Asian Journal of Agricultural Extension, Economics & Sociology

39(6): 59-67, 2021; Article no.AJAEES.69975
ISSN: 2320-7027

A Study on Performance of Dairy Sector in India

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Authors' contributions

This work was carried out in collaboration between both authors. Author KV designed the study, performed the statistical analysis and wrote the draft of the manuscript. Author GSKB managed the analysis of the study and the literature searches and approved the final manuscript.

Article Information

DOI: 10.9734/AJAEES/2021/v39i630594
Editor(s):
(1) Dr. Roxana Plesa, University of Petrosani, Romania.
Reviewers:
(1) R. Richard Churchil, Tamil Nadu Veterinary and Animal Sciences University, India.
(2) Jaiprakash Bisen, ICAR-National Rice Research Institute, India.
Complete Peer review History: http://www.sdiarticle4.com/review-history/69975

Original Research Article

Received 14 April 2021
Accepted 17 June 2021
Published 19 June 2021

ABSTRACT

The present study was undertaken to analyse the performance of the dairy sector in India by using compound growth rate analysis and to determine the trends observed in the parameters. It was observed that the compound growth rate of the livestock population was 0.89 per cent, positive and significant from 1956 to 2019. Buffalo population has shown a positive and significant growth rate of 1.43 per cent and 0.31 per cent for cattle and 1.58 per cent for goats. In comparison to indigenous cows, exotic or crossbred cows showed a greater significant growth rate of 5.14 per cent against 1.71 per cent. There has been observed a positive and significant compound annual growth rate of 4.71 per cent to milk production and 3.26 per cent for per capita availability. Dairy cooperative societies, producer members, milk procurement and liquid milk marketing showed a positive and significant compound annual growth rate of 3.47, 2.31, 7.78 and 6.04 per cent respectively. The compound annual growth rate of exports in quantity showed a positive rate of 14.24 per cent and imports with a negative growth rate of 9.70 over the period which indicates that India is a net exporter of dairy products.

Keywords: Dairy sector; performance; milk production; exports & imports and compound annual growth rate.

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1. INTRODUCTION

Over the years, the dairy sector underwent a momentous change which contributed significantly to the growth of India's dairy sector, popularly known as 'Operation Flood' (OF). OF provided a platform in the form of cooperatives to a large number of milk producers by procuring milk, providing inputs & services and made available modern technology to all the members. The dairy sector plays a vital role in generating employment opportunities and providing income to small, marginal farmers and landless labourers, which strengthen the rural economy. It contributes more than one-fifth to the agricultural value of output and provides employment to about 21 million people, the majority of whom are resource-poor [1]. The dairy sector supports around 10 million members/farmers through one lakh cooperative societies existing in the country [2]. As dairying was attaining such prominence, the present study was employed to know the trends in livestock population and dairy-related parameters in India.

2. MATERIALS AND METHODS

The study is based on the secondary data compiled from various sources like Basic Animal Husbandry statistics (BAHS), Ministry of Agriculture, Government of India and National Dairy Development Board (NDDB). The basic statistical tool used was compound annual growth rate to estimate the trend for various parameters selected.

The growth rate is worked out to assess the magnitude of the rate of change per unit of time. The simple rate of growth showing an absolute rate of change per unit of time can be expressed mathematically as

$$Y_{(t+1)} - Y_t$$

The rate of change in Y per unit of time 't' expressed as a fraction of the magnitude of Y itself, is usually termed as a compound growth rate and denoted by

$$C_r = \frac{Y_{t+1} - Y_t}{Y_t} * 100$$

There is a general agreement amongst researchers that given the fluctuation in data within the study period, a point-to-point method of measuring the growth rates may lead to a seriously biased estimate unless due care is taken in selecting the points for comparison. Hence, a more appropriate method according to most of the scholars would be to take into account the entire series of observations over the period [3]. There are several simple functional forms to calculate the trend growth rate. Trend equations are also used to see the tendency of data over time, and also to estimate the magnitude of the rate of change per unit of time. The more frequently used equation for calculating the growth rate formula has been presented below.

The exponential growth function of the form [4],

$$Y = ab^t + e$$

Where

Y = dependent variable for which growth rate is to be estimated
a = intercept
b = regression coefficient
t = time variable
e = error term

The compound growth rate was obtained from the logarithmic form of the equation as follows:

$$logY = \log a + t \log b$$

Thus, the per cent compound growth rate (g) was computed using the relationship:

$$g = antilog(b - 1) * 100$$

The compound growth rates of livestock population for the collected census were calculated using point to point growth rate [5]

$$G = \left[\frac{e^{\{ln(y_t/y_o)\}}}{t - 1}\right] * 100$$

where,

G = Annual compound growth rate
y_o = Population of livestock species in the base year
y_t = Population in the t^{th} year (current year)
t = Number of years (current year – base year)

3. RESULTS AND DISCUSSION

The data collected were tabulated and analysed using the growth rate for different parameters. Table 1 shows the growth rate of the overall livestock population in India from 1956 to 2019.

The livestock population shows an increasing trend from 306.60 to 535.82 million from 1956 to 2019. It was observed to be a positive and significant growth rate of 0.89 per cent. The highest annual growth was noticed between 2003 to 2007 with 2.23 per cent, increased population from 485.00 to 529.70 million in number. The negative growth rate was observed from 1997 to 2003 and 2007 to 2012.

Table 2 shows the inter census annual growth rate of cattle, buffaloes and goats from 1956 to 2019. The livestock showed a positive and significant annual growth rate over the census. Over the three livestock, the growth rate of cattle was low compared to buffaloes and goats. The cattle population increased from 158.70 million in the year 1956 to 192.52 million in 2019 with an annual increase of0.31 per cent. A negative growth rate was observed during the census period of 1992 to 2003 and 2007 to 2012. In the case of buffaloes and goats, there has been a prominent increase in population from 44.90 to 109.85 million and 55.40 to 148.88 million, respectively from 1956 to 2019. The buffalo population from 2007 to 2019, showed a decreasing trend and the goat population observed a negative growth rate of 0.78 per cent from 2007 to 2012. The overall annual growth rate of the buffalo population was 1.43 per cent, whereas that of the goat was 1.58 per cent from 1956 to 2019.The reason for the reduced growth rate in the cattle population compared to other livestock could be due to the shift of indigenous to a crossbred group, reduction in the bullock population. The increase in the use of farm machinery for agriculture was enhanced by subsidized credit schemes from the central and state governments [6]. The cause for decreasing growth rate of the goat population was mainly due to the tremendous usage of fertilizers and pesticides which indirectly affect their reproductive parameters as these ruminants are herbivorous [7]. Even the overall growth rate of the population is showing positive, there was a decrease in the population from 2007 to 2012, which could be due to a hike in human demands for consumption, lack of proper breeding policies and indiscriminate cross-breeding also influence the decline in the goat population [8].

The growth rate of different species of in-milk animals was shown in Table 3. When compared to the indigenous cows, exotic or crossbred species shown a very high compound annual growth rate of 5.14 per cent over the period (2009-10 to 2018-19) against 1.71 per cent for the indigenous population. The reason for the decrease in the indigenous population was shifting towards crossbred group animals because of their low productivity. The exotic/crossbred population of cows increased from 11261.81 to 17674.96 (‘000) and the indigenous population increased from 30198.61 to 35166.85 (‘000) over a period. It was noticed that the buffalo population has shown a positive and significant compound annual growth rate of 2.40 per cent from 2009-10 to 2018-19 and its population increased from 36166.39 to 44769.06 in thousand numbers. The growth rate of goat in-milk animals was observed to be 175 per cent and its population has been increased from 31521.73 to 36834.31 in thousand numbers.

Table 1. Compound Annual Growth Rate (CAGR) of Livestock Population in India

Year	Total Livestock (No. in million)	Compound Annual Growth Rate (%)
1956	306.60	
1961	335.40	1.81
1966	344.10	0.51
1972	353.60	0.45
1977	369.00	0.86
1983	419.59	2.60
1987	445.29	1.20
1992	470.86	1.12
1997	485.39	0.61
2003	485.00	-0.01
2007	529.70	2.23
2012	512.06	-0.68
2019	535.82	0.65
CGR from 1956 to 2019		0.89*

*Source: Basic Animal Husbandry Statistics (various years); * Significant (p<=0.05)*

Table 2. Compound Growth Rate (CGR) of Cattles, Buffaloes and Goats in India

Calendar Year	Cattle (no. in million)	Intercensal Growth Rate (%)	Buffaloes(no. in million)	Intercensal Growth Rate (%)	Goats (no. in million)	Intercensal Growth Rate (%)
1956	158.70		44.90		55.40	
1961	175.60	2.04	51.20	2.66	60.90	1.91
1966	176.20	0.07	53.00	0.69	64.60	1.19
1972	178.30	0.20	57.40	1.34	67.50	0.73
1977	180.00	0.19	62.00	1.55	75.60	2.29
1983	192.45	1.35	69.78	2.39	95.25	4.73
1987	199.69	0.74	75.97	1.71	110.21	2.96
1992	204.58	0.49	84.21	2.08	115.28	0.90
1997	198.88	-0.56	89.92	1.32	122.72	1.26
2003	185.18	-1.18	97.92	1.43	124.36	0.22
2007	199.08	1.83	105.34	1.84	140.54	3.11
2012	190.90	-0.84	108.70	0.63	135.17	-0.78
2019	192.52	0.12	109.85	0.15	148.88	1.39
CGR from 1956 to 2019		0.31*		1.43*		1.58*

Source: Basic Animal Husbandry Statistics (various years)
**Significant (p<=0.05)*

Table 3. Annual Growth Rate (AGR) of number of in-milk animals ('000) in India

Financial Year	Exotic/CB Cows	Annual growth rate (%)	ND/ Indigenous Cows	Annual growth rate (%)	Buffaloes	Annual growth rate (%)	Goats	Annual growth rate (%)
2009-2010	11261.81		30198.61		36166.39		31521.73	
2010-2011	11807.35	4.84	30947.62	2.48	37131.05	2.67	30500.13	-3.24
2011-2012	12294.71	4.13	31881.52	3.02	38193.67	2.86	30889.48	1.28
2012-2013	12642.41	2.83	31870.92	-0.03	38638.94	1.17	31860.18	3.14
2013-2014	13755.77	8.81	31035.49	-2.62	39286.20	1.68	30911.92	-2.98
2014-2015	14147.22	2.85	31801.94	2.47	39725.23	1.12	30928.79	0.05
2015-2016	15411.63	8.94	31752.98	-0.15	41190.08	3.69	32464.58	4.97
2016-2017	15962.63	3.58	33165.62	4.45	42569.46	3.35	34513.15	6.31
2017-2018	16761.66	5.01	34143.53	2.95	43187.60	1.45	36135.62	4.70
2018-2019	17674.96	5.45	35166.85	3.00	44767.06	3.66	36834.31	1.93
CAGR		5.14		1.71		2.40		1.75

Source: Basic Animal Husbandry Statistics (various years)
** Significant (p<=0.05)*
CB-Crossbred, ND-Non-descript

India continued to be the largest milk producing nation and its contribution to world milk production was 22 % during 2018-19. Table 4 shows the growth rate of milk production and per capita availability in India for1999-2000 to 2018-2019.The overall compound annual growth rate of milk production was observed to be positive and significant with rise of 4.71 per cent over two decades. Milk production has been increased from 78.3 to 187.7 in million tonnes from 1999-00 to 2018-19. Over the selected period, per capita availability of milk increased from 214 (1999-2000) to 394 grams per day (2018-19) with an overall compound annual growth rate of 3.26 per cent. The highest annual growth rates for both the parameters were noticed in the year of 2017-18 with 6.59 per cent for milk production and 5.63 per cent for per capita availability.

The dairy cooperatives in India had a significant role in promoting rural development by providing facilities to dairy farmers thus upgrading the standard of living particularly to small and marginal farmers. Table 5 shows the number of dairy cooperative societies, producer members, milk procurement and liquid milk marketing in India. The data on these parameters were collected for ten years. Dairy cooperative societies have been increased from 1,40,227 to 1,90,627 and showed a positive and significant compound annual growth rate of 3.47 per cent. The highest annual growth rate was observed from 2017 through 2018 with a growth rate of 4.57 per cent. Producer members are the essential part of the cooperative dairy societies who are majorly benefited through these societies by improving their nature of livelihood. The participation of producer members was increasing from 14,019 to 17,216 in number from 2009-10 to 2018-19 with a positive and significant compound annual growth rate of 2.31 per cent. The highest annual growth rate of 4.12 per cent was recorded between2017-18 and 2018-19. Milk procurement (‘000 kg/day) by the cooperative societies has been increased from 25,864 (2009-10) to 50,748 (2018-19) with a positive and significant compound annual growth rate of 7.78 per cent. The highest annual growth rate was observed from 2011-12 to 2012-13 with a rise of 16.72 per cent. Liquid milk marketing (‘000 litres/day) is another parameter that is most important in the dairy sector, has shown a positive and significant annual compound growth rate of 6.04 per cent over a period from 2009-10 to 2018-19. The quantity of liquid milk marketing has been increased from 21,125 to 35,809 (‘000 litres/day) for the given period. With the increase in the dairy cooperative societies with adequate facilities like providing input services, in time transfer of their deposits, health services, make easy availability of feed and fodder encourage the dairy farmers to become the members of their societies. With these, milk procurement and milk marketing capacity of the cooperative societies were increased.

3.1 Export and Import Status of the Dairy Sector in India

Despite being the largest milk producer in the world, the export potential of the country was not greatly up to the mark compared to other countries. From Table 6, it was observed that over the years the exports of dairy products from India were highly fluctuating. The reasons behind this variation could be due to domestic demand and prices in international markets [9] and the other reasons were due to high population pressure, low level of milk processing, high transportation costs, stringent food safety measures, an occasional ban on export dairy exports because of poor quality and hygiene standards, insufficient international marketing efforts [10]. The compound annual growth of export quantity was about 14.24 % from 2009-10 to 2018-19. The highest exports of dairy products from India were taken place during 2013-14. From that period, exports were decreased and then again increased in 2018-19 and the quantity in million tonnes raised to 1,12,725.53. The export value of the dairy products in the year 2018-19 was Rs. 2,422.99 (crores).

Even after the successful implementation of the operation flood, India stayed as a net importer of dairy products. From Table 6, it was observed that India imported dairy products in large quantities from 2010 to 2012. The dairy products imported value was Rs. 822.41 (crores) for the year 2010-11 and the highest value paid was Rs. 1203.93 (crores) for the year 2011-12. The reason behind being a net importer was mainly due to an increase in population and a domestic increase in demand. The compound annual growth rate of imports in their quantity was negative at 9.70 per cent. But the overall performance of India for the dairy products acted as a net exporter, challenges faced needed to be overwhelmed.

Table 4. Annual Growth Rate (AGR) of milk production (million tonnes) and per capita availability of milk (gm/day) in India

Year	Milk Production (million tons)	Annual growth rate (%)	Per capita availability (gm/day)	Annual growth rate (%)
1999-2000	78.3		214	
2000-2001	80.6	2.94	217	1.40
2001-2002	84.4	4.71	222	2.30
2002-2003	86.2	2.13	224	0.90
2003-2004	88.1	2.20	225	0.45
2004-2005	92.5	4.99	233	3.56
2005-2006	97.1	4.97	241	3.43
2006-2007	102.6	5.66	251	4.15
2007-2008	107.9	5.17	260	3.59
2008-2009	112.2	3.99	266	2.31
2009-2010	116.4	3.74	273	2.63
2010-2011	121.8	4.64	281	2.93
2011-2012	127.9	5.01	290	3.20
2012-2013	132.4	3.52	299	3.10
2013-2014	137.7	4.00	307	2.68
2014-2015	146.3	6.25	322	4.89
2015-2016	155.5	6.29	337	4.66
2016-2017	165.4	6.37	355	5.34
2017-2018	176.3	6.59	375	5.63
2018-2019	187.7	6.47	394	5.07
CAGR		4.71		3.26

Source: National Dairy Development Board
** Significant (p<=0.05)*

Table 5. Annual Growth Rate (AGR) of dairy cooperative societies (DCS), producer members, milk procurement and liquid milk marketing in India

Financial Year	DCS (no.)	Annual growth rate (%)	Producer members ('000)	Annual growth rate (%)	Milk procurement ('000 kg/day)	Annual growth rate (%)	Liquid milk marketing ('000 litres/day)	Annual growth rate (%)
2009-2010	140227		14019		25864		21125	
2010-2011	143126	2.07	14464	3.17	26202	1.31	21985	4.07
2011-2012	148965	4.08	14722	1.78	28706	9.56	22944	4.36
2012-2013	155634	4.48	15115	2.67	33507	16.72	27802	21.17
2013-2014	162600	4.48	15452	2.23	34162	1.95	29444	5.91
2014-2015	165835	1.99	15399	-0.34	37953	11.10	31241	6.10
2015-2016	171062	3.15	15836	2.84	42557	12.13	32128	2.84
2016-2017	177314	3.65	16287	2.85	42868	0.73	33082	2.97
2017-2018	185414	4.57	16535	1.52	47529	10.87	34954	5.66
2018-2019	190627	2.81	17216	4.12	50748	6.77	35809	2.45
CAGR		3.47		2.31		7.78		6.04

*Source: National Dairy Development Board; * Significant (p<=0.05)*

Table 6. Exports of dairy products in India

Financial Year	Export Quantity (Million Tonnes)	Export Value (Rs. crore)	Import Quantity (Million Tonnes)	Import Value (Rs. crore)
2009-2010	34323.82	401.45	31374.76	322.25
2010-2011	37435.75	548.00	54334.61	822.41
2011-2012	25632.82	289.30	70699.92	1203.93
2012-2013	87823.93	1412.09	7417.44	166.54
2013-2014	159228.51	3318.53	9916.42	212.84
2014-2015	66424.27	1205.38	11901.61	282.78
2015-2016	33442.55	755.49	16989.74	322.30
2016-2017	39166.96	905.72	22683.19	282.09
2017-2018	48039.30	1196.17	22683.19	282.09
2018-2019	113725.53	2422.99	12513.08	198.49
CAGR (%)	14.24		-9.70	

Source: DGCIS

4. CONCLUSIONS

The dairy sector not only improves the rural livelihood but also provides employment opportunities that largely depends on it, which makes a significant contribution to the nation. So, there is a need to strengthen the dairy sector, particularly with the increase in the average milk yield capacity which can be enhanced through genetic improvement programmes to bring changes in the genetic nature of the animals. The number of cooperatives needs to be increased with adequate facilities and services as they were playing a vital role for the dairy farmers particularly for women dairy farmers to enhance their empowerment. More quality and high standards of the products need to be maintained and ensure that regulation, standards and certification procedures should be followed meticulously. The country needs to focus on these aspects to build a specific place in international marketing.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/69975