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Growth and instability of livestock population in Karnataka: Economic perspectives

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Abstract

This paper examines the growth and instability of cattle and buffalo populations in Karnataka, India, from 1997 to 2019, utilizing quantitative data to understand the trends and regional variations. The livestock population in India experienced marginal change, with a mere 0.08 percent decrease from 1997 to 2003. Whereas cattle populations in Karnataka saw a significant decline, dropping from 10.83 million in 1997 to 8.47 million in 2019. District-specific analysis shows alarming negative growth rates, with Kalaburagi notably experiencing a 53.16 percent decrease. Buffalo populations in Karnataka also decreased across districts, except for Belagavi, which reported a 10.00 percent increase. Analyzing the compound annual growth rates, Kalaburagi and Tumakuru district had the most substantial declines in cattle populations at -4.11 percent and -1.01 percent, respectively. At the state level, Karnataka registered a negative growth rate of -0.31 percent, contrasting with India's marginal positive growth of 0.27 percents. Buffalo populations displayed a parallel trend, with Kalaburagi and Hassan experiencing the most substantial declines at -6.14 percent and -3.10 percent, respectively. Karnataka showed a negative growth rate of -1.71 percent for buffalo populations, while India recorded a 1.25 percent increase at the national level.

The findings include instability indices, with Karnataka indicating moderate instability in bovine populations, while India demonstrates a relatively higher level of inconsistency, emphasizing regional disparities. In summary, this paper highlights regional variations and challenges in livestock management, with Karnataka facing a significant decline in cattle and buffalo populations. The data suggests an urgent need for region-specific policy interventions to address sustainability and economic viability in the livestock sector.

Keywords: Livestock population, cattle, buffalo, Karnataka, growth trends, instability, quantitative analysis, regional disparities, economic perspective, sustainability, policy interventions

Introduction

Livestock plays a vital role in global agriculture. It forms the backbone of the global food system and helps to reduce poverty, food insecurity and agricultural development. According to FAO, 40 percent of the total value of agricultural output comes from livestock. Livestock supports the livelihoods, food security and nutrition of nearly 1.3 billion persons worldwide. Within developing countries, livestock contributes up to 80 percent of agricultural GDP. About 600 million rural poor depend on livestock for livelihood (Anon, 2023) ^[1]. The livestock sector is a major source of export for many countries, especially for meat, dairy products and wool. Rapid growth in demand, rising population, urbanization and rising income in developing countries are amplifying the global livestock sector.

In India, the livestock sector is a critical component of the agricultural economy and holds first position in the global share of buffalo population (54.26%) and goat population (13.43%) and second position in the global share of cattle population (12.80%) and sheep population (5.49%). About 20.5 million people depend upon livestock for their livelihood. The livestock sector also contributes 4.11 percent to GDP and 25.6 percent of total Agriculture GDP. Livestock also helps in building the social capital by strengthening the cultural diversity and heritage of several ethnic groups and populations. It also acts as an important buffer against external shocks. Gross value added at basic prices (2011-12) by agriculture and allied sectors during 2021-22 contributed 21,15,040 Crores, which is 18 percent of the sectoral share in India's economy, out of which livestock sector alone contributed 6,54,937 crores during 2021-22. The sector also plays a vital role in exports with India being the largest global exporter of buffalo meat. Nevertheless, the sector faces several challenges, such as low productivity, limited market access and inadequate infrastructure, impeding its growth and development. The government of India has undertaken various initiatives to address these challenges.

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These initiatives include promoting livestock insurance, providing subsidies for improved breeds and feeding practices and also supporting the establishment of livestock markets and processing units (Anon, 2021a, Anon, 2021b) [2, 3].

According to the 20th Livestock Census data, the total livestock population is 536.76 million in the country indicating an increase of 4.8 percent over Livestock Census-2012. The population of cattle, buffalo, sheep and goats exhibited a percentage growth rate of 1.34 percent, 1.06 percent, 14.13 percent and 10.14 percent respectively. The total livestock population in rural and urban area is 514.11 (95.78%) million and 22.65(4.22%) million respectively. The species occupying highest proportion of livestock in India is cattle (36.04%), followed by buffalo (20.4%), goat (27.74%), sheep (13.83%), pig (1.69%), others (0.23%) which include mithun, yaks, horses etc. Karnataka is renowned for its diverse agricultural and livestock production systems. The state boasts a substantial livestock population encompassing cattle, buffalo, sheep and goats, which play a crucial role in supporting the local economy and the livelihoods of rural communities. According to the 20th Livestock Census conducted in 2019, Karnataka's livestock population amounts to approximately 29 million, encompassing cattle, buffalo, sheep, goats and pigs.

The livestock population in India experienced dynamic change. Understanding these changes is vital for ensuring that the livestock sector remains a resilient and productive component of India's agricultural landscape, catering to the diverse needs of its growing population while promoting sustainability and animal welfare. Studying the growth trends in livestock populations, especially the bovine population, holds immense importance for various facets of agriculture, economics and food security. Bovine animals including cattle and buffalo are fundamental to agricultural systems worldwide. Monitoring their population trends provides valuable insights into the dynamics of food production, given their role in providing milk, meat and draft power. Understanding these trends is essential for optimizing resource allocation, as it helps governments and policymakers to anticipate the demand for livestock products and allocate resources accordingly such as in healthcare, breeding and fodder production. Furthermore, it aids in evaluating the sustainability of livestock farming practices, particularly in relation to environmental impacts and resource utilization. By studying bovine population growth trends, we can make informed decisions to ensure food security, rural livelihoods and the sustainable management of agricultural resources. These are critical in today's rapidly changing global landscape.

The approach of the paper features as follows: Section 2 will present the methodology. It will be followed by Results and Discussions given in section 3. Finally, section 4 will represent the Conclusions and Policy Implications.

Methodology

Sources of Data

The secondary data pertaining to livestock population in India over the years were collected from livestock census of India to analyse the growth trend and instability. The Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Government of India, Indiastat.com website, various publications of Department of Animal Husbandry and Fisheries, Government of Karnataka etc. were reviewed to collect the relevant data pertaining to

livestock. Time series data on cattle and buffalo population for the period from 1997-98 to 2019-20 were collected from Animal Husbandry and Veterinary, Services Department, Government of India, Livestock Census, Government of Karnataka, Bengaluru, and Indiastat.com website. The census data collected were intra-polated to estimate growth and trends.

Annual Percent Change

The percent change from one period to another is calculated using below given formula:

$$PR = (V \text{ present} - V \text{ past}) \div V \text{ past} * 100$$

Where,

PR= Percent change

V present = Present or future value

V past = Past or present value

The annual percent change is simply the percent growth divided by N, the number of years.

Compound Growth Rate analysis

In order to assess the trend in population of cattle and buffalo in the study district, Karnataka and Country as a whole, the compound growth rate analysis was employed.

Compound growth rates were computed using the exponential function of the form,

$$Y_t = ab^t u^t \quad (1)$$

Where,

Y_t : Dependent variable (Population)

a: Intercept (constant)

b: Regression coefficient

t: Years which take values, 1, 2, ..., n

u^t : Disturbance term for the year t

For the purpose of estimation, equation (1) was transformed into log linear form and in percentage was then computed from the following relationship,

$$g = (\text{Antilog of } \ln b - 1) * 100 \quad (2)$$

The significance of regression coefficient were tested for their significance level using, 't' test which was defined as,

$$t = b_i / SE(b_i) \quad (3)$$

Where,

b_i = Regression coefficient

SE (b_i) = Standard error of the regression coefficient

Cuddy Della Valle Instability Index

Cuddy and Valle created the Cuddy- Della Valle index to measure the instability in time series data that is characterised by trend. The co-efficient of variation was calculated using the expression to investigate the stability of species population. The Cuddy Della Valle Index is used to measure the instability in this study. The Cuddy Della Valle index detrends the given series first indicating the direction of instability. The use of the coefficient of variation (CV) as a measure of instability in time series data has significant drawbacks. If the time series data show any trend, the

variation assessed by coefficient of variation can be overstated, i.e., if coefficient of variation is used to quantify instability, the region with expanding output at a constant rate will score high in instability. In contrast, the Cuddy-Della Valle index uses coefficient of determination to de-trend the coefficient of variation.

The coefficient of variation (CV) is a statistical measure of data points' dispersion around the mean in a data series. The coefficient of variation is a useful statistic for assessing the degree of variation between two data series, even if the means are radically different. It indicates the ratio of the standard deviation to the mean.

$$CV = \text{Standard deviation} / \text{Mean} \quad (4)$$

The co-efficient of variation (%) was calculated to determine the extent of fluctuation in bovine population over time. The instability index was also calculated to look at the instability of different breeds of bovine population over time using the following formula:

$$\text{Instability Index (I)} = CV * \sqrt{1 - R^2} \quad (5)$$

Where

CV = Coefficient of Variation

R^2 = Adjusted coefficient of determination

The ranges of CDVI (Sihmar, 2014) are given as follows:

Low instability = between 0 and 15

Medium instability = greater than 15 and lower than 30

High instability = greater than 30

Results and Discussion

Bovine trends over census in India and Karnataka

The trend in absolute livestock population in India and Karnataka and the percentage changes in different census periods were presented in Table 1. A clear perusal of table revealed that the cattle population experienced a significant decline of 11.94 percent from 1997 to 2003 in Karnataka. Subsequently, it increased by 10.11 percent from 2003 to 2007 and 9.66 percent during 2007 to 2012 later experienced a higher decline by 26.47 percent from 2012 to 2019. Karnataka saw a decline in cattle population from 10.83 million in 1997 to 8.47 million in 2019. The significant decrease in cattle population might be due to factors such as urbanization, land-use changes and a shift from traditional agriculture to non-agricultural occupations. The decline in Karnataka's cattle population during 2012 to 2019 is due to a shift towards more mechanized agriculture, leading to reduced demand for draught animals.

Buffalo population also experienced a similar trend and fluctuated with an 8.61 percent decline from 1997 to 2003 followed by an 8.42 percent increase during 2003 to 2007. However, it showed a substantial decline of 19.78 percent from 2007 to 2012 and a further 14.00 percent decline during 2012 to 2019. Buffalo population in Karnataka showed fluctuations but had an overall declining trend from 4.37 million in 1997 to 2.98 million in 2019. The substantial decline in buffalo population was mainly due to the changes in livestock management practices, preferences for other livestock activities and also disease outbreaks. Collectively, the total bovine population in Karnataka showed a decreasing trend over the years from 15.19 million in 1997 to 11.45 million in 2019 reflecting the declines in both cattle and

buffalo populations with the highest decline of 23.25 percentage in 2019 over to 2012 census. This might be due to changes in land use and farming practices, scarcity of grazing land, non availability of fodder and feed, higher cost of feed and fodder etc.

In Karnataka, the total livestock population had shown fluctuations with decreased trend of 10.18 percent from 1997 to 2003, followed by a substantial 20.44 percent increase during 2003 to 2007. However, again it declined by 10.23 percent from 2007 to 2012 and then increased by 9.53 percent during 2012 to 2019. Despite fluctuations, the total livestock population in Karnataka increased from 28.53 million in 1997 to 30.34 million in 2019. This growth might be due to the rise in poultry and small ruminant populations, which could compensate for the decline in cattle and buffalo populations.

Indian livestock scenario revealed that the total livestock population decreased marginally from 485.40 millions in 1997 to 485.00 millions in 2003 census which showed a negligible decrease of 0.08 percent and then increased to 529.7 million in 2007 before declining to 512.1 million in 2012 and further increased to 535.8 millions in 2019. Therefore, total livestock population declined twice in 2003 and 2012 compared to the previous livestock census.

The total bovine population recorded similar trend of growth and decreased from 288.8 millions in 1997 to 283.1 millions in 2003 and then increased to 304.4 millions and declined to 299.6 million in 2012 and further showed a negligible increase of 0.90 percent (302.3 millions) in 2019. The major reason for decrease in bovine population during 2003 was due to decrease in cattle population. Within the total bovine population, cattle population was higher than that of buffaloes during the study period. Cattle population decreased from 198.9 million in 1997 to 185.2 million in 2003 but showed a significant increase to 199.1 million in 2007. The population declined again to 190.9 million in 2012 but showed a slight recovery to 192.5 million in 2019. It is important to note that the cattle population also showed similar trend as that of livestock population and showed a decrease of 6.89 percent from 1997 to 2003 but rebounded with a 7.51 percent increase from 2003 to 2007. However, it declined again by 4.12 percent during 2007 to 2012 and slightly increased by 0.84 percent from 2012 to 2019. The decline in cattle population in 2012 were mainly due to decreased trend of bullock population. The reason might be increased use of farm machinery in agriculture enhanced by subsidized credit from the central and state governments for purchase of agricultural implements (Sserunjogi and Lokesh, 2014) [15]. The reasons for further increased cattle population in 2019 was mainly because of increase in number of crossbred/cross bred cattles by 29.3 percent compared to previous census

On the other hand, the buffalo population registered a consistently strong increase in its absolute population during the study period. India's buffalo population showed steady growth over the years, with a significant change of 8.90 percent increase during 1997 to 2003. The growth continued at a slower pace from 2003 to 2007 (7.56%) and from 2007 to 2012 (3.23%) and a modest 1.10 percent increase was observed during 2012 to 2019. Buffalo population steadily increased from 89.9 million in 1997 to 109.9 million in 2019. The steady growth of buffalo population could be attributed to their adaptability to different environmental conditions, higher milk yield and the fact that buffalo milk is preferred for preparation of some dairy products.

Table 1: Livestock trend over census in India and Karnataka

Sl. No	Species	Population (millions)					Percent change over previous census			
		1997	2003	2007	2012	2019	2003	2007	2012	2019
I. India										
a.	Cattle	198.90	185.20	199.1	190.9	192.5	-6.89	7.51	-4.12	0.84
b.	Buffalo	89.90	97.90	105.3	108.7	109.9	8.90	7.56	3.23	1.10
c.	Total bovines	288.80	283.10	304.4	299.6	302.3	-1.97	7.52	-1.58	0.90
d.	Others	196.60	202.10	225.20	212.50	233.60	34.17	10.22	-19.72	9.51
e.	Total Livestock	485.40	485.0	529.7	512.1	535.8	-0.08	9.22	-3.32	4.63
II. Karnataka										
a.	Cattle	10.83	9.54	10.50	11.52	8.47	-11.94	10.11	9.66	-26.47
b.	Buffalo	4.37	3.99	4.33	3.47	2.98	-8.61	8.42	-19.78	-14.00
c.	Total bovines	15.19	13.53	14.83	11.99	11.45	-10.98	9.61	1.07	-23.58
d.	Others	13.34	12.09	16.03	15.71	18.89	0.80	10.83	-11.30	33.11
e.	Total Livestock	28.53	25.62	30.86	27.70	30.34	-10.18	20.44	-10.23	9.53

A critical analysis of the livestock population trends in Karnataka and the country as a whole revealed a combination of positive and negative trends. There was a notable increase in livestock population during the 2007 and 2019 census compared to previous census but a decreased trend was observed during the 2003 and 2012 census. These fluctuations could be attributed to various inter related factors. Govindaraj *et al* (2017) [7] reported the impacts of foot and mouth disease outbreaks in cattle and buffalo in Karnataka and its effect on the population. Similar results were observed by Sonavale *et al* (2020) [13] and reported that among bovine animals, buffaloes population registered consistently increased trend based on higher consumer preference for buffalo milk due to its high-fat content and ease of maintaining the stock. On the other hand, the cattle population registered a consistent decline after 1992 which might be due to increased use of machines for agricultural operations in Indian agriculture which resulted decreased demand for bullocks for draught purpose.

Cattle and buffalo population trend in the study area

Trend in cattle and buffalo population in Kalaburagi, Belagavi, Tumakuru and Hassan districts, Karnataka state and Country as a whole was worked out for the period 1997 to 2019 and is presented in Table 2.

In Kalaburagi district, population of cattle decreased from 824 thousands in 1997 to 386 thousands in 2019, with a mixed trend across the livestock census with a highest population of 907 thousands were recorded in the year 2007. The Belagavi district having 500 thousands of cattle in 1997 increased to 550 thousands in 2019. While in case of Tumakuru district, population of cattle decreased from 598 thousands in 1997 to 431 thousands in 2019. In Hassan district, the population of

cattle was 614 thousands in 1997 census and came down to 548 thousands in 2019. Similarly, cattle population in Karnataka decreased from 10831 thousands to 8469 thousands during study period. However, country as a whole, cattle population decreased from 198900 thousands in 1997 to 192500 thousands in 2019. It is worth to note that, there was significant decrease in cattle population in 2019 over 1997 livestock census in the study area, as well as in the state and country as a whole. However, in the subsequent livestock census (2003, 2007 and 2012), the cattle population showed mixed trend.

Similarly, buffalo population showed a decreased trend and population of buffalo decreased from 218 thousands in 1997 to 73 thousands in 2019 with a mixed trend of percentage change over previous census in Kalaburagi district. While, Belagavi district was having 651 thousands of animals in 1997 and increased to 844 thousands in 2019. In Tumakuru district, the population decreased from 269 thousands to 142 thousands during study period. Further, Hassan district also showed decrease of animals to 108 thousands in 2019 from 208 thousands in 1997. Similarly, buffalo population decreased from 4367 thousands to 2985 thousands in Karnataka during study period with a mixed trend of increase and decrease across different livestock census. However, the country as a whole depicted increased trend. The buffalo population increased from 89900 thousands to 109900 thousands during study period from 1997 to 2019. It is important to note that there was significant increase in buffalo population during 2003 to 2007 livestock census in the study area, Karnataka state and country as a whole. However, 2012 and 2017 livestock census revealed that the buffalo population was of mixed trend.

Table 2: Cattle and buffalo population in the study area over the livestock census

Sl. No	Particulars	Population ('000)					Percent change over previous census			
		1997	2003	2007	2012	2019	2003	2007	2012	2019
I. Cattle										
a.	Kalaburagi	824	819	907	473	386	-0.61	10.74	-47.85	-18.39
b.	Belagavi	500	508	599	593	550	1.60	17.91	-1.00	-7.25
c.	Tumakuru	598	502	589	527	431	-16.05	17.33	-10.53	-18.22
d.	Hassan	614	541	633	606	548	-11.89	17.01	-4.27	-9.57
e.	Karnataka	10831	9538	10502	11517	8469	-11.94	10.11	9.66	-26.47
f.	India	198900	185200	199100	190900	192500	-6.89	7.51	-4.12	0.84
II. Buffalo										
a.	Kalaburagi	218	224	249	91	73	2.75	11.16	-63.45	-19.78
b.	Belagavi	651	702	860	829	844	7.83	22.51	-3.60	1.81
c.	Tumakuru	269	216	242	181	142	-19.70	12.04	-25.21	-21.55
d.	Hassan	208	194	191	141	108	-6.73	-1.55	-26.18	-23.40
e.	Karnataka	4367	3991	4327	3471	2985	-8.61	8.42	-19.78	-14.00
f.	India	89900	97900	105300	108700	109900	8.90	7.56	3.23	1.10

A critical analysis of trend in cattle and buffalo population indicated that there was a mixed trend in percentage change over previous livestock census in the study area, Karnataka and country as a whole. A positive and significant change in cattle and buffalo population was noticed during 2007 over 2003 census except Hassan (-1.55%) in case of buffalo population. However, there was negative trend during 2012 and 2019 livestock census in both cattle as well as buffalo population except for Belagavi which showed an increase of 1.81 percent in 2019 over 2012 census. Fluctuating trend in cattle and buffalo population is mainly due to climate led factors which affected availability of feed and fodder and also outbreak of diseases namely, PPR, ET and FMD. This clearly indicated that, although there was negative trend in the overall study period their fluctuation from census to census were very high in case of cattle and marginal change was observed in case of buffalo population.

Growth in cattle and buffalo population in the study districts

Compound growth rate in cattle and buffalo population is

presented in Table 3 The results of the study revealed that, growth in cattle population in Kalaburagi, Belagavi, Tumakuru and Hassan districts were -4.11, 0.72,-1.01 and -0.09 percent per annum respectively during study period (1997-2019). Similarly, Karnataka state as a whole indicated negative growth rate of -0.31 percent per annum while, the country as a whole showed a marginal positive growth of 0.27 percent. In case of buffalo population, negative growth rate was noticed in the study area, except Belagavi (1.30%/annum) district. However, highest negative growth rate of 6.14 percent was observed in Kalaburagi district followed by Hassan (-3.10%) and Tumakuru (-2.68%) districts. Further, Karnataka state also showed a negative growth rate of -1.71 percent whereas country as a whole depicted an increased growth of 1.25 percent in the buffalo population. Across the census, mixed trend of growth in cattle and buffalo population was found in the study area, Karnataka state and country as a whole.

Table 3: Growth in cattle and buffalo population in the study area (percent)

Sl. No.	District	1997-03	2003-07	2007-12	2012-19	1997-19
I. Cattle						
a.	Kalaburagi	-0.10**	2.58**	-12.13**	-2.86**	-4.11*
b.	Belagavi	0.26**	4.20**	-0.20*	-1.07*	0.72*
c.	Tumakuru	-2.87*	4.08**	-2.20**	-2.83**	-1.01**
d.	Hassan	-2.09*	4.00**	-0.87*	-1.43*	-0.09**
e.	Karnataka	-2.10*	2.44**	1.86**	-4.29*	-0.31*
f.	India	-0.76*	1.46**	-0.60*	0.07*	0.27*
II. Buffalo						
a.	Kalaburagi	0.45*	2.68**	-17.98**	-3.10**	-6.14**
b.	Belagavi	1.26**	5.20**	-0.73**	0.26**	1.30**
c.	Tumakuru	-3.59*	2.88**	-5.64*	-3.40**	-2.68*
d.	Hassan	-1.15*	-0.39*	-5.88*	-3.73**	-3.10**
e.	Karnataka	-1.49*	2.04**	-4.31**	-2.13**	-1.71*
f.	India	0.92*	1.47*	0.46*	0.09*	1.25**

Note: * Significant at 5 percent level of significance

**Significant at 1 percent level of significance

The compound growth rate of cattle and buffalo population revealed fluctuations in the growth rate between inter periods. A positive growth rate of cattle and buffalo population across the districts was observed during 2003-2007 period except in Hassan where buffalo population showed a marginal decrease of -0.39 percent per annum. During the period of 2012-2019, study districts showed a negative trend with respect to cattle and buffalo population except Belagavi district which showed a marginal growth of 0.26 percent per annum in buffalo population. Highest growth rate of cattle and buffalo was observed during 2003-2007 in Belagavi district with 4.20 and 5.20 percent per annum respectively and lowest growth rate observed during 2007- 2012 period in Kalaburagi districts with a substantial negative growth of -12.13 and -17.98 percents respectively. It could be inferred from the above discussion that in the last two decades cattle and buffalo population growth rate was decreased due to decline in bullock population, mechanization of agricultural operations and outbreak of diseases. A study by Patil *et al.* (2019b) [12] reported that urbanisation has got negative impact on the cattle population in Kalaburagi district. The similar results in cattle and buffalo population was also reported by Yasmeen (2018) [17] respectively.

To ameliorate these impacts and stabilize the population of bovines, a multifaceted approach is necessary. Firstly,

encouraging the conservation of bullocks, diversifying livestock usage and providing mechanization training can address the decline in bullock numbers while modernizing agriculture. Additionally, measures such as disease control, access to veterinary services and proper feed management can improve the health of bovines. By implementing these strategies, policymakers and agricultural authorities could ensure that bovine population continue to play an important role in agriculture and rural livelihoods. This approach aimed to find a balance between tradition and modernization, promoting the resilience and growth of bovine populations in the changing agricultural landscape.

Instability index of cattle and buffalo population in the study area

Instability in livestock population refers to fluctuations or variations in the number of animals within a specific region or over a defined period. Instability in livestock populations have significant implications for food security, rural economies and agricultural sustainability. Managing and stabilizing livestock populations often require a combination of strategies including disease control, improved animal husbandry practices, access to veterinary care and market interventions to reduce the adverse impacts of fluctuations and ensure a more consistent and sustainable livestock sector.

The Coefficient of Variation (CV) and CDVI (Cuddly Della Vella Index for Instability) were used to measure variation and instability in cattle and buffalo populations across different districts in Karnataka and at the state and national level during the period 1997 to 2019 and the results were presented in Table 4.

The coefficient of variation and cuddly della vella index values of cattle population showed fluctuations across the study districts. In Kalaburagi district, the value of CV is relatively high at 29.10, indicated a moderate level of variation in cattle population over time. The instability index of 24.41 suggested moderate instability in cattle population during the study period. In contrast, Belagavi district showed a lower CV of 6.83, indicating lower variation in cattle population and instability index of 18.83 suggests moderate instability. The relative stability might be attributed to the presence of dairy cooperatives, which support cattle farming in Belagavi district. Tumakuru district had slightly higher CV of 8.81 which indicated moderate variation with instability index of 19.32 revealed moderate instability. Further, Hassan district had relatively low CV of 4.64 among the districts indicating

lower variation in cattle population and the instability index of 14.12 suggested low instability. The Karnataka as a whole exhibited very low CV for cattle at 1.52 depicted lower variation. However, the instability index of 11.97 suggested slight instability. Further, country as a whole indicated moderate CV for cattle at 9.13, depicted some variation with high instability index of 20.70, suggested significant instability in the cattle population during the study period.

Similarly, the coefficient of variation (CV) and instability values of buffalo population also showed fluctuated trends across the districts. The results of the study revealed that, the CV values of Kalaburagi, Belagavi, Tumakuru and Hassan districts were 41.33, 9.81, 18.51 and 20.95 respectively during study period (1997-2019). The instability index of Kalaburagi district (29.33) showed the higher instability followed by Hassan (16.87), Belagavi (15.71) and Tumakuru (13.93) and districts respectively. Further, Karnataka as a whole showed instability index of 13.91 indicated lower instability. In contrast to Karnataka, India showed a relatively stable value of instability index (11.65) revealing a very little variation in buffalo population during the study period.

Table 4: Instability index of bovine population in study area during 1997-2019

Sl. No.	District	Cattle		Buffalo		Bovine	
		CV	Instability Index	CV	Instability Index	CV	Instability Index
1.	Kalaburagi	29.12	24.41	41.33	29.33	31.53	25.58
2.	Belagavi	6.83	18.83	9.81	15.71	8.58	16.67
3.	Tumakuru	8.81	19.32	18.51	13.93	11.33	16.84
4.	Hassan	4.64	14.12	20.95	16.87	6.58	15.93
5.	Karnataka	1.52	11.97	12.33	13.91	7.38	19.36
6.	India	9.13	20.70	3.67	11.65	21.38	44.83

Note: CV indicates coefficient of variation

From the above discussions, it was clear that the cattle and buffalo population were not consistent across the districts depicting variation in the population growth during the study period. However, country as a whole cattle population showed more variability compared to the buffalo population which seems more stable. The same trend of findings was observed in case of instability index. The major reasons for these findings were the droughts which affected the fodder availability of dairy farming, changing land use pattern, urbanisation, outbreak of diseases, shortage of feed and fodder availability etc. These were also influenced by a complex interplay of factors including climatic conditions, agricultural practices, policy changes and economic dynamics.

Conclusion

The livestock scenario in India, particularly in Karnataka reveals a mixed picture of population trends among cattle and buffalo over the years. The Indian livestock population remained relatively stable experiencing a negligible decrease of 0.08 percent from 1997 to 2003. However, growth rates further reflect the disparities among districts, with Kalaburagi and Tumakuru experiencing significant declines. In contrast, the national level data portrays a marginal positive growth in bovine population, indicating regional disparities within the country. The instability index also highlighted variations, with Karnataka showing moderate instability while India exhibits a higher level of inconsistency in bovine populations. These findings emphasize the need for region-specific strategies to address the challenges facing livestock management and conservation.

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