0.38	2.04	1.83	-0.67
	Tamil Nadu	2.51	0.97	0.61	-0.97	0.89	-0.15

NA – Data not available

Table 9. Annual compound growth rate of Buffalo milk productivity in different districts of Tamil Nadu (2016-17 to 2019-20)

S.No.	District	ACGR (%)	
		Indigenous buffalo	Non-descript buffalo
1	Ariyalur	1.19	1.69
2	Chennai	14.63	13.26
3	Coimbatore	1.29	5.71
4	Cuddalore	2.24	-2.90
5	Dharmapuri	0.97	2.17
6	Dindigul	3.76	-19.56
7	Erode	5.39	1.64
8	Kanchipuram	2.93	3.15
9	Kanyakumari	-3.75	-98.22
10	Karur	-0.76	2.07
11	Krishnagiri	2.48	4.70
12	Madurai	-1.00	3.67
13	Nagapattinam	-0.95	4.36
14	Namakkal	2.94	5.23
15	Perambalur	-11.47	4.88
16	Pudukottai	4.49	1.89
17	Ramnad	8.06	9.73
18	Salem	2.08	2.28
19	Sivagangai	1.11	6.35
20	Thanjavur	0.94	2.96
21	The Nilgiris	2.19	4.44
22	Theni	1.00	2.30
23	Thiruvallur	1.17	4.30
24	Thiruvannamalai	1.95	2.69
25	Thiruvarur	3.95	9.71
26	Thoothukudi	2.19	5.77
27	Tiruchirapalli	0.43	9.55
28	Tirunelveli	2.73	1.05
29	Thiruppur	0.12	1.42
30	Vellore	-2.74	2.45
31	Villupuram	0.28	7.87
32	Virudhunagar	0.75	3.80
	Tamil Nadu	2.14	3.26

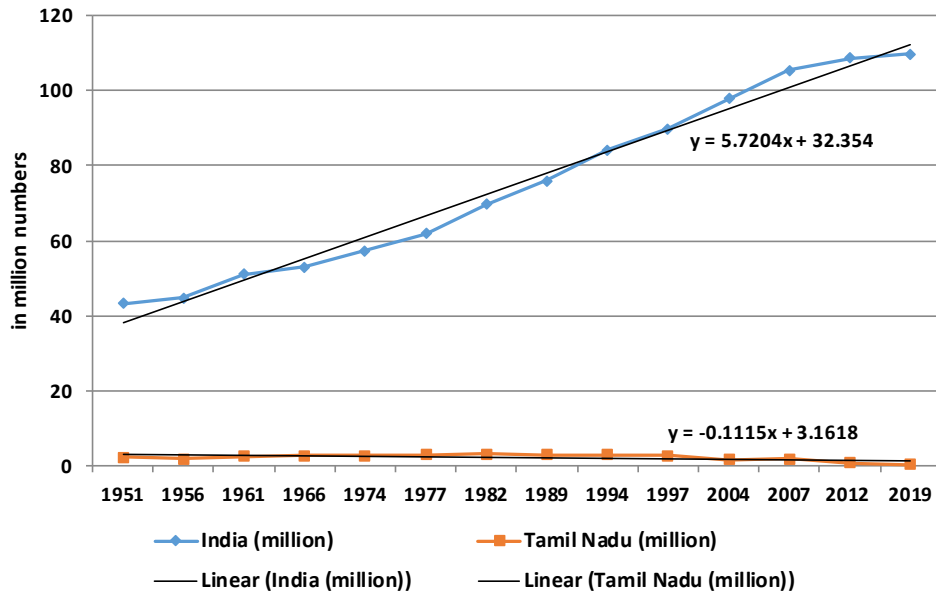


Fig. 1. Comparative scenario of buffalo population in Tamil Nadu and India (1951 to 2019)

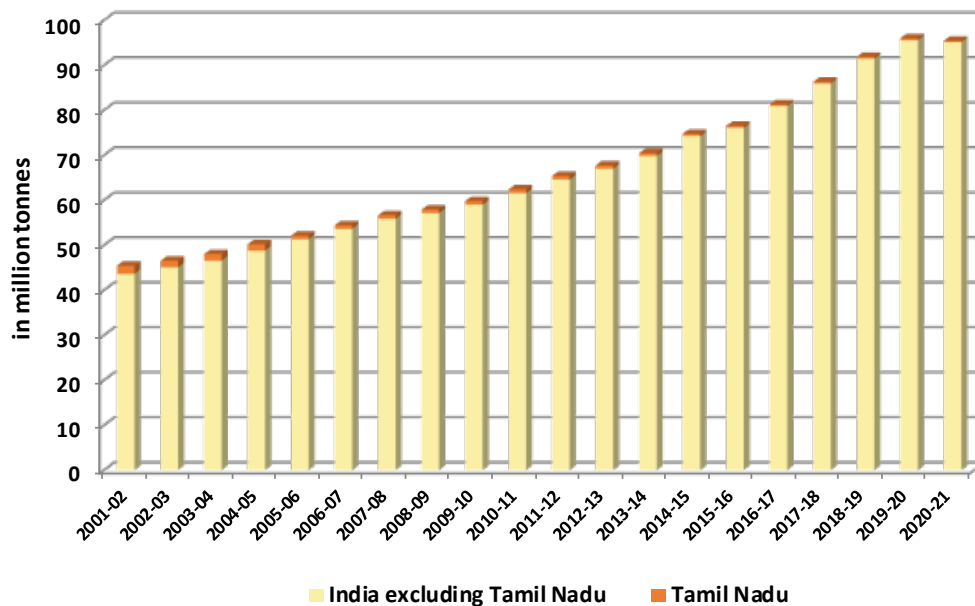


Fig. 2. Comparative scenario of buffalo milk production in Tamil Nadu and India

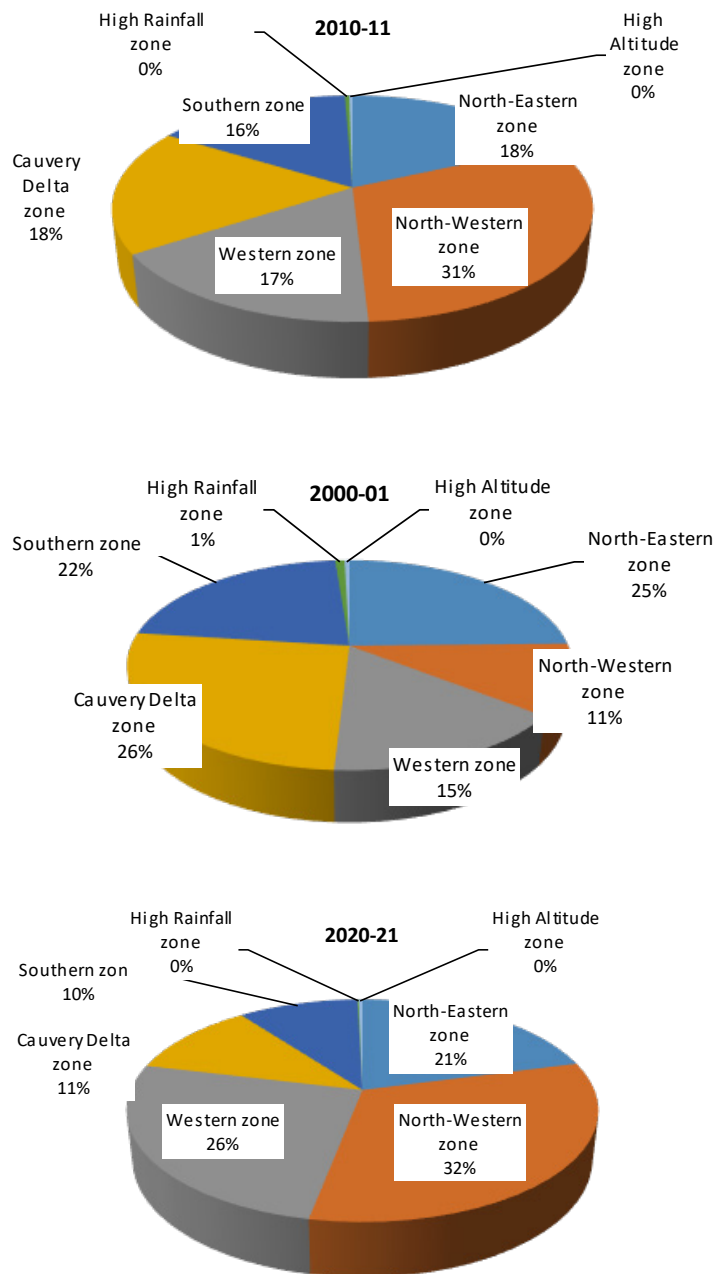


Fig. 3. Composition of buffalo milk production among various agro-climatic zones of Tamil Nadu in last three decades

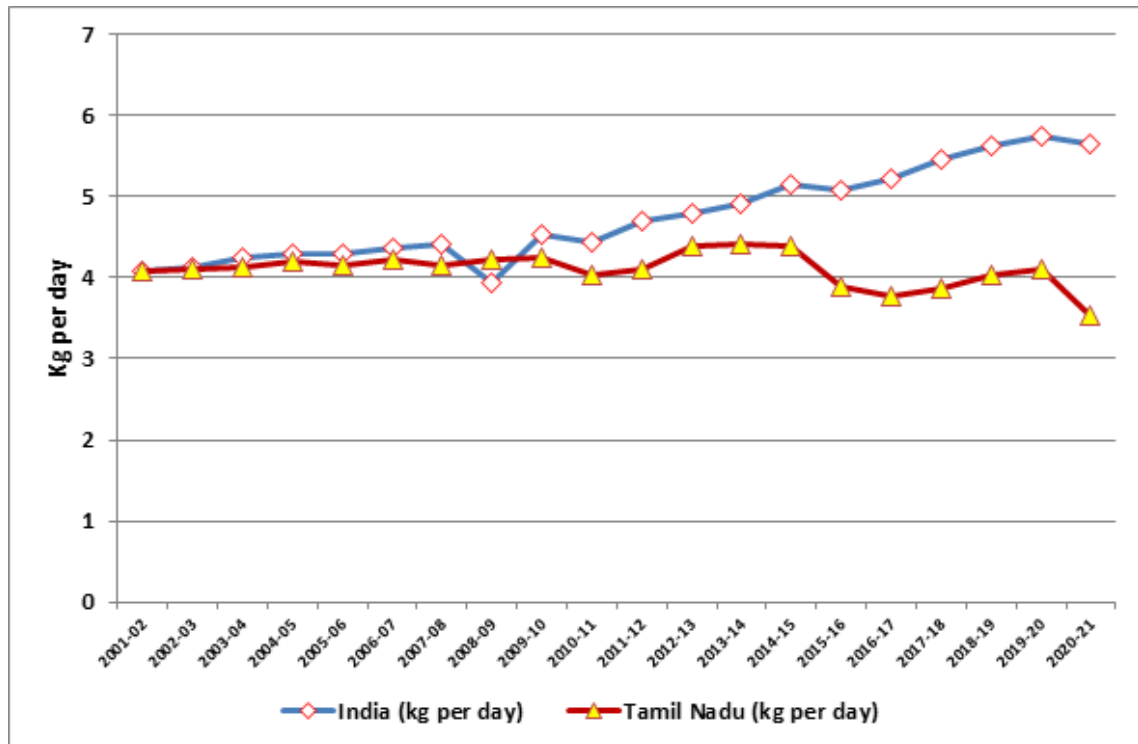


Fig. 4. Composition of buffalo milk production among various agro-climatic zones of Tamil Nadu in last three decades

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