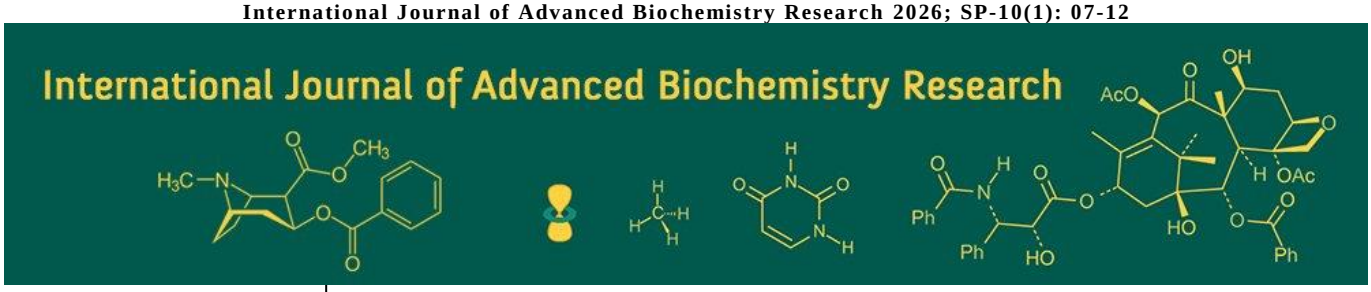

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Dynamics of bovine populations in India and Karnataka

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Abstract
This study examined the growth patterns of India's and Karnataka's bovine populations and analyzed the spatial distribution and species composition of cattle and buffaloes across the major districts of Karnataka. Using secondary data drawn from multiple rounds of the national Livestock Census, the study assessed long-term trends, regional disparities, and structural shifts within the bovine sector. At the national level, the bovine population exhibited a general upward trajectory over several decades, shaped by rising demand for milk, improvements in veterinary services, genetic enhancement initiatives, and supportive government programs. In contrast, Karnataka displayed considerable fluctuations, with alternating periods of growth and decline, ultimately reflecting a long-term contraction in bovine numbers influenced by shrinking grazing lands, mechanization, and a shift towards maintaining fewer but more productive animals. District-level analysis revealed substantial variation in bovine density and species composition, with some regions dominated by buffalo-based dairying, others by cattle, and several maintaining moderately mixed systems. These patterns were closely linked with agro-climatic conditions, fodder availability, cultural preferences, and market incentives. The findings highlight the importance of region-specific livestock development strategies that strengthen productivity, ensure resource sustainability, and support dairy-dependent livelihoods while addressing ongoing demographic and structural transitions in the bovine population.

Keywords: Bovine population dynamics, livestock census, cattle and buffalo distribution, dairy sector growth

1. Introduction
The agriculture sector in India has been undergoing a rapid transformation, driven by rising incomes, urbanization, population growth, evolving consumer preferences, and increased integration with the global economy. Traditionally cantered on food grain production, Indian agriculture has gradually diversified toward high-value sectors such as horticulture, livestock, and fisheries. Among these, the livestock sector especially dairying has emerged as a key driver of agricultural growth due to the high-income elasticity of demand for milk and dairy products, rising per capita income, expanding urban markets, and shifts in dietary habits toward protein-rich foods. Livestock also plays an indispensable role in integrated farming systems by efficiently utilizing crop residues, coarse grains, and by-products while returning organic manure to maintain soil fertility across generations.

Dairying, in particular, has become central to rural livelihoods, providing a stable source of income, employment, and nutritional security for millions of small and marginal farmers. It serves as a reliable "bank on hooves," offering both economic resilience and social security. With a total livestock population of 535.78 million and a bovine population of over 302 million, India remains the world's largest producer of milk. Growth in crossbred cattle, rising female cattle numbers, and stable buffalo populations further illustrate the evolving structure of the dairy sector. Karnataka, contributing significantly to the national livestock pool, has also witnessed similar changes, although district-level variations are substantial.

Despite its importance, dairy farming is also associated with environmental concerns, particularly greenhouse gas emissions, land degradation, and water use. Livestock is the single largest source of methane emissions in India, accounting for nearly two-thirds of agricultural greenhouse gas emissions. Methane released through enteric fermentation represents a direct loss of feed energy, reducing production efficiency. Emissions from

manure management further add to the environmental burden, especially in regions where dung is stored or processed under anaerobic conditions. These impacts vary widely across agro-climatic zones, production systems, and feeding practices.

Given these complexities, there is a growing need to quantitatively assess both the positive and negative externalities of dairy farming. This study addresses that need by focusing on Hassan, Belagavi, and Kalaburagi—three dairy-intensive districts in Karnataka representing diverse ecological and farming conditions. By examining feed consumption patterns, dung evacuation, methane emissions, and bovine population dynamics, the study aims to provide a comprehensive understanding of the environmental implications of dairy farming. The insights generated will help design targeted interventions, promote climate-smart dairy strategies, and strengthen sustainable development pathways for the dairy sector in Karnataka.

2. Materials and Methods

2.1 Nature and Source of the Data

The study relies on secondary data to analyze trends in bovine populations and their distribution across districts. National, state, and district-level livestock statistics were used to track changes in cattle and buffalo numbers, including shifts in indigenous and crossbred populations and variations in milch animal strength. District-wise data helped identify regional patterns and the intensity of dairy farming in Karnataka. Growth trends were assessed using livestock census data for India (1951-2019) and Karnataka (1997-2019) through the compound annual growth rate (CAGR) method, drawing entirely from reliable secondary sources such as the Livestock Census, MoFAHD, DAHD, and reports from the Commissionerate of Animal Husbandry.

3. Analytical tools employed

3.1 Compound annual growth rate analysis

The linear, log-linear, exponential and power functions are some of the important functional forms was employed to study the growth rates. Different functional forms were tried in the past for working out of growth rates in area, yield and production by Chengappa (1981), Sikka *et al.* (1985) and Bieche *et al.* (1992). Some of the important forms tried were the linear growth model (Y = a + bt), exponential function ($Y = ab^t$) and quadratic function ($Y = a+bt+ct^2$). However, it was found that the exponential form of the function $Y_t = ab^t$ is the better and most frequently used one. In the study, compound growth rates of livestock were estimated by specifying the following relationship.

$Y_t = ab^t U_t$ …… (3.1)

Where,

Y_t = area, production, quantity and value of livestock exported in year 't'

t = year which takes value 1,2, ……. n

U_t = disturbance term in year 't'

'a' and 'b' are parameters to be estimated.

The equation (3.1) was transformed into log- linear form and written as:

$\log Y = \log a + t \log b + \log U_t$ ……. (3.2)

Equation (3.2) was estimated by using ordinary least square (OLS) technique.

Compound growth rate (g) was then estimated by the identity given in equation (3.3).

$\hat{g} = (\hat{b} - 1)100$ …… (3.3)

Where,

$\hat{g}$ = estimated compound growth rate in per cent per annum.

$\hat{b}$ = antilog of log b.

The standard error of the growth rate was estimated and tested for its significance with 't' statistic.

4. Results and Discussion

4.1 Growth of bovine population in India and Karnataka

Table 1 presented the long-term trends in India's bovine population over seven decades, revealing a generally upward trajectory despite intermittent fluctuations. The bovine population increased steadily from 198.7 million in 1951 to 302.8 million in 2019, reflecting a substantial expansion of the national livestock resource base. Although the Annual Growth Rate (AGR) varied considerably between census years, with highs such as 2.19 per cent in 1961 and periods of negative growth such as -0.33 per cent in 2003 and -0.32 per cent in 2012, the overall pattern indicated sustained improvement. The post-2007 period, in particular, showed renewed growth momentum. The mean bovine population during the assessed period stood at 260.1 million, with a standard deviation of 369.19 lakh and a coefficient of variation of 14.19 per cent, suggesting moderate variability. The statistically significant Compound Annual Growth Rate (CAGR) of 3.29 per cent affirmed consistent long-run growth in the country's bovine population.

The expansion at the national level may be attributed to a combination of structural and policy-driven factors. Rising demand for milk and dairy products, fuelled by population growth, rising incomes and dietary diversification, stimulated improvements in livestock management. Parallel advancements in genetic enhancement programs, expanded artificial insemination networks, strengthened veterinary infrastructure, and government-supported initiatives such as the National Dairy Plan and Rashtriya Gokul Mission contributed to improved cattle and buffalo productivity and survival rates. Together, these interventions shaped a conducive environment for long-term growth in the bovine sector across India.

Table 1: Trends in bovine population of India

Census Year	Total Bovine Population (in lakhs)	AGR
1951	1987	-
1956	2036	0.48
1961	2268	2.19
1966	2292	0.21
1972	2357	0.47
1977	2420	0.53
1982	2622	1.61
1987	2757	1.00
1992	2888	0.93
1997	2888	0.00
2003	2831	-0.33
2007	3044	1.85
2012	2996	-0.32
2019	3028	0.15
Mean	2601	
SD	369.19	
CV	14.19	
CAGR (%)	3.29**	

Note: ** Significant at 5% level source: livestock census reports

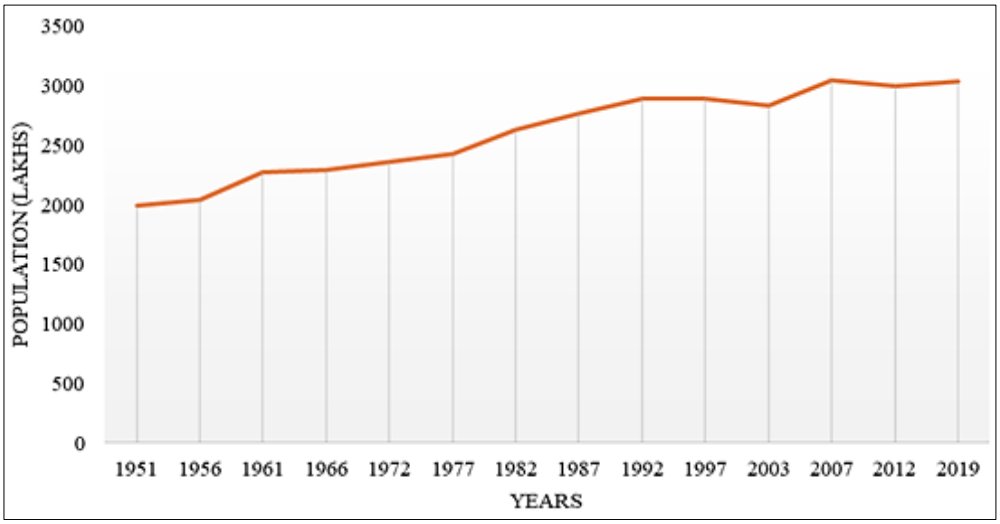

Fig 1: Trends in bovine population of India

Table 2: Trends in bovine population of Karnataka

Years	No. of animals (in, 000)	AGR
1982	143.9	-
1987	156.5	8.77
1992	174.3	11.35
1997	152.0	-12.78
2003	135.3	-10.96
2007	148.3	9.58
2012	129.9	-12.39
2019	114.5	-11.85
Mean	144.3	
SD	18.13	
CV (%)	12.56	
CAGR (%)	-2.82**	

Note: ** Significant at 5% level source: livestock census reports

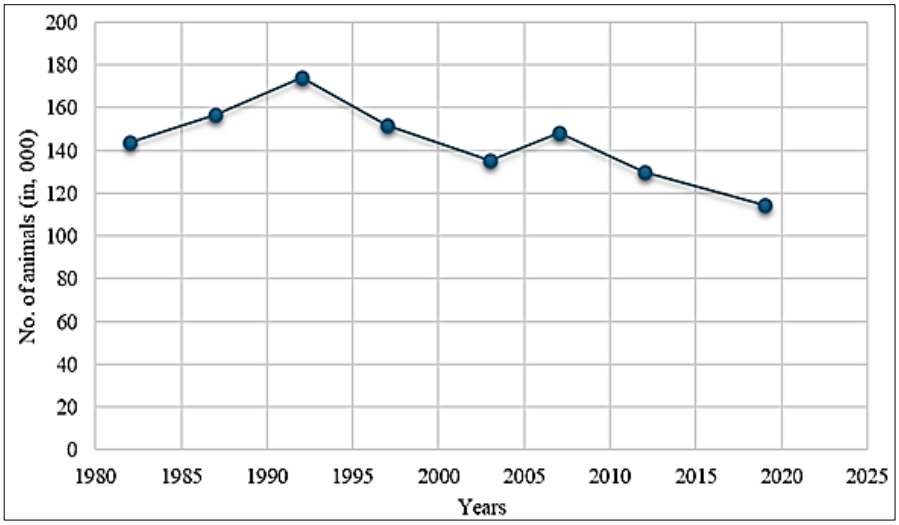

Fig 2: Trends in bovine population of Karnataka

In contrast to the national scenario, Table 2 showed that Karnataka's bovine population experienced significant fluctuations between 1982 and 2019. The state witnessed periods of expansion, such as the substantial increase from 14.39 million in 1982 to 17.43 million in 1992, which corresponded to an AGR of 11.35 per cent. However, this growth phase was followed by marked declines during subsequent census years, including -12.78 per cent in 1997, -10.96 per cent in 2003, -12.39 per cent in 2012, and -11.85 per cent in 2019. By the end of the study period, the bovine population had decreased to 11.45 million, well below the levels recorded in earlier decades. The mean population was 14.43 million, with a standard deviation of 1.813 million and a coefficient of variation of 12.56 per cent, indicating moderate instability. The negative CAGR of -2.82 per cent, statistically significant at the 5 per cent level, clearly reflected a long-term downward trend.

Multiple structural and socio-economic factors likely contributed to this persistent decline in Karnataka. The reduction in grazing land due to land-use changes, urban expansion and agricultural intensification limited the carrying capacity for large herds. Mechanization of agriculture reduced the need for draught animals, diminishing the economic value of maintaining unproductive or low-yielding bovines. Declining profitability in traditional dairy systems, coupled with rising feed and labour costs, further discouraged farmers from retaining large numbers of indigenous cattle. Additionally, farmers increasingly preferred maintaining smaller herds of high-yielding crossbred cows, reducing overall bovine numbers while improving milk output efficiency. Together, these factors shaped a contrasting trajectory for Karnataka relative to national trends, underscoring the need for targeted interventions to stabilize and strengthen the state's bovine sector.

4.2 Top districts in Karnataka by bovine population and its composition

Table 3: Distribution of Bovine Population by Major Districts (20th Livestock Census)

Sl. No.	District	Cattle	Buffaloes	Total Bovine	% To State total
1	Belagavi	549,540	844,171	1,393,711	11.86
2	Hassan	548,185	107,971	656,156	5.59
3	Shivamogga	518,653	120,563	639,216	5.44
4	Tumakuru	431,251	142,047	573,298	4.88
5	Mysuru	492,598	21,682	514,280	4.38
6	Kalaburagi	343,275	159,107	502,382	4.28
7	Mandya	369,986	109,443	479,429	4.08
8	Ballari	385,580	73,176	458,756	3.91
9	Chitradurga	225,603	113,304	338,907	2.89
10	Koppal	231,413	63,467	294,880	2.51

Table 3 presents the distribution of the bovine population across the ten leading districts of Karnataka as per the 20th Livestock Census (2019), highlighting substantial regional variation in livestock composition and dairy reliance. Belagavi district ranked first, with 1.39 million bovines, accounting for 11.86 per cent of the state's total. Buffaloes constituted the majority (60.6%), indicating a strong preference for buffalo-based dairying, likely driven by agro-climatic suitability and the higher market value of fat-rich buffalo milk commonly used in traditional dairy products. Hassan and Shivamogga followed, with 656,156 and 639,216 bovines respectively, both demonstrating clear cattle dominance (over 81% cattle). These districts represent regions where cow-based dairying is prevalent, supported by crossbred cattle adoption, established cooperative networks, and favorable climatic conditions for cattle rearing.

Table 4: Composition of Bovine Population in Karnataka (20th Livestock Census)

District	Cattle	Cattle pop%	Buffaloes	Buffaloes pop%	Total Bovine
Belagavi	549,540	39.4	844,171	60.6	1,393,711
Hassan	548,185	83.5	107,971	16.5	656,156
Ballari	385,580	84.0	73,176	16.0	458,756
Mandya	369,986	77.2	109,443	22.8	479,429
Tumakuru	431,251	75.2	142,047	24.8	573,298
Dakshina Kannada	250,569	99.3	1,832	0.7	252,401
Kalaburagi	343,275	68.3	159,107	31.7	502,382
Chitradurga	225,603	66.6	113,304	33.4	338,907
Shivamogga	518,653	81.2	120,563	18.8	639,216
Koppal	231,413	78.5	63,467	21.5	294,880

Tumakuru held the fourth position with 573,298 bovines, where cattle accounted for 75.2 per cent of the total, indicating a moderately balanced bovine system. Mysuru, with 514,280 bovines, exhibited an overwhelming cattle preference (95.8%), reflecting environmental conditions less favourable for buffalo husbandry. Kalaburagi, Mandya and Ballari occupied the next positions, showing mixed but cattle-leaning populations, shaped by factors such as irrigated agriculture in Mandya, or semi-arid conditions in Ballari where buffaloes remain valuable for resilience and fat-rich milk. Chitradurga and Koppal completed the top ten, with notable buffalo presence (33.4% in Chitradurga and 21.5% in Koppal), reflecting adaptation to drought-prone, dry agro-climatic zones where buffaloes thrive on coarse fodder resources.

Table 4 further elaborates on the cattle-buffalo composition in these leading districts, reinforcing three distinct bovine systems across Karnataka. Belagavi emerged as the only buffalo-dominant district, shaped by ecological compatibility and strong market linkages for buffalo milk products such as ghee and khoa. Districts including Hassan, Shivamogga, Kalaburagi and Dakshina Kannada exhibited overwhelming cattle dominance, influenced by widespread adoption of crossbred cows, consumer preference for cow milk, and agro-climatic conditions less favourable for buffalo rearing. Conversely, Mandya, Tumakuru, Koppal, Ballari and Chitradurga reflected moderately mixed bovine systems, supported by better fodder availability or semi-arid environments where buffaloes complement cattle in contributing to milk production and draught power.

Together, the results of Tables 3 and 4.4 reveal a spatially heterogeneous bovine distribution across Karnataka, shaped by agro-ecology, resource availability, market preferences, and dairy farming systems. These insights underscore the need for region-specific livestock development policies promoting buffalo value chains in buffalo-rich districts, strengthening cattle productivity and cooperative systems in cattle-dominant regions, and supporting balanced livestock systems in mixed districts to enhance dairy sector sustainability.

5. Conclusion

The study provided a comprehensive assessment of bovine population dynamics in India and Karnataka, as well as the spatial distribution and species composition of bovines across the top livestock-holding districts of Karnataka. At the national level, the bovine population showed a strong long-term expansion, rising from 198.7 million in 1951 to 302.8 million in 2019, with an overall CAGR of 3.29 per cent, significant at the 5% level. Despite occasional declines such as -0.33 per cent in 2003 and -0.32 per cent in 2012the broader trend confirmed sustained growth driven by rising milk demand, improved veterinary infrastructure, and policy interventions. The mean population of 260.1 million and CV of 14.19 per cent suggested relative stability, underscoring the robustness of India's bovine resource base over seven decades.

In contrast, Karnataka exhibited a declining trajectory. Although the bovine population increased from 14.39 million in 1982 to 17.43 million in 1992, it declined sharply in subsequent census periods, with AGR values of -12.78 per cent (1997), -10.96 per cent (2003), -12.39 per cent (2012), and -11.85 per cent (2019). By 2019, the population had dropped to 11.45 million, yielding a negative CAGR of -2.82 per cent, also significant at the 5% level. This decline reflected structural challenges such as shrinking grazing lands, mechanization reducing draught animal use, and a shift from large herds to smaller, high-yielding crossbred cows.

District-wise analysis revealed significant spatial heterogeneity. Belagavi emerged as the largest bovine-holding district with 1,393,711 animals (11.86% of the state total), dominated by buffaloes (60.6%). In contrast, cattle dominance was observed in Hassan (83.5% cattle of 656,156 total), Shivamogga (81.2% of 639,216), and Mysuru (95.8% of 514,280). Mixed bovine systems prevailed in Mandya (77.2% cattle), Tumakuru (75.2% cattle), and Koppal (78.5% cattle), while Chitradurga and Ballari displayed notable buffalo shares (33.4% and 16.0%, respectively). Dakshina Kannada was overwhelmingly cattle-based (99.3%).

Overall, the study demonstrated that while India's bovine population grew substantially, Karnataka experienced sustained decline, accompanied by pronounced district-level contrasts in species composition. These findings highlight the need for region-specific livestock policies, including buffalo-focused value chains in buffalo-rich regions, crossbred cow development in cattle-dominant districts, and integrated fodder and grazing management strategies to stabilize and enhance the state's bovine sector in a sustainable manner.

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