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# The Philippine Livestock Industry: A Review of Current Status, Key Challenges, Emerging Opportunities, and Sustainable Growth Strategies in a Developing Country Context

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## Abstract

**Purpose:** The livestock industry of the Philippines is a significant contributor to the nation's gross domestic product (GDP) and offers much potential for economic development, rural livelihood and national food security. The purpose of this review is to examine the current state of the industry, highlighting the main challenges and opportunities and demand for more sustainable growth, especially in the developing country context.

**Methodology:** This systematic literature review employed a content analysis and thematic synthesis. It reviewed a diverse set of papers from peer-reviewed articles, research reviews, government documents, and industry analyses that were relevant to the specifics of the livestock industry in the Philippines.

**Findings:** The industry's sustainability development is mainly limited by widespread challenges including disease outbreaks, restricted market outlets, environmental pollution, and massive production inefficiency. But the review in fact highlights the urgency of grasping current and emerging opportunities, such as digitalization and new technologies, to fundamentally improve productivity and sustainability. Promising models for sustainable growth that distinguish the value chain and green economy practices are also provided.

**Unique Contribution to Theory, Practice, and Policy:** This paper compiles dispersed information to provide a broad overview of the development trajectory of the Philippine livestock sector. However, in practice, it offers more concrete recommendations for farmers and industry actors, meaning it accentuates the role of digitalization and technological excellence as a driver of the rise of productivity and sustainability. On policy, it spells out explicit conditions for a conducive policy environment, such as coordinated animal health systems, pro-poor value chains, demand-led research and education, effective institutional capacities, global prize, and sound monitoring and evaluation. In the end, however, to achieve the full potential of the sector as an engine of sustainable rural development and national food security, a concerted effort of policymakers, farmers, researchers and digital firms is required.

**Keywords:** *Livestock Industry; Key Challenges; Opportunities; Digitalization; Biosecurity; Sustainable Growth; Developing Country; Philippines*

## 1. INTRODUCTION

Livestock industry is one of the most important sectors of global agriculture since approximately one billion rely on this for their nutrition, savings, and income generation (Bessell et al., 2023). The Philippines as one of the developing countries considered agriculture as major source of livelihood. A large number of Filipino families invested in agriculture, especially in rural communities where farming and different related work are the primary economic activities. The socioeconomic importance of livestock extends beyond direct consumption, as it creates significant employment and economic opportunities throughout value chains, particularly in developing countries (Herrero et al., 2013). Although still one of the key drivers of gross national product, the Philippine livestock sector is an essential part of the structural interweaving of agriculture in the nation since it improves the livelihoods of rural areas and offers food security. For underprivileged communities, raising cattle has multiple benefits since it provides means of escape from poverty and helps to meet different livelihood needs. It also has an impact in human capital by improving nutrition and health (Randolph et al., 2007). In 2022, among different industry groups, animal production posted the highest number of 1,572 establishments or equivalent to 49.3 percent of the total as per Philippine Statistics Authority (PSA) (PSA, 2024). Animal production as part of fastest-growing subsectors in the agricultural industry contributes in the annual value production in agriculture and fisheries sector. As the main source of protein for the Filipino population, the sector ranges from traditional backyard farming (which has been common across local communities) to next generation (agri-social enterprise) commercial farms. In the Philippines swine, carabao (water buffalo), cattle, goat and poultry production are the backbone of the livestock industry because it is essential in meeting domestic consumers' needs while ensuring that there is a livelihood in the rural sector. This sector alone constitutes some 28.8% of total (agricultural and fisheries) gross value added (GVA) that stood at roughly 139.27 billion Philippine pesos in the last quarter of 2024 (Del Prado et al., 2025 ) thus confirming, if needed, its significance in this component of the industry. The most consumed livestock in the Philippines were the swine (hogs) and chickens (Mulet et al, 2023) made it as main contributor to the value of livestock production. Poultry has played a major role in the nation's agricultural industry as it has a progressive potential worldwide in animal enterprise (Tanquilut et al, 2020).Among the various major obstacles, the Philippine dairy sector must overcome are environmental sustainability, disease control, and production limits. Rising demand for animal protein brought on by population increase causes the sector to suffer with low productivity, high manufacturing costs, and large post-production losses. Notwithstanding these difficulties, the cattle industry has great potential for development of agriculture, poverty reduction, food security enhancement, and better human nutrition. Food safety and public health depend on providing effective, safe, and safe animal production as large-scale production systems and food chains change to meet rising demand (Hernandez-Patlan et al, 2023). Advanced drug delivery systems, disease control tactics, dietary improvements, reproductive technologies, precision farming techniques, and genetic enhancement have been studied in response to these as other methods to increase productivity (Hernandez-Patlan et al, 2023). Furthermore, endangering native cattle breeds and posing environmental hazards including greenhouse gas emissions and land degradation threatened sector's growth (Ortega et al., 2021). Technology innovation is required to enable

widespread adoption. Several important elements need to be addressed to improve farmers' digital literacy and abilities, bolster rural infrastructure, create a user-friendly and reasonably priced technology solutions, and establishing supportive government policies and incentives (Taer et al., 2025). Addressing these challenges requires innovative strategies and collaborative efforts among stakeholders, including farmers, policymakers, and technology providers.This review pursuits to study and discuss current status, elaborate the multifaceted challenges, and explore opportunities for sustainable growth and suggest strategies to enhance the Philippine livestock industry.

## 2. LITERATURE REVIEW

### 2.1. Philippine Economy Status in Southeast Asia

The structure of the Philippine livestock industry is situated in the dynamic and heterogenous economic context of the Southeast Asia region, which is experiencing rapid expansion and changing food systems. As "Asia's next Tiger economy" (Kyath, 2017), although the Philippines has been lumped in the "medium-low" HDI category, which is similar in classification to Myanmar and Laos, the country has always shown vast economic potential. The nation's economy has been growing at an average of nearly 5% over the last decade (with a very robust 6.56% average pre-pandemic) and has a gross domestic product of USD 360 billion (Cueto et al., 2022). Economic dynamics are driven by the service (61% of GDP) and industry (29% of GDP) sectors, with food processing as the most significant of the manufacturing sectors, producing 40% of manufacturing output, 20% of national GDP, and employing 37% of the Filipino workforce (Kyath, 2017). This fundamental aspect of agriculture and livestock supplies the backbone of the nation's economic model. The livestock sector in Southeast Asia is currently undergoing radical change due to demographic and economic changes in the region. The region consistently maintained strong economic dynamism; the average growth rate was circa 5% in each year for 2000-2016, and the strong growth continued in 2017 (5.11%) and then 2018 (4.62%) (Amin et al., 2019; Nguyen et al., 2022). This economic dynamism has placed several countries, including the Philippines, as "emerging Asian dragons" (Nguyen et al., 2022). These economic changes have a direct bearing on food systems, as population growth, rapid urbanization, and increasing income result in a significant increase in demand for animal-source foods, particularly meat (Kang et al., 2021; Muhammad et al., 2017), offering substantial opportunities for growth and modernization in the Philippines livestock sector.Despite these relatively bright regional trends and its own recent economic achievements, the Philippines, like any developing nation, continues to confront ongoing problems. The Philippines' performance and its rate of progress have been slow regarding several development indicators, including life expectancy, poverty reduction, education enhancement, infrastructure spending, and technology diffusion over several decades compared to East Asian nations, most other Southeast Asian countries, and much of the world (Mitra, 2013). With the service sector beginning to contribute more than industry to GDP from the mid-1980s, the economic structure of India will also depend more on service exports than manufactured goods (Mitra, 2013). A notable developmental conundrum is the long duration spent by the country in the lower-middle-income rank for over 35 years beginning in 1987 is a demonstration of the middle-income trap (Masatoshi, 2023). Malaysia and Thailand have become upper-middle-income countries among their peers, but

the Philippines and Indonesia are still in this middle-income category (Thinagar et al., 2021). This is frequently associated with a lack of prioritization on the health and education sectors when governments try to reach for extremely high growth rates, which hampers the chances to reach an upper-middle-income (Thinagar et al., 2021).Amid this transition to a growing economy, the Philippine livestock industry encounters some challenges, especially the dairy sector. Looking ahead, the broader Southeast Asian economic environment presents both avenues for growth and persistent obstacles for the Philippine livestock industry. The regional Southeast Asian business landscape offers opportunities and continues to bring challenges to the Philippine livestock sector. Steady infrastructure development, investment expansion, and notable clearing in the region could bring robust growth of agricultural production systems, such as livestock (Lu, 2021). Yet despite such progress, in many countries in the region, including the Philippines, there is a wide gap between their aspirations for economic development and an underdeveloped industrial base (Lu, 2021).

**2.2. Market Trends and Projections**

Looking into the future, the Philippine livestock sector will face a series of serious supply-demand problems. A comprehensive literature review reveals that production of chicken meat in the Philippines is likely to triple by 2050. However, failure to implement measures in production and consumption could lead to significant challenges. The poultry subsector is expected to be confronted with severe challenges; chicken meat self-sufficiency is expected to decline from 87% in 2015 to 60% by 2050 if necessary measures are not implemented (Espino & Bellotindos, 2020). This projected gap emphasizes that strategic planning is needed to solve constraints on future production capacity.Asian research patterns offer hints about possible future developments pertinent for the Philippine situation. Analysis of more than 200 research papers shows that studies mostly focus on cattle species with high breeding scales and market presence; pigs have the highest population and market in Asia; followed by beef, poultry, and milk; studies concentrate mostly on livestock species with big breeding scales and market presence. Recent research keywords indicate that priorities are changing as "meat quality," "probiotics," and "antioxidants" are followed by emerging topics like "cultured meat" (Lee et al., 2023).Future research and market trends will also need to show the alternative livestock products (e.g., cultured and plant-based meats) and the further improvement of meat product functionality and safety. Furthermore, anticipated to take center stage are environmental effects of animal welfare studies and cattle rearing (Lee et al., 2023). Notable research needs, meanwhile, in areas like actual industrial applications, animal food regulations and policies, consumer preferences, and sustainable livestock development methodologies (Lee et al., 2023) abound.The direction of the sector will be much shaped by technological advancements. In Philippine livestock production, projected to boost efficiency and productivity, increases are precision agriculture, genetic enhancements, and better management techniques. Gradually being embraced in underdeveloped areas, precision livestock farming technologies, including automated milking systems, wearable sensors for health monitoring, and precision feeding systems, offer possible answers to long-standing problems in livestock farming (Kimutai, 2024).Policy structures and international cooperation will also greatly affect the future direction. Good policies can advance market access, animal welfare, and sustainable practices, as well as help deal with the worldwide issues confronting the cattle sector, while satisfying

increasing demand and reducing environmental effects would depend on cooperative efforts, including international organizations such as the FAO and regional agencies (Kimutai, 2024).

## 3. METHODOLOGY

Systematic literature review and content analysis through the thematic synthesis approach were then used in this study to synthesize and make a comprehensive analysis of the existing practices, challenges, and opportunities of sustainable development in the Philippine livestock industry. The main objective of this review was to compile available evidence from local knowledge and expert perspectives (especially focusing on smallholder farming and technological innovation) so as to build a nuanced understanding of the forces shaping the industry. This was pursued by a systematic review, searching all major academic databases, such as ScienceDirect, Google Scholar, Scopus, ResearchGate, and PubMed, as well as the relevant institutional repositories and the publication portals of governments. The search encompassed publications from their inception up to April 2025. A precise combination of keywords and Boolean operators was utilized, such as: ("Philippine livestock industry" OR "Philippine animal production") AND ("sustainability" OR "sustainable development" OR "green economy"); ("animal health" OR "disease outbreaks") AND ("Philippine"); ("precision livestock farming" OR "digitalization" OR "technological innovations") AND ("Philippine agriculture"); ("value chain development" OR "market access") AND ("Philippine livestock"); and ("food security" OR "rural livelihoods") AND ("Philippine livestock").Studies were included if they were published in English, presented empirical findings (e.g., quantitative surveys, experimental studies, qualitative research, case studies) from original data or analysis, were directly related to the Philippine livestock industry, and were peer-reviewed journal articles, dissertations, or government research reports. Conversely, non-English publications, opinion pieces, non-peer-reviewed commentaries, general reviews without empirical findings, duplicate publications (with only the most comprehensive version retained), and conference proceedings (unless subsequently published as full peer-reviewed articles) were excluded.

## 4. DISCUSSION

### 4.1. Current Status of Philippine Livestock Industry

The Philippine livestock sector on the whole has continued to grow steadily, with significant expansion in the poultry, swine, carabao, cattle (including dairy), goat, and meat processing subsectors. This expansion is indicative of the food and beverage sector's importance to the wider Philippine economy; agriculture, hunting, forestry, and fishing all form around 10% of the country's GDP. Significantly, the poultry industry is an aggressive sector with a share of 17.41% of the total agricultural output in the country, with about 197 million chickens and ducks produced (Paras, 2020). Despite the generalized growth support, the sector is chiefly controlled by scattered small-scale creole farms that continue to suffer from the inability to adopt new technologies and to effectively integrate the market (Domingo and Olaguera, 2017; Duong et al., 2024).The primary role of the livestock sector is not economic but as a key cushion to the blows of climate change, which looms large as a major threat to Philippine agriculture. The crop and fisheries subsectors contracted in 2016 because of adverse weather, but non-crop agriculture such as livestock and poultry expanded by nearly 6% (Escarcha et al.,

2018). This climate resilience is derived from the fact that livestock can frequently be moved to safer areas and fed supplementary feed when there is extreme weather. This comparative advantage for livestock production has prompted the Philippine government to support livestock production as a key strategy for adapting to climate change (Escarcha et al., 2018). The cattle industry is one of the sectors responding to the increasing demand for animal protein, driven by population growth and changing consumption habits (Escarcha et al., 2018), while simultaneously facing challenges posed by climate change worldwide. In addition, novel management practices, such as silvopasture, can contribute to forestry and ruminants' conservation and enhance resilience by integrating trees, forages, and livestock as alternatives for sustainable land use (Diaz, 2022).

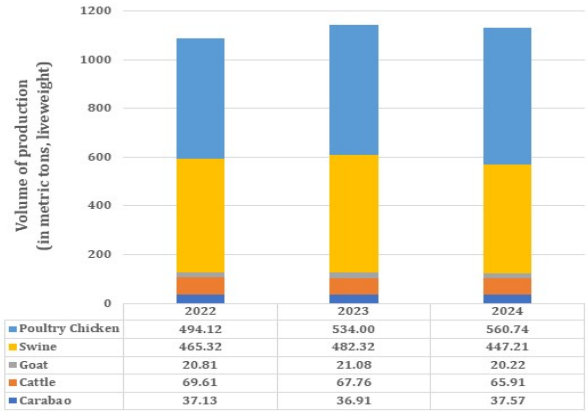
**Table 1.**
***Current Status and Challenges Faced by the Philippine Livestock Industry***

| Animal Type | Current Status | Challenges Faced |
|---|---|---|
| Swine | Dominant in urban and peri-urban areas, with growing demand for pork products | Environmental concerns, market access, and disease outbreaks |
| Poultry | Significant contributor to agricultural output, with a focus on broiler chickens | Antimicrobial resistance, competition, and waste management |
| Cattle | Small-scale production, with declining population due to limited resources | Limited resources, competition from imports |
| Carabao | Vital for draft power and milk production, with conservation efforts underway | Genetic erosion, limited market demand |
| Goat | Dominant native breeds, with focus on meat production | Genetic erosion, limited access to resources |

The Philippines livestock industry faced unique challenges across all the major subsectors. The swine sector, which is at the center of environmental protest, is suffering from both market closure and ASF trade outbreaks. The problems associated with poultry range from a struggle with antimicrobial resistance to waste management. Cattle and carabao breeding are constrained by population decrease, resource poverty, and genetic depletion. In the goat industry, there are also issues related to genetic erosion and resource constraints. While all sectors here are relevant to agriculture, each one requires particular actions to address such challenges in order to ensure sustainable development.However, the performance of individual animal industries within the Philippine livestock sector shows mixed trends. While recent advancements in precision livestock farming and IoT technologies are beginning to improve resource utilization and productivity (Taer & Taer, 2025), significant production and marketing issues persist, especially in rural areas (Domingo & Olaguera, 2017). The swine industry, for example, is a thriving industry driven by robust pork demand but still affected by substantive environmental issues, especially as it becomes more intensified in the urban areas (Catelo et al., 2008). While smallholder producers continue to be a dominant force, 71% of the nation's swine sector struggles with problems such as limited access to markets (Intal & Palaoag, 2023)

and issues related to unregulated drug applications and insufficient veterinary control, which may contribute to the development of antimicrobial resistance (Barroga et al., 2020). The hog industry has been severely impacted by persistent outbreaks of African Swine Fever (ASF) since 2020, leading to substantial losses, supply disruptions, and skyrocketing market prices (Obrador & Pasco, 2024; Duong et al., 2024).Contributing risk factors to the spread of ASF include feeding of swill, poor biosecurity, and movement of people (Hsu et al., 2023)—food waste from the ports is already banned (Barrion et al., 2023). The ASF outbreak resulted in increased pork costs and was declared a national disaster in 2021 (Hsu et al., 2023; Portugaliza, 2024). Preventive measures by the government include the 1-7-10 surveillance protocol, the National Zoning and Movement plan, and the National African Swine Fever Prevention and Control Program (NASFPCP) initiated in 2021 (Hsu et al., 2023; Hsu et al., 2024). The outbreak was the crisis that led the Department of Agriculture (DA) to roll out the Integrated National Swine Production Initiatives for Recovery and Expansion (INSPIRE) in 2022, with an emphasis on repopulation and raised biosecurity protocol.Good Animal Husbandry Practices (GAHP) are developed and promoted in the Philippines by the Bureau of Animal Industry (BAI) in collaboration with the Bureau of Agriculture and Fisheries Standards (BAFS) in the DA. Such GAHP standards are necessary to ensure not only food safety but also animal welfare, environmental concerns, and the welfare of farm workers in the Philippine livestock industry. While the exact requirements may differ slightly based on the animal species (e.g., swine, beef cattle and buffalo, and poultry), the core tenets of BAI's GAHP cover several vital aspects. The BAI conducts inspections and provides GAHP certification to farms that adhere to these Philippine National Standards (PNS). This verification is voluntary but highly recommended, as it indicates producers are working to produce safe, high-quality, and humanely raised livestock commodities that can increase market access and consumer confidence. Specific requirements for each species are discussed in separate PNSs, like PNS/BAFS 267:2022 for Swine and PNS/BAFS 200:2023 for Beef Cattle and Buffalo (Barzanas et al., 2022; Constante et al., 2023).Figure 1 portrays the performance of the different livestock commodities in the Philippines for the last quarters of 2022 to 2024 in terms of supply and market value status. Panel (a) directly measures output in terms of metric tons (liveweight), and panel (b) reflects the percentage change in output, which displays the movement in production. Simultaneously, panel (c) displays the average farmgate price in pesos per kilogram, i.e., bringing about the producer's return, and panel (d) displays the percentage growth rate, presenting the market's instability. These four sets of panels provide a complete picture of the production health and market performance of each livestock commodity in the specified time period.

***Volume and Annual Growth Rate and Average Farmgate Price and Annual Growth Rate of Farmgate Price of Different Livestock Commodity Philippines: October to December 2022– 2024***

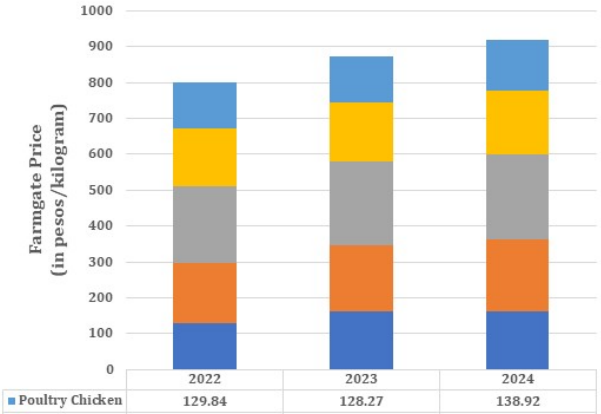



| | 2022 | 2023 | 2024 |
|---|---|---|---|
| Poultry Chicken | 494.12 | 534.00 | 560.74 |
| Swine | 465.32 | 482.32 | 447.21 |
| Goat | 20.81 | 21.08 | 20.22 |
| Cattle | 69.61 | 67.76 | 65.91 |
| Carabao | 37.13 | 36.91 | 37.57 |

(a)

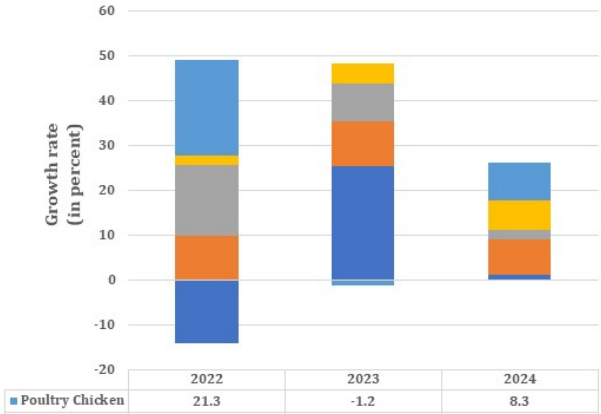

| | 2022 | 2023 | 2024 |
|---|---|---|---|
| Poultry Chicken | 2.3 | 8.1 | 5.0 |
| Swine | 3.4 | 3.7 | -7.3 |
| Goat | -2.5 | 1.3 | -4.1 |
| Cattle | -0.4 | -2.6 | -2.7 |
| Carabao | -0.3 | -0.6 | 1.8 |

(b)




| | 2022 | 2023 | 2024 |
|---|---|---|---|
| Poultry Chicken | 129.84 | 128.27 | 138.92 |
| Swine | 160.84 | 167.69 | 178.88 |
| Goat | 214.01 | 232.16 | 236.87 |
| Cattle | 169.14 | 186.18 | 201.30 |
| Carabao | 128.08 | 160.47 | 162.10 |

(c)




| | 2022 | 2023 | 2024 |
|---|---|---|---|
| Poultry Chicken | 21.3 | -1.2 | 8.3 |
| Swine | 2.3 | 4.3 | 6.7 |
| Goat | 15.6 | 8.5 | 2.0 |
| Cattle | 9.9 | 10.1 | 8.1 |
| Carabao | -14.3 | 25.3 | 1.0 |

(d)

*Sources: Philippine Statistics Authority, BLPS, CLPS, NDA, and PCC*

**Figure 1.** ***The volume of production versus growth rate and farmgate price versus growth rate of different livestock commodities in the fourth quarter from 2022-2024: (a) volume of production (in metric tons,liveweight); (b) corresponding growth rate (in percent); (c) farmgate price (in pesos/kilogram); and (d) corresponding growth rate (in percent).***

Meanwhile, the dairy industry is a special case that accounts for approximately 1% of the national dairy requirements and, therefore, is highly dependent on imports (Leyte et al., 2021; Ang, 2017). Notwithstanding, the sector experiences positive growth attributed to soaring private investment, while production is still dominated by smallholder crop-livestock farms limited to feeding possibilities and the availability of quality forage production (Leyte et al., 2021). The increasing demand for milk and milk products is evidenced by US$1.08 billion in dairy imports in 2020 (Aquino et al., 2024). In the cattle industry, while smaller, a moderately stable growth trend is sustained by strong local demand and government initiatives like the Unified National Artificial Insemination Program (UNAIP), which enhanced herd quality. The carabao industry also contributes to both draft power and milk production, receiving some

support from the Philippine Carabao Center (PCC) to increase output (Flores, 2017). However, the competition brought about by the mechanized agriculture has threatened the existence of carabao, which is why continued support for sustainability is necessary.On the other hand, the poultry industry has increased by 2.4% from native to commercial chicken detention as of March 2022 (Liangco et al., 2023) and has grown significantly given its economic impact, though there is a gradual shift and preference to commercial over native chicken operations. The poultry industry, especially broiler chickens, is a major contributor, having seen significant improvements in breeding and feeding. Nonetheless, the extensive use of antibiotics raises concerns about antimicrobial resistance (Imperial et al., 2022), and the adoption of contract growing models aims to meet consumer demand for safe products (Tiongco et al., 2008). The government's proactive Avian Influenza Protection Program, established in 2005, includes biannual sampling and diagnostic capabilities (Domingo et al., 2016).

**Table 2.**

***Inventory and Annual Growth Rate of Chicken by Type, Philippines: as of 31 December 2024***

| Type of Chicken | Inventory (in million birds) | Growth Rate (in percent) |
|---|---|---|
| Native/Improved | 80.26 | -6.0 |
| Broiler | 68.03 | 15.1 |
| Layer | 48.36 | 6.6 |
| Gamefowl (for breeding) | 9.72 | -2.6 |
| **Total** | **206.37** | **3.3** |

*Sources: 2025 Livestock and Poultry Quarterly Bulletin, Philippine Statistics Authority*

During the period, the inventory of chicken in the Philippines rose by 3.3% to 206.37 million birds as of December 31, 2024, based on data from the Philippine Statistics Authority. This remarkable increase was driven mainly by the commercial sectors: stocks of broiler chickens were up by 15.1%, and layers continued to record a 6.6% increase in their populations, as the need for both meat and eggs was actively pursued. On the other hand, the stock of native/improved chickens decreased by 6.0%, and that of game fowl for breeding descended by 2.6%. This dual trend reflects the continuing evolution of the poultry industry, driven by both robust commercial growth and adaptation within the traditional and specialized segments. In addition, the goat industry primarily focuses on meat production, and the native goat breed is the most widespread and significant for smallholder farmers due to its early sexual maturity and short gestation period (Bondoc et al., 2002). However, uncontrolled crossbreeding threatens genetic diversity, and the sector's low capital intensity and backyard farming nature limit modernization and scale. Finally, the country's underdeveloped dairy industry is largely dependent on imports from Australia, the US, and New Zealand (Leyte et al., 2022; Ang, 2017). Established in 1995, the National Dairy Authority (NDA) is the government agency responsible for promoting milk production in the country. The industry, composed mainly of smallholder farmers who raise dairy cattle and carabaos, remains largely untapped despite its limited capacity. To facilitate the collection, processing, and marketing of milk produced in a locality, efforts are being made to form dairy cooperatives and associations. The DA promotes this

through various programs, such as the Dairy Multiplier Farm Program and the Dairy Competitiveness Enhancement Fund, which aim to heighten farmers' management skills and improve dairy animal genetics. The PCC is also a major player in the development of carabao-based milk production by supporting milk feeding programs and participating in enterprise development/gene improvement activities. In the long run, the goal is to be more self-reliant and less dependent on imports. Confronting long-standing issues such as smallholder market access, disease outbreaks, feed supply, and the role of technology would be of vital importance to achieving sustainable growth and resilience in the Philippine livestock sector.

**Table 3.**

***The new farm classifications and definitions based on the approved PSA Board Resolution No. 04, series of 2022, and PSA Board Resolution No. 11, series of 2023 for swine***

| Animal Type | Classification | Definition |
|---|---|---|
| Carabao and Cattle | Smallhold | ≤ five caracows/ cows |
| | Semi-commercial | 6 – 50 heads of caracows/ cows |
| | Commercial | ≥ 51 caracows/ cows |
| Goat | Smallhold | ≤ 35 does |
| | Semi-commercial | 36 – 100 does |
| | Commercial | > 100 heads of does |
| Swine | Smallhold | 1 – 10 sow level or 1 –100 heads |
| | Semi-commercial | 11 – 50 sow level or 101 – 500 heads |
| | Commercial | ≥ 51 sow level or ≥ 501 heads |
| Broiler Chicken | Smallhold | ≤ 500 birds |
| | Semi-commercial | 501 - 10,000 birds |
| | Commercial | ≥ 10,001 birds |
| Layer Chicken, Native/Improved Chicken, and Duck | Smallhold | ≤ 250 birds |
| | Semi-commercial | 251 – 5,000 birds |
| | Commercial | ≥ 5,001 birds |

*Sources:2025 Livestock and Poultry Quarterly Bulletin, Philippine Statistics Authority*

The PSA changed the livestock farm classifications based on the update it made, particularly in the classification of swine, as the old “backyard” and “commercial” categories have changed to Smallhold, Semi-Commercial, and Commercial categories. This change is produced as part of PSA Board Resolutions 04 (2022) and 11 (2023) that seek to give the government more accurate information when planning and for aid programs, to discard outdated nomenclature,

and to better align the industry's actual structure. By swine, a Smallhold Farm is currently 1-10 sows or 1-100 heads, Semi-commercial Farm is 11-50 sows or 101-500 heads and Commercial Farm is >51 sows or 501 heads or more. These new definitions also coordinate with other government agencies to enhance response efforts, including ASF recovery efforts, and have been in use since November 2022.

### 4.2. Key Challenges Facing the Livestock Industry

#### 4.2.1. Production Bottlenecks, Marketing and Supply Chain Issues, and Disease Threats

The livestock sector in the Philippines is greatly challenged in terms of production and marketing, with a serious impact on small farmers. There are problems in obtaining resources and in keeping the animals healthy and able to reproduce besides the cloud hanging over production. Furthermore, issues related to market access, price volatility, and transportation disproportionately affect rural producers, complicating their ability to sell goods and generate stable income (Duong et al., 2024).A primary constraint to the sector's development and sustainability is the prevalence of disease outbreaks and emerging diseases. This situation is exacerbated by uncontrolled animal movements, several vaccination steps, a lack of technical skills in the field, a lack of biosecurity, little to no involvement of local communities in disease prevention, and a lack of emergency response capacities (Blacksell et al., 2019). Highly Pathogenic Avian Influenza (HPAI) continues to be a major threat to the global poultry industry with recurrent outbreaks and enormous economic and social impacts; it is still the Philippine poultry sector's top concern, combined with high imports of meat, supply deficits, and escalating feed prices (Tanquilut et al., 2020). African Swine Fever (ASF) is also a major transboundary animal disease that is contagious and often lethal with no cure or vaccination; it also requires culling for its control (Hsu et al., 2024; Roth et al., 2024). First detected in the Philippines in 2019, ASF decimated the swine sector, affecting 67 provinces, costing upwards of 50 million pesos in losses, resulting in approximately 300,000 pigs culled, and substantially constraining the growth of pork production by 2021 (Hsu et al., 2023; Portugaliza, 2024). In the past, there have been occasional outbreaks of Foot and Mouth Disease (FMD), which have added significant financial pressure on farmers (Blacksell et al., 2019). In addition to diseases, feed-related constraints predominate, including inadequate stocks of quality feeds at suitably low prices for raw materials (Balehegn et al., 2020; Tanquilut et al., 2020). Although there have been proven technologies for feed and livestock production of smallholder farmers, the rate of adoption is low (Balehegn et al., 2020), which is further hindered by the fluctuating market and high cost of drugs and feed concentrates, particularly among micro-scale producers (Bollido et al., 2020).The successful husbandry practices required for them to manage their stock also require skills in husbandry, nutrition, communication, and adaptability, which some of the farmers may lack (Victor et al., 2024; Ponnusamy et al., 2018). Limited inputs and low knowledge on animal hygiene worsen production inefficiencies, including poor hygienic management, as a consequence of poor sanitary conditions (Chinchilla et al., 2022). The situation is complicated more by environmental changes such as climate change with which livestock farmers have to contend (Mwanga et al., 2020; Singh et al., 2023). For niche markets like the Halal goat industry in the Philippines, these production constraints immensely stifle industry development as well as affect the lives of the people who rely on it (Sanchez et al., 2020). It is an essential but difficult task to balance nutrient management in farmland, as an

imbalance between inputs and outputs will result in environmental problems, such as nutrient leaching and soil erosion (Victor et al., 2024).At present, the persistent availability and quality of feed is a major challenge that faces the livestock producers in the Philippines. Indigenous forage sources frequently do not satisfy the high nutritional requirements of high-producing livestock such as dairy cattle, and although there are expensive commercial feeds, cheaper alternatives such as maize silage may not contain enough protein to support the highest production (Leyte et al., 2021).

**4.2.2. Food Security Implications**

In the Philippines, food insecurity is a significant issue, as smallholder households still generally have inadequate access to nutritious food. Impasse in livestock production and trading ultimately results in poor diet and food skipping among these households (Duong et al., 2024). The ability of industry to expand and address these issues is further hampered by its dependence on local and regional markets (Duong et al., 2024). Raising livestock is integral in addressing food poverty in the Philippines in its contribution to improving farmer incomes in poor locations and thereby reducing food scarcity (Hatab et al., 2019). The nation's progress in combating hunger and food insecurity is challenged by a rising population coupled with concurrently reduced agricultural output and food production. Disease outbreaks, particularly African Swine Fever (ASF), which led to a "State of Calamity" across 12 regions and 46 provinces, have severely aggravated the food security situation (Leon et al., 2023). The interaction between food security and cattle output in the Philippines is influenced by various pressures, including socio-economic factors (income growth, market developments, institutional infrastructure), natural resource challenges, environmental concerns (pollution, land use changes, climate change), demographic transitions, and urbanization (Hatab et al., 2019). These pressures contribute to both positive functions of cattle in food security (improved supply) and negative effects (natural resource degradation and pollution) (Hatab et al., 2019).The COVID-19 pandemic exacerbated food shortages, especially for small cattle producers in developing countries like the Philippines. Their vulnerability stems from the limited and informal scope of their activities, with data indicating that the epidemic's effects on cattle systems jeopardize livelihoods and worsen food security for rural households (Hatab et al., 2021). The outbreak caused a sudden collapse in supply and demand in cattle markets, harming farmers and destabilizing numerous levels of livestock value chains (Hatab et al., 2021). Furthermore, cultural practices can influence food security outcomes, as conventional practices like assigning cattle to rituals can deplete resources for consumption or market exchange, intensifying food poverty (Benti et al., 2022). Production risk factors such as drought, conflict, and animal sickness further deplete pastoral resources and lower consumption capacity (Benti et al., 2022). Obstacles in market access, such as long travel distances, deter trade for herders, limiting their access to non-pastoral food sources (Benti et al., 2022). Rural producers also face a daunting challenge competing with large-scale producers who dominate urban markets, a struggle amplified by their impoverished households and conventional production techniques (Hatab et al., 2019). An integrated supply chain approach is essential for enhancing the fragmented local food supply chain and improving coordination among farmers, slaughterhouses, processors, distributors, and consumers. Digitalization, facilitating comprehensive animal tracking from birth to final products, is considered vital for a sustainable

livestock sector capable of addressing the nation's food security challenges (Ariffin et al., 2021). Government entities are also exploring alternative food sources, such as rabbit meat, to address food security issues (Leon et al., 2023).

**4.2.3. Technological and Digital Divide**

Despite the immense potential of digital technology, including the Internet of Things (IoT) and precision agriculture, its adoption in the Philippine livestock industry is significantly hampered by high costs, insufficient digital literacy, and inadequate rural infrastructure (Taer & Taer, 2025; Roca et al., 2024). This technological and digital divide constrains the overall development and sustainability of the industry. Small-scale farmers, who form the backbone of the sector, often lack access to improved technological innovations in agriculture, leading to persistently low agricultural productivity. For instance, in the dairy sector, limited access to high-quality forage is a major barrier for smallholder farmers, as most still rely on traditional cut-and-carry systems that do not meet the nutritional requirements of modern dairy cows (Leyte et al., 2021). This technological disparity contributes to inefficiencies, resulting in the Philippines fulfilling only a mere 1% of its national dairy demand. While the global shift towards digitalization and Precision Livestock Farming (PLF) technologies offers advantageous alternatives for sustainable livestock agriculture, enabling farmers to boost productivity, minimize environmental harm, protect livelihoods, and promote animal health and well-being (Papakonstantinou et al., 2024), significant barriers impede their adoption by the majority of smallholders in the Philippines. A coherent digital supply chain is necessary to improve the current fragmented and inefficient local food supply chain in the country. This digital transformation could significantly enhance animal monitoring "from the time of their birth to the products' end" and optimize synergies between various actors in the supply chain, from producers to end-users (Ariffin et al., 2021). However, realizing these opportunities requires addressing the fundamental constraints of technology access and adoption that most livestock producers in the country currently face.

**4.2.4. Environmental and Sustainability Concerns**

The Philippines is among one of the most vulnerable countries to the impacts of climate change and faces extreme weather events such as typhoons, floods, and droughts, which all adversely affect the Philippine agricultural sector. Between 2006 and 2013, the agriculture industry lost an estimated $3.8 billion to climate change. Projections indicate that by 2100, these climate impacts could reduce the nation's annual GDP by 2.2 percent (Escarcha et al., 2018; Perez et al., 2015). Despite these challenges, the livestock and poultry sectors demonstrated resilience, growing by approximately 6% in 2016, while crop and fisheries subsectors declined. It intimates a relative livestock advantage: livestock can be moved or additional feed can be supplied during periods of adverse weather, and, as a result, it has been recommended as one of the pivotal climate adaptation strategies by the Philippine government (Escarcha et al., 2018).But sustainable and efficient meat production must be developed through integrated management systems throughout the value chain. Many of the livestock producers in the Philippines are smallholder farmers who have great difficulty in accessing and adapting to shifting conditions such as the opening of new urban markets, economic fluctuations, and technologies for production (Hatab et al., 2019). Another issue facing them is the increasing requests concerning food safety, traceability, and compliance standards that are generally not

beneficial for resource-poor farmers (Hellyward et al., 2022). To rise to these challenges, potential solutions include collective action models, such as cooperatives or contract farming. These have the potential to increase productivity, streamline operations, and minimize losses for smallholders. Furthermore, state actions such as extension services, infrastructure investment, provision of information, and standard business practices could potentially correct some market shortcomings, mitigate information premium, reduce transaction costs, and generally enhance market coordination (Hellyward et al., 2022).In addition to market access issues, environmental and sustainability challenges remain large impediments for the Philippine livestock sector in the future. The global cattle industry alone is responsible for some 14.5% of all greenhouse gas emissions, a number that is projected to increase with growing animal product consumption (Smith, 2024). This scenario forms a contradiction between environmental degradation, future cuts, and the necessity of enhancing local food production. In particular, the livestock systems in the Philippines are dealing with specific environmental challenges, such as nutrient management. Surplus nutrients can cause contamination to the environment, i.e., leaching and runoff, since inputs of e.g., feed and bedding exceed plant and animal requirements (Victor et al., 2024; Roche et al., 2013). This challenge is compounded by farmers' limited competencies in husbandry, nutrition, and adaptability (Victor et al., 2024; Ponnusamy et al., 2018).The adverse effects of climate change further threaten farmlands and livestock output, impacting harvests and family farmers who are crucial to cattle production (Chao, 2024). Industrial facilities, which tend to depend on foreign direct investment and sophisticated technology, are particularly exposed to extreme weather and supply chain disruptions and require heavy investments to protect against threats such as heat stress (Papakonstantinou et al., 2024). Dairy production is a critical component of the cattle industry, and it embodies these problems, where intensive systems are responsible for emitting more greenhouse gases (GHGs) and for undermining sustainability initiatives (Mwirigi et al., 2025). Addressing these environmental and sustainability challenges requires a multifaceted approach. Precision Livestock Farming (PLF) technology offers a promising path to boost productivity while reducing environmental damage and improving animal welfare (Papakonstantinou et al., 2024). Moreover, enhancing production efficiency through sustainable intensification can decrease ruminant emissions, providing a crucial path for climate-resilient livestock systems (Singh et al., 2023). Improving animal husbandry, cultivating oil crops instead of traditional grains, and encouraging better land use models will help balance environmental protection with food security (Papakonstantinou et al., 2024).

### 4.3. Emerging Opportunities for the Livestock Industry

#### 4.3.1. Technological Innovations and Digitalization

Modern technologies are changing the world of agriculture, suggesting progress in production and the effective use of resources. These breakthroughs cover a wide range of domains, including the use of advanced drug delivery systems, disease control (as vaccinations and antibiotic alternatives), better animal nutrition through prebiotics and probiotics, as well as the development of reproductive technologies, Precision Livestock Farming (PLF), and genetics (Hernandez-Patlan et al., 2023). This shift in technology is important for the competitiveness, efficiency, and sustainability of agriculture around the world.With the predominance of smallholder farming in the country, precision livestock farming using IoT has enormous

potential in the Philippines. These technologies can make a substantial positive impact in the proper utilization of resources, which can enhance productivity and, in turn, improve rural livelihoods (Taer et al., 2025). Areas with high potential can be improved by optimizing supply chains and by monitoring farm conditions. In enriched countries there is already a feeling of precision agriculture with automatic feeding belt systems, odor-detecting wearables, and automated feeding (Kimutai, 2024). It is also being adopted in other countries, including the Philippines, to address age-old agricultural problems by furnishing real-time data on animal behavior and health and facilitating improved management practices (Ostaev et al., 2024; Norton et al., 2019).The development of highly competitive and efficient livestock production is determined by digitalization, biotech, and resource technologies (Ostaev et al., 2024). Greater mechanization and the use of digital platforms can decrease dependence on low-skilled labor and ineffective mechanization and contribute to the increase of overall efficiency and export opportunity.In the Philippines the research on the adoption framework for Precision Livestock Farming (PLF) technology for hog raisers at Sorosoro Ibaba Development Cooperative (SIDC) in the province of Batangas (Estrella, 2023) is a great illustration of this digital transformation in action. This study directly tackles the existing challenges encountered by hog raisers by examining the implementation of Precision Livestock Farming (PLF) technology, incorporating a PEST analysis to contextualize its integration within the cooperative and the wider Batangas hog-raising sector. Across the Philippines, the digital and precision farming revolution is actively working to improve productivity, efficiency, and sustainability. The integration of IoT, AI, and blockchain offers powerful tools for real-time animal health monitoring, optimized resource use, and eco-friendly farming practices (Taer & Taer, 2025; Vlaicu et al., 2024; Salem & Mohamed, 2024). For instance, IoT technologies are used for animal welfare and waste management, and blockchain ensures supply chain transparency and traceability (Salem & Mohamed, 2024).But these technological breakthroughs alone cannot promote the level of widespread change that's needed throughout the livestock sector. Evidence also indicates that focus on purpose is essential for the supply side (Gratton et al., 2024). Its successful implementation requires a comprehensive approach with a favorable policy foundation, which takes into account the socioeconomic conditions of the country and emphasizes capacity building. Support from international institutions (such as the FAO and regional institutions) is important for research, finances, and technology transfer (Kimutai, 2024). Apart from IoT and blockchain, other disruptive technologies include multi-sensor tools for air quality monitoring in livestock farmhouses (Danev et al., 2024), AI and ML for optimal feeding and disease and heat detection (Vlaicu et al., 2024), and human-computer/animal-computer interaction technologies for welfare (Neethirajan et al., 2024). Furthermore, new technologies such as satellite systems, remote sensing, and drones provide farmers the power to gather data about monitoring, forecasting, and production prediction (Cordero & Park, 2023).

**4.3.2. Biosecurity Measures and Health Management**

Effective biosecurity measures and health management practices are increasingly crucial in livestock production systems, serving as vital protections against disease outbreaks and ensuring animal welfare. Although these measures were initially developed for pigs and broilers, they are now also applicable to layers, swine, and cattle (including beef, dairy, and

veal). In the Philippines, broiler farms have already implemented biosecurity measures; however, areas that received low scores require prioritization for improvement and upgrading (Tanquilut et al., 2020). This study highlights the importance of the first quantitative evaluation of biosecurity in Philippine broiler farms, as high biosecurity levels are indicative of stronger defense against disease invasion (Tanquilut et al., 2020). The proper application of biosecurity in health services demonstrably reduces animal morbidity and mortality.Modern biosecurity strategies leverage technology as a powerful tool for controlling animal diseases and enhancing agricultural output. Digital technologies support comprehensive disease control strategies by promoting good biosecurity practices across the entire value chain. This approach helps improve economic efficiency and governance, enables multi-disease strategies, and strengthens food safety controls, thereby advancing the holistic concept of One Health (Indrawan et al., 2023). These technologies facilitate the gathering and analysis of data, enabling more precise monitoring of health parameters and early identification of potential disease hazards.The application of sensible biosecurity policies must consider the inherent complexity and variety of cattle production systems. Organizational frameworks need to account for numerous elements, including the coexistence of different production systems within the same rural area (e.g., indoor and outdoor systems), diverse farmer strategies (e.g., choosing to live with pathogens versus eradicating them), insights from health data (including interactions with wildlife), and both technical innovations (like precision livestock farming) and organizational innovations (such as farmer networks) (Ducrot et al., 2024). Integrated strategies that merge conventional biosecurity protocols with innovative technologies are progressively being adopted in livestock production management. This integration creates multi-layered defensive mechanisms against infections while simultaneously enhancing production efficiency and promoting animal welfare. The advancement of digital technologies in biosecurity and health management offers significant opportunities to improve the resilience and sustainability of livestock production systems, enabling them to better confront disease challenges and meet increasing consumer demands for food safety and animal welfare.

**4.3.3. Expanding Market Opportunities**

Digital technology integration into livestock production systems is creating unprecedented opportunities for market expansion and value creation. Innovations in digital agriculture facilitate the development of more diverse and equitable supply chains, enable heightened monetization of the content of animal product attributes, and foster more responsive management systems capable of effectively meeting evolving consumer demands and environmental challenges. As products move through the food chain, low-cost, high-precision sensors provide abundant data about animals, their surroundings, and products, presenting opportunities for product differentiation and targeted marketing techniques (Baker et al., 2022).Improving supply chains, refining market infrastructure, and supporting value-added goods will significantly enhance the sector's competitiveness (Duong et al., 2024; Taer & Taer, 2024). In the Philippines, where smallholder farming groups are prevalent, the application of creative agricultural methods shows enormous potential to improve production processes and support rural livelihoods. New market prospects can arise from enhanced supply chain logistics, higher product quality and homogeneity, and better monitoring and control of environmental conditions. Realizing these benefits, however, requires strong cooperation among all

stakeholders: researchers, technology companies, policymakers, and farmers. To encourage smallholder farmers to capitalize on this growing market opportunity, it is essential to develop accessible and reasonably priced technologies, coupled with improved rural infrastructure, enhanced farmer digital literacy, and the establishment of an enabling policy environment (Taer et al., 2025).The ideal outcome of introducing digital technology across livestock systems is a significant diversification of supply chains and improved monetization of product quality attributes. The use of digital technologies enables better tracking and easy verification of product quality, allowing manufacturers to increasingly tailor products to specific consumer demands and command premiums for proven quality features. These innovations foster Market structures that are stronger and highly adaptable to both consumer preferences and environmental conditions are essential (Baker et al., 2022).

**4.3.4. International Cooperation and Support Frameworks**

International collaboration is recognized as essential for successful livestock systems, particularly in the context of developing countries striving to adopt modern production practices. Research and extension centers play crucial roles by communicating new knowledge to farmers regarding technical innovations and efficient management practices that can lead to improved productivity and sustainability of animal operations (Rohaeni et al., 2024). The linkages between these organizations and farmers create a channel for knowledge sharing that facilitates the rapid uptake of improved technologies in breeding, feeding, reproduction, disease control, and housing.Cooperation has also expanded institutionally through farmer cooperatives, which have proven effective in managing systems as farmers frequently exchange information and knowledge collectively. When farmers work together and cooperate with institutions and customers, they can significantly reduce the costs associated with production, processing, and distribution infrastructure (Rohaeni et al., 2024). These cooperative ventures are particularly beneficial to smallholder farmers who may lack the individual resources to invest in new technologies or access larger markets.International organizations like the Food and Agriculture Organization (FAO), KOICA, USAID, and other NGOs supported the Philippines. International and regional/local private organizations have integral roles to play to promote development of the livestock sector through research, funds, and capacity-building programs. They promote the dissemination of knowledge across international boundaries so that lower-income countries can benefit from technological breakthroughs made elsewhere. As there are global issues affecting the livestock industry, such as environmental sustainability, food security, and animal welfare, the contributions are crucial (Kimutai, 2024).To modernize the industry, heavy investment is necessary in innovation and new techniques, which can be advanced through strategic partnership models. These systems could help farmers to perform the management and organizational tasks indispensable to the adoption of new technologies. With proper support, investments in modernization can boost farmers market exposure and rewards, fostering a virtuous circle for innovation and improvement in the livestock industry.Multistakeholder partnerships and collaborative efforts between farmers, the national agricultural research systems, government departments, and international organizations are essential if global livestock production is to meet these complex challenges. These stakeholders can achieve total solutions through combining efforts, exchanging information, and working in convergence to meet sustainable

livestock production and demand for animal products (Kimutai, 2024). This holistic approach to international cooperation will act as a basis for further developments in the livestock sector for producers, consumers, and the environment alike.

### 4.4. Sustainable Growth Strategies

Sustainability is an important priority of the Philippine livestock sector, where a significant emphasis is now being made to minimize the sector's carbon footprint by encouraging eco-friendly feeding practices. Low-carbon technologies, e.g., biogas digesters and low-protein feed formulations, can decrease GHG emissions by 31.93% with respect to non-carbon emission systems, according to a study on swine production (Demafelis et al., 2023). These technologies also provide financial benefits, such as greater return on investment (ROI) and shorter payback periods.Sustainable growth in the Philippine livestock subsector will require coordinated interventions that not only address the constraints that currently inhibit competitiveness but also set the subsector on a solid foundation for the future. Strengthening animal health systems is a fundamental approach, as disease control is a primary bottleneck to livestock productivity (Bessell et al., 2023; Thornton et al., 2010).

#### 4.4.1. Promoting Technological Adoption and Addressing the Digital Divide

To ensure wider adoption of digital technology, it is essential to provide cost-efficient and user-friendly solutions, strengthen rural infrastructure, and enhance the digital competence of farmers (Taer & Taer, 2025; Roca et al., 2024). The government's policies and incentives can play a significant role in promoting precision farming and IoT applications (Taer & Taer, 2025). Overcoming the digital divide is crucial for democratizing access to digital technologies. Enabling smallholder farmers to access digital agriculture tools can be one of the village-level strategies, such as community organizing, rental markets, and investments in rural connectivity (Briones et al., 2023).The digitalization of the animal husbandry industry is a chance to grow it sustainably in the Philippines. Digital animal science, such as precision livestock farming (PLF) and information and communications technology (ICT), will be the next generation megatrend strategy, including big data, the Internet of Things (IoT), wireless biosensors, artificial intelligence, and automation (Cordero & Park, 2023). These innovations provide new and groundbreaking solutions to climate change problems, as well as improvements in feeding management, ventilation, and animal welfare with an overall superior livestock production. Digital systems allow operators to access them through smartphones or computers with an integrated air cleaning function that helps remove dust, ammonia, and odor to provide a more comfortable environment for animals and target the mitigation of harmful environmental side effects (Cordero & Park, 2023).

#### 4.4.2. Enhancing Market Access and Infrastructure

Expansion of market accessibility and infrastructure is fundamental to resolving problems related to production and marketing. Access to markets and non-state market regulations can reduce food insecurity and improve livelihoods in support of smallholder farmers (Duong et al., 2024). Livestock policy should focus on value addition and infrastructure support, including cold storage, processing centers, and market linkages, which are vital for enabling farmers to improve their production and access high-value markets. Moreover, focused assistance for collective marketing initiatives, farmer cooperatives, and business development services could augment the negotiating strength of smallholder farmers, enabling them to

secure improved pricing for their animal goods (Habimana, 2024). Such initiatives are particularly pertinent for rural producers who frequently encounter high transaction costs that hinder market participation, inadequate infrastructure, and unfavorable negotiating positions.

#### 4.4.3. Promoting Sustainable Practices

The integration of sustainable livestock production practices is an important tool to secure the growth of the Philippine livestock industry over the long term. Key methods recommended include the implementation of best practices such as precision agriculture, integrated pest management (IPM), organic farming, rotational grazing, and diverse cropping systems, all of which can enhance productivity while contributing to environmental conservation (Smith, 2024).Technology solutions are crucial in driving sustainable practices in the livestock sector. The combining of intelligent technologies will provide transformative pathways for the development of more efficient, humane, and environmentally sustainable livestock production systems (Vlaicu et al., 2024). These precise technologies optimize input application, decrease water consumption in cattle, and enhance renewable energy systems; collectively, they mitigate waste and diminish the environmental effect of the livestock sector (Vlaicu et al., 2024).Investment in research and innovation will be crucial in the move towards these sustainable systems to develop technologies that enhance feed efficiency, lower methane output, and optimize waste management (Smith, 2024). Education and capacity building for farmers to facilitate the adoption of these practices will also be key components, facilitated by enabling policy frameworks and financial mechanisms, which reward eco-efficient stewardship of the environment along the livestock value chain (Smith, 2024).

#### 4.4.4. Strengthening Policy and Institutional Support

Institutional and government support is a key factor for the sustainable development of the Philippine livestock industry. Targeted research and development (R&D) funding, technology transfer policies, and regulation permitting flexible incorporation of new technologies should focus on animal production policies towards innovation and adoption of technology (Habimana, 2024). While maintaining the dynamism of corporate innovation, intergovernmental processes must be coordinated to guarantee clarity, scientific integrity, and public safety. Reducing capital costs, which are rather high for the introduction of biotechnological tools, will depend critically on economic incentives, including grants and tax rebates; these will be even more burdensome to small and medium-scale farmers (Kimutai, 2024).Government can support the move away from environmentally damaging and economically marginal livestock production for smallholder farmers with enlightened policy. This high-precision technology will help the livestock industry become greener, as environmental impact and waste are suppressed. Having appropriate legislative environments allows the government to accelerate its transition to a sustainable livestock system and to ensure the economic viability of the production.It is essential that appropriate policy settings and institutional support are in place to manage livestock sector challenges. These challenges include modernization projects, localized capacity building, and collaboration between industry and academe to foster innovation and technology transfer (Taer & Taer, 2024; Taer & Taer, 2024; Cordero & Park, 2023).

## 5. Conclusions

The Philippine livestock sector is crucial in ensuring the economic sustainability of the country, rural livelihoods, and food security, and the industry is seen as having the potential to generate

substantial growth. The standing of the livestock sector is primarily determined by the production volume in metric tons of meat, eggs, and milk, which is distributed among species such as hogs, chickens, cattle, and carabaos; statistics are periodically updated by the PSA, farm gate prices indicate profit, and the animal inventory reflects the stock on hand. The BAI also monitors key indicators, including mortality rates and adherence to GAHPs, to provide a comprehensive assessment of the sector's health and the economic viability of operations. However, sustainable development is required to address the main bottlenecks in the Philippine livestock industry, which includes the prevalence of high-cost diseases, constraints on market access, environmental degradation, and low production efficiency. Sustainable approaches, such as value chain development and eco-friendly approaches, are imperative for the long-term survival of the industry. There is a need for policymakers, farmers, academics, and the digital businesses to work together to improve productivity and sustainability. The sector can fulfill aspirations and play a significant role in national development by adopting technology and digital solutions, fostering international collaboration, and nurturing responsible and sustainable business practices.

### 5.1 Future Directions

A systems approach supported by the indicative list of priority recommendations is necessary to improve the sustainability and efficiency of the Philippine livestock industry. Key to this strategy is the promotion of mixed agriculture, which aims at maximizing resource use and at the same time minimizing any disease occurrence, as well as focusing on the breeding and conservation of native breeds and genetic resources in partnership with the DA, concerned agencies, and State Universities and Colleges (SUCs). Also, increasing quality forages through researching drought-tolerant forage alternatives and improved management training is crucial. Enhancing market access through strengthening capacities, cold chain infrastructure, and value addition, and increasing exports to comply with international quality standards will also be key. Finally, the adoption of climate-smart practices, including better manure management, agroforestry, and renewable energy options, will greatly improve resilience. These strategies aim to change smallholder farming into a more productive, resilient, and environmentally friendly sector by working together with local and international partners, connecting government, schools, and businesses, and actively participating in private discussions through DA-PCAF, while also supporting current livestock plans and biosecurity rules. Future research and development should focus on solving global challenges, reconciling economic and ecological goals, and adopting smart farming tools such as artificial intelligence, blockchain, and big data, as these advancements will enable the establishment of climate-resilient structures and systems, setting the sector on a path to become competitive, productive, and a major contributor to 21st-century solutions for food security, environmental sustainability, and rural development.

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