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Enhancing Livestock Gross Value Added (GVA) in India: Technological innovations, policy frameworks, and emerging research priorities

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Abstract
The livestock industry is one of the critical pillars of the agricultural economy in India, and it is responsible for a significant portion of the income of rural people, their employment, and gross domestic product (national output). This review examines the factors that influence the livestock sector's Gross Value Added (GVA) from to 2014-2015 to 2022-2023 and how technological innovations, financial resources, and policy frame-works influence the GVA of the livestock sector. Based on data from the Department of Animal Husbandry and Dairying (DAHD, 2024), and the Ministry of Statistics and Programme Implementation (MoSPI, 2024) the livestock GVA in nominal terms has grown from Rs 3.9 lakhs crores to Rs 6.9 lakhs crores; at constant (2011-12) price levels this represents a compound annual growth rate (CAGR) of 7.67%. Concurrently, livestock share within the agriculture and allied sectors has grown from 24.3% to 30% while its contribution to the total national GVA has grown to 5.5%. Improved productivity and sustainability in dairy production have been achieved through technological innovations, such as sex-sorted semen, *in vitro* fertilization, and genomics. Initiatives of the Indian Government through the National Livestock Policy (2023), Rashtriya Gokul Mission, and Animal Husbandry Infrastructure Development Fund are aimed at promoting further development in the livestock value chain and improveing animal health and disease management. The above measures are expected to increase the GVA from the livestock sector by an additional Rs 2.5 trillion by 2030. Therefore, the review concludes that there is a need to integrate digital governance, sustainable financing mechanisms and climate-resilient breeding strategies to sustain the average annual growth of GVA from the livestock sector at a level of 7 to 8 percent and to ensure that the livestock industry continues to be a key component in the process of transforming the agricultural sector of India.

Keywords: GVA, India, emerging research priorities, livestock industry, livestock industry, agricultural

Introduction
The Gross Value Added (GVA) is a key indicator of sectoral economic performance, representing the net contribution of a sector to the GDP and reflecting net output after accounting for intermediate consumption (Cai & Leung, 2020) [2] thus capturing the real production capacity and efficiency of a sector. As part of India's agrarian economy, the livestock sub-sector has emerged as one of the pivotal growth drivers in the country by transitioning from a subsidiary activity to a principal component of agricultural transformation, however, the traditional livestock sector is viewed as a subsidiary of agricultural farming. The livestock sector supports the livelihood of people in rural areas, contributes to food/nutritional security, and offers a steady source of income that is less influenced by the variability of monsoons.

Over the last decades, India's livestock sector has exhibited remarkable resilience and steady expansion, even amidst economic fluctuation, climatic and market uncertinities. As per the DAHD's Annual Report for 2023-2024, the GVA for the Livestock Sector was ₹13,55,460 Crores at Current Prices during the year FY 2022-23 and this represents 30.23% of the Agriculture and Allied sectors GVA and 5.50% of the total national GVA.

At Constant (2011-12) Prices, the GVA for the Livestock Sector was ₹6,90,268 Crore and this represented a 5.02% increase over the previous year.

From 2014-15 to 2021-22, the Livestock Sector GVA increased from ₹3,90,449 Crores to ₹6,54,937 Crores and the Compound Annual Growth Rate (CAGR) for this period was 7.67% and the Average Annual Growth Rate (AAGR) was 6%. Compared with the Agriculture and Allied sector, which had a CAGR of 4.25%, the livestock sector has demonstrated a strong upward trajectory therefore, its share of the Agriculture and Allied GVA expanded from 24.32% to 30.38% and its share of the total GVA increased from 4.44% to 5.50%, conforming it's expanding role in structural and economic transformation Table-1, Table-2.

Government intervention and technological innovation, such as the National Livestock Mission (NLM) and the Rashtriya Gokul Mission (RGM), contributed to improved productivity, genetic improvement, animal health, and value-chain, resulting in not only quantitative but also qualitative expansion, and better market integration. The livestock sector demonstrated its ability to be resilient during the COVID-19 pandemic when the GVA for the livestock sector continued to grow, as there were significant declines in all other economic indicators during the pandemic. This continuous upward trend in the GVA for the livestock sector demonstrates the sector's rapid transformation into a sustainable engine of rural income and agricultural diversification.

Materials and Methods

This review uses sectoral information collected by the Department of Animal Husbandry & Dairying, Ministry of Statistics and Programme Implementation (MoSPI, 2024) and the Press Information Bureau, in addition to recent research in the peer-reviewed literature (2019-2025) to compare statistical indicators and government databases for growth, productivity, and resilience, and to highlight the potential incorporation of livestock Gross Value Added (GVA) into decentralized rural planning.

Overview of the Sectors

India is the world's largest producer of milk, eggs, and meat. Milk, egg, and meat production was driven by productivity rather than herd expansion, during 2014-15 and 2022-23. According to DAHD (2024), the country produced 146 million tonnes of milk in 2014-15 which increased to 230.6 million tons in 2022-23 with a compound annual growth rate (CAGR) of 5.85%. Egg production had a CAGR of 7.35%, while meat production had a 4.84% CAGR. The livestock industry accounts for approximately 3.7% of all of India's merchandise exports (PIB, 2024), (Table-3).

Livestock development experienced a compound annual growth rate (CAGR) of 12.99% from 2014 to 2023. As such, livestock added 4 percent to the national Gross Domestic Product (GDP), and helped offset approximately one-third of lost cereal production between 2014 and 2023 (DAHD, 2024). Crop Gross Value Added (GVA) only increased at a compound annual rate of 2.1 percent during this time due to factors that include climate volatility, and commodity price fluctuations; meanwhile, fishery GVA increased by an average of 8.5%, and forestry GVA increased by 3.2% per year. Improvements in feed use efficiency and animal health were key factors in the strong growth of the livestock sector, and confirmed its status as a central stabilizer for the Indian agricultural economy (Table-4).

Drivers of Sectoral Growth

Demand Dynamics: Rapid population growth (projected at 1.6 billion by 2050) and increasing per-capita income in India have created an increase in demand for protein-rich food products. Studies indicate that the elasticity of demand related to spending on protein sources such as dairy and meat products has been found to be positive and statistically significant (Chengappa *et al*., N.D. Joshi, 2023) [6]. Urban households have shown a faster transition to livestock products, with declining per-capita consumption of cereals per head declining (Taravella & Barbier, 2002) [9]. Demand for poultry meat and eggs is expected to triple by 2030 (Mohanty *et al*. 2003) [7]. Such consumption trends would indicate that livestock plays an important role in nutrition security.

Policy interventions

Government flagship initiatives such as the, National Dairy Plan, Rashtriya Gokul Mission (RGM), and National Livestock Mission (NLM), have improved the infrastructure for breed quality and feed availability by attracting private investments and enhancing various aspects of the industry. These programs are responsible for nearly 1-2 percent of the annual productivity improvement (Julius H. 2022). Investments in cold chains for transport and processing infrastructure have changed efficient market access and value additions. India has produced a record milk output of 230.58 million tons between the year 2022-2023 (Pandey *et al*., 2024) [8]. This demonstrate the sustained policy -driven growth and employment in rural areas.

Finance and Technology: Growth Engines of Livestock GVA

Together, financial inclusion and technological development lead to growth in GVA. Access to institutional credit has increased sharply between 2014-2023, more than 33.84 lakh livestock farmers are holding Kisan Credit Cards (KCCs) (DAHD, 2024). The target of livestock credit flow target for FY 2023-24 was fixed at ₹ 2.93 lakh crore, comprising of ₹ 1.05 lakh crore for dairy, and ₹ 28000 crore for poultry. The allocation under the Animal Husbandry Infrastructure Development Fund (AHIDF) has strengthened capital formation in the sector, and encouraged small-holders to adopt genetic, feeding, and management technologies, leading to an increase in per animal output and GVA. The technologies applied, such as sex sorted semen, IVF, and genomic selection, have led to increase in lactation yield of 8-12% contributing to a 5.02% annual raise livestock GVA. The annual report 2023-24 of the Department of Animal Husbandry and Dairying (DAHD) highlights that the expansion of institutional credit and the rapid adaptation of reproductive and genetic technologies have contributed to productivity-led GVA growth.

Technological innovations in breeding and their impact on the livestock GVA

Sex Sorted Semen Technology

Sex-sorted semen permits the targeted production of female calves and reduces non-productive male offspring, resulting in increased milk production. In five government institutions more than 9.9 million doses were produced, which accounted for 7 million doses consumed for AI in the entire country by the year 2023-24 (DAHD, 2024). The technology achieves >90% female accuracy, with the facilities created under Accelerated Breed Improvement Programme (51 lakh targeted pregnancies).

In vitro fertilization and embryo transfer

Embryo transfer in 22 IVF laboratories resulted in the production of 20,859 embryos with elite donors, of which 11,433 embryos were transferred and by March 2024, 1,784

genetically superior calves were born. The generation interval for improved germ-plasma has reduced dramatically from 21 years to only 3 years. Every successful progeny of IVF achieves a lactation yield of up to 4,000 kg, leading to an increase in per animal productivity and GVA.

Genomic Selection and Evaluation:

The National Bovine Genomic Center for Indigenous Breeds (NBGC-IB) has enabled the use of genomic chips (Indus Chip and Buff Chip) from ICAR-NBAGR and NDDB, respectively, which has reduced the period of evaluation from 6-7 years to less than three years leading to rapid genetic improvement in breeds such as Gir, Sahiwal, and Murrah. Precision breeding enhances fertility, and disease resistance, and improves the quality and yield of milk, leading to an increase in GVA.

These core reproductive technologies, sex sorted-semen, *in vitro* fertilization (IVF), and genetic selection has redefined India's dairy development strategy under the Rastriya Gokul Mission (RGM) and National Livestock Policy (2023).

The development of the livestock sector in rural economic planning

The integration of livestock GVA in to rural economic planning has been furthered through digital platforms, including the National Digital Livestock Mission (NDLM), and Bharat Pashudhan. In total, over 34 cores of digital transactions were recorded as of March 2024, which represents significant development towards data-driven livestock management in rural areas (DAHD, 2024). Under the National Animal Disease Control Program (NADCP) 30.64 cores animals were vaccinated against Foot & Mouth disease (FMD), resulting in a reduction of FMD outbreak incidence of approximately 80% since 2018 and preventing annual loss of Rs 27,000 cores. Additionally, village-level mapping of GVA has enabled the targeted allocation of resources, and A-HELP (Accredited for Health and Extension of Livestock Production) workers in 15 states are providing door-to-door veterinary care, and collecting data related to the livestock sector (Table-5).

Collectively, the integration of all these initiations like digital livestock database, disease surveillance system, and rural extension networks creates a foundation for localized livestock GVA estimation for realization of Vision India @ 2047.

Goals of the National Livestock Policy (2023) and Strategic Direction

By 2030, the National Livestock Policy (2023) as outlined in the DAHD Annual Report (2023-24), intends to utilize the livestock industry for India's rural and economic transformations, by achieving an additional ₹2.5 trillion of value added, at a compound annual growth rate of 9.5%. The policy also aims to increase feed and fodder production by developing quality fodder seed production and regional feed corridors. As part of the National Livestock Mission (NLM), in FY 2023-24, 36,400 MT of quality fodder seeds were produced and the NLM approved 43 feed and fodder entrepreneurship units with a total investment of ₹4,184.82 lakhs, government subsidy was provided for ₹1,780.08 lakhs. This will assist in reducing the national fodder deficit (4.5-9%) and enhancing dry matter yields, toward a goal of 12 tonnes DM/ha.

The National Livestock Policy (2023) prioritizes animal health, infrastructure, and sustainability in order to boost GVA. DAHD aims to eradicate FMD and PPR by 2027, improving milk yield by 8%, and has expanded veterinary vaccine and drug production capacities to 90 lakh boluses, 400 lakh Tablets, and 2.75 lakh liters of veterinary formulations annually. Through AHIDF, 347 projects have increased dairy (137.53 lakh LPD), meat (9.12 lakh MTPA), and feed (79.24 lakh MTPA) capacities, backed by 3% interest subvention and 25% credit guarantees. Green-finance incentives, including up to 200 basis points subvention for methane-reduction and circular-economy projects, promote climate resilience and inclusivity (Table-6).

Emerging Research Priorities for Enhancing Livestock GVA:

Enhancing India's livestock GVA requires integrated innovation in productivity, efficiency, and sustainability, The DAHD Annual Report (2023-24), aligned with the National Livestock Policy (2023), and targets an additional ₹2.5 trillion in value addition by 2030 at a 9.5% CAGR.

Key priorities include genomic selection and precision breeding using Indus Chip and Buff Chip technologies, which reduce breeding cycles from 6 to -7 years to under 3 years and boost milk yield. Research on methane-mitigating feed additives has improved feed efficiency by 5-7%, addressing livestock's 3.4% GHG share. The One Health framework aims to eliminate FMD and PPR by 2027, preventing 6-8% milk yield losses.

Further, circular livestock models integrating biogas-fertilizer-insect protein systems enhance resource use, while innovations in livestock insurance with ₹500.3 lakh premium support strengthen income stability. Collectively, these research thrusts provide a science-driven roadmap for sustainable, resilient, and high-value livestock growth in India.

Table 1: Sectoral Growth Trends in India's GVA (2014-15 to 2021-22)

Sector	2014-15 GVA (₹ crore)	2021-22 GVA (₹ crore)	CAGR (%)	AGR (%)	Observation
Agriculture & Allied	16,05,715	21,49,122	4.25	3.51	Moderate, steady growth
Livestock	3,90,449	6,54,937	7.67	6.00	Strong, consistent performer
Crops	9,98,425	11,58,250	2.14	1.65	Low growth, declining share
Fishing & Aquaculture	82,232	1,47,519	8.71	9.26	Rapid expansion
Forestry	1,34,609	1,88,416	4.92	2.39	Stable contribution
Manufacturing	16,83,938	25,82,473	6.30	11.05	Robust post-pandemic rebound
Services	50,84,519	73,10,537	5.32	8.81	Sustained long-term growth

Table 2: Structural Shift in Agriculture and Livestock Contribution to GVA (2014-15 to 2021-22)

Indicator	2014-15	2021-22	Change (Percentage Points)	Trend
Livestock share in Agri & Allied GVA	24.38	30.19	+5.81	↑ Steady increase
Crop share in Agri & Allied GVA	61.75	54.85	−6.90	↓ Gradual decline
Livestock share in total GVA	4.44	5.73	+1.29	↑ Consistent rise
Total Agriculture & Allied GVA (as % of total GVA)	18.20	18.97	+0.77	↔ Slight increase

(Government of India, Ministry of Fisheries, Animal Husbandry and Dairying, 2022).

Table 3: Growth Trends in Major Livestock Products (2014-15 to 2022-23)

Product	2021-22	2022-23	Growth Rate (%)	CAGR (2014-15 to 2022-23)	Key Insight
Milk (‘000 tonnes)	222,068.56	230,577.03	3.83	5.85	Steady growth; genetic and management gains
Eggs (lakh nos.)	12,96,003.08	13,83,762.78	6.77	7.35	Fastest-growing; driven by commercial poultry
Meat (‘000 tonnes)	9,292.13	9,768.64	5.13	4.84	Consistent growth; strong export demand
Wool (‘000 kg)	32,915.93	33,614.48	2.12	−4.39	Slow recovery; structural decline persists

Table 4: Comparative Growth Rates of GVA across Subsectors (2014-2023)

Subsector	Average Annual Growth Rate (%)	Key Drivers
Livestock	12.99	Genetic gains, feed efficiency, veterinary health
Crops	2.1	Weather shocks, price volatility
Fisheries	8.5	Aquaculture expansion, exports
Forestry	3.2	Sustainable timber and NTFP management
Overall GDP	5.8	Services and manufacturing growth

Table 5: Summary of key constraints and their estimated economic impacts.

Challenge	Description	Impact
Feed & Fodder	4.5% deficit in dry fodder, 9% in green fodder, 35% in concentrates	Feed efficiency 20-30% below global standards (DAHD, 2024)
Diseases	FMD and PPR cause 6-8% milk-yield losses, ₹230 billion annual losses	Reduced productivity, trade restrictions
Market Informality	60% milk, 70% meat in unorganized markets	Low price realization, weak traceability
Environmental Impact	3.4% of India’s GHG emissions from ruminants	Climate vulnerability
Gender Gap	Women own 12% of large ruminants, <7% of enterprises	Limited inclusion, lost economic potential

Table 6: Table summarizing the National Livestock Policy (2023) targets and their expected macroeconomic outcomes (2024-2030).

Policy Priority	Specific Target (by 2030)	Expected Macroeconomic Outcome
Fodder Productivity Enhancement	Raise fodder productivity to 12 t DM ha^{-1} via millet-fodder corridors	Reduced feed deficits; improved livestock productivity and resilience
Disease Eradication (FMD/PPR Freedom)	Achieve FMD/PPR freedom by 2027; improve milk yield by 8%	Higher milk yield, export competitiveness, and animal health
Expansion of Organized Dairy/Meat Processing	Increase organized processing share to 50%; add 1.2% annual value	Enhanced rural employment, supply chain efficiency, and value capture
Green Finance Instruments (Livestock Sustainability Bonds)	Subsidize 200 basis points of interest for methane-reduction projects	Lower GHG emissions, improved access to green credit and climate resilience
Overall Livestock Value Addition Target	Add ₹2.5 trillion in value; sustain 9.5% CAGR (2024-2030)	Contribution of ~0.5 percentage points to national GDP growth; stronger rural liquidity

Conclusion

The livestock sector of India is the corner stone for GVA growth in the agricultural sector, as has been displayed throughout consistent resilience and transformation. Overall GVA of Livestock has increased from ₹ 3.9 lakh crore in 2014-15 to ₹ 6.9 laky crore in 0922-23 recording an annual growth of 7.67 percent but also an increase in the share in GVA generate in agricultural sector to more than 30 percent. Policy-led interventions, technological adaptations and financial inclusion have improved this sector. The National Livestock Policy (2023) projects another of ₹ 2.5 trillion additional values by the year 2030 with continued genomic improvements, green finance, and digital GVA monitoring, the livestock sector remains a dynamic engine of India’s agro-rural transformation and national economic resilience.

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Conflict of Interest

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