



Strengthening Sustainability-Based Policies for the Protection and Conservation of Livestock Genetic Resources in Bali Province

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ABSTRACT

Livestock genetic resources represent a critical component of biodiversity conservation, food security, and socio-cultural sustainability in Indonesia, particularly in Bali Province, where indigenous livestock breeds are deeply embedded in local traditions and livelihoods. This study examines sustainability-based policy frameworks for the protection and conservation of livestock genetic resources in Bali Province. A qualitative research approach was applied, integrating policy document analysis, in-depth interviews, field observations, and stakeholder surveys. Force Field Analysis was employed to evaluate the balance between driving and inhibiting factors influencing policy effectiveness. The results show that the cumulative strength of driving forces (3.832) exceeds inhibiting forces (3.333), indicating a potential reinforcement zone for conservation policy. Socio-cultural values and regulatory availability support conservation efforts, while weak genetically specific regulations, land constraints, and market dominance of hybrid breeds remain significant challenges

INTRODUCTION

Livestock genetic resources represent a strategic foundation for sustainable agricultural development, food security, and rural economic resilience. Indigenous livestock breeds embody adaptive genetic traits shaped by long-term interactions between biological, environmental, and socio-cultural systems. Increasing pressures from land conversion, climate change, genetic dilution, and market-oriented production systems have accelerated the erosion of local genetic diversity, thereby threatening the sustainability of livestock-based livelihoods. Sustainability-based policy frameworks are therefore essential to ensure that protection and conservation efforts are aligned with environmental integrity, economic viability, and social equity (Ciptadi et al., 2023; Yasminingrum, 2023).

Indonesia possesses substantial livestock genetic diversity that plays a critical role in supporting adaptive and resilient farming systems. Local livestock breeds have demonstrated superior performance under low-input conditions and in environments with environmental stress, making them highly relevant in the context of climate change and sustainable development (Desheri, 2020; Widiawati et al., 2023). Bali cattle are among the most prominent indigenous genetic resources, recognized for their adaptability, reproductive efficiency, and contribution to rural livelihoods. Policy and institutional constraints, however, continue to undermine the long-term sustainability of Bali cattle populations, particularly in relation to breeding management, land-use dynamics, and limited policy integration across sectors (Abadi et al., 2025; Widiarta et al., 2021).

Bali Province presents a distinctive case in livestock genetic resource conservation, given the strong interconnection among agriculture, cultural heritage, and regional development priorities. Conservation initiatives targeting endemic livestock, including White Taro cattle, illustrate localized efforts to safeguard genetic resources through community participation and traditional management systems (Suarna et al., 2017). Fragmentation of policy instruments and limited alignment with sustainability principles remain persistent challenges, resulting in suboptimal conservation outcomes. Evidence from broader genetic resource conservation studies suggests that ecosystem-based and sustainability-oriented policy approaches are more effective at balancing protection and utilization objectives (Apriliana et al., 2025; Nuraini et al., 2022). Policy coherence and governance integration constitute critical determinants of successful genetic resource conservation. Legal frameworks, environmental management strategies, and local knowledge systems require systematic integration to ensure policy effectiveness and long-term sustainability. Previous studies emphasize that conservation policies embedded within sustainable development agendas, including circular economy principles and community empowerment strategies, are more likely to generate durable socio-economic and environmental benefits (Indrayati et al., 2021; Azzara et al., 2025). Sustainable livestock development models incorporating circular business practices and environmentally responsible waste management have demonstrated potential to strengthen rural economies while reducing ecological pressures (Widiarta et al., 2025a; Widiarta et al., 2025b).

Empirical research examining the strengthening of sustainability-based policies for livestock genetic resource conservation at the provincial level remains limited. Existing studies in Bali Province predominantly emphasize technical, managerial, and community-based dimensions of livestock development, with insufficient attention to policy integration and governance effectiveness. Analytical gaps persist in aligning conservation objectives with regional development strategies and sustainability principles. This study aims to analyze and formulate strategies for strengthening sustainability-based policies for the protection and conservation of livestock genetic resources in Bali Province. The analysis integrates environmental, socio-economic, and governance perspectives to support evidence-based policy development that ensures the long-term conservation and sustainable utilization of indigenous livestock genetic resources.

LITERATURE RIVIEW

Sustainability-Based Policy Theory

Sustainability-Based Policy Theory emphasizes integrating environmental protection, economic viability, and social equity into public policy formulation and implementation. Policy effectiveness under this framework is assessed based on its capacity to balance resource conservation with long-term development objectives. Sustainable policies are expected to generate adaptive governance mechanisms that respond to ecological constraints while ensuring livelihood security and institutional resilience. In the context of livestock genetic resource conservation, sustainability-based policies function as regulatory and incentive-based instruments that align conservation goals with productive and socio-economic outcomes (Ciptadi et al., 2023; Yasminingrum, 2023).

Empirical studies indicate that sustainability-oriented policies contribute positively to biodiversity conservation when institutional coordination and stakeholder participation are adequately integrated. Conservation outcomes tend to be suboptimal when policies focus solely on protection without addressing economic incentives for local communities. Evidence from livestock and agricultural systems suggests that sustainability-based governance enhances conservation performance by internalizing environmental values into development planning and rural economic systems (Indrayati et al., 2021; Azzara et al., 2025).

H1: Sustainability-based policies have a positive and significant effect on the protection and conservation of livestock genetic resources in Bali Province.

Community-Based Resource Management Theory

Community-Based Resource Management Theory posits that local communities play a central role in the sustainable management and conservation of natural and genetic resources. The theory highlights the importance of local knowledge, customary institutions, and participatory governance in ensuring effective conservation outcomes. Community engagement enhances compliance, reduces enforcement costs, and strengthens the social legitimacy of conservation policies. In livestock genetic resource management, farmer participation is

critical for maintaining breeding purity, adaptive traits, and population sustainability (Suarna et al., 2017; Abadi et al., 2025).

Previous empirical findings demonstrate that conservation initiatives involving livestock keepers and rural communities achieve higher levels of sustainability compared to top-down regulatory approaches. Community-based conservation has been shown to strengthen local ownership, improve genetic resource monitoring, and support intergenerational knowledge transfer. Conversely, weak community involvement often leads to policy resistance and ineffective implementation (Desheri, 2020; Dewi et al., 2023).

H2: Community-based management positively and significantly influences the effectiveness of livestock genetic resource conservation policies in Bali Province.

Circular Economy and Sustainable Livestock Development Theory

Circular Economy Theory in agriculture emphasizes resource efficiency, waste minimization, and value creation through closed-loop production systems. Sustainable livestock development under this framework integrates environmental management with economic productivity by transforming livestock waste into valuable inputs, thereby reducing ecological pressure and improving farm profitability. Circular approaches enhance the economic incentives for farmers to engage in conservation-oriented practices, indirectly supporting the sustainability of local livestock genetic resources (Azzara et al., 2025; Widiarta et al., 2025a).

Studies in livestock systems indicate that circular economy practices strengthen the economic foundation of smallholder farming while contributing to environmental sustainability. Integration of circular business models has been associated with increased adoption of sustainable breeding and management practices. Limited adoption of circular approaches has been linked to weak policy support and insufficient institutional facilitation (Widiarta et al., 2025b).

H3: Circular economy-based livestock management positively and significantly strengthens the conservation of livestock genetic resources in Bali Province.

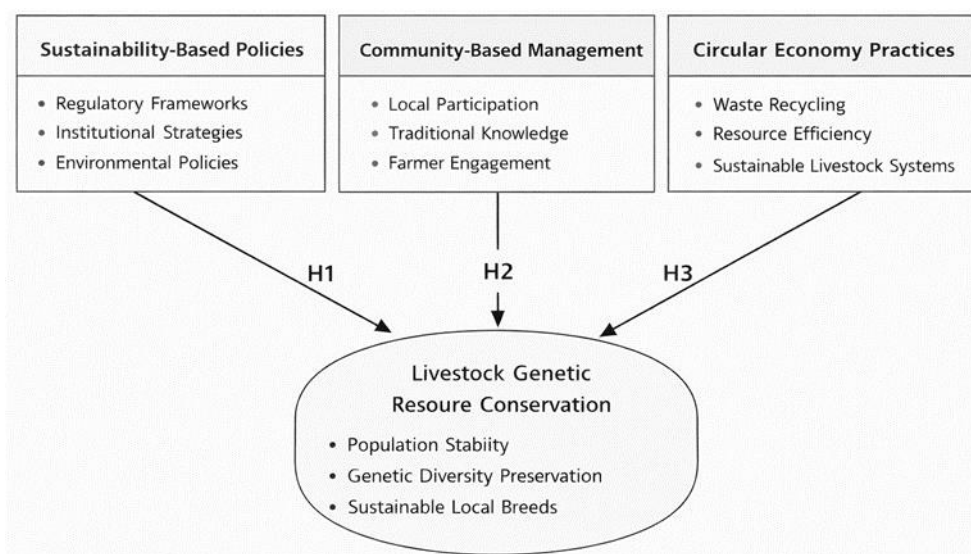


Figure 1. Conceptual Framework

METHODOLOGY

This study employed a qualitative research approach to examine sustainability-based policies for the protection and conservation of livestock genetic resources in Bali Province. The research was conducted across several regencies to capture diverse policy contexts, institutional dynamics, and community perspectives related to livestock genetic resource management. The qualitative approach was selected to enable an in-depth understanding of policy processes, stakeholder interactions, and governance mechanisms underlying conservation practices.

The study utilized a survey method complemented by secondary data collection and document analysis. Secondary data were obtained from relevant governmental agencies and institutions responsible for livestock development, environmental management, and genetic resource conservation. Document analysis was conducted on policy regulations, strategic plans, and official reports to identify policy orientations, regulatory frameworks, and implementation gaps. Primary data were collected through in-depth interviews and field observations to enrich the analysis and validate documentary evidence.

The target population consisted of senior officials from relevant governmental institutions and community leaders with direct involvement in or influence over livestock genetic resource protection. The sampling technique applied was non-probability sampling, specifically purposive sampling, to ensure the inclusion of informants with substantive knowledge and decision-making authority in the policy domain under study.

Policy research inherently draws upon multiple data sources and methodological instruments to generate comprehensive and reliable insights. Data integration in this study was organized within a systemic analytical framework derived from theoretical and empirical literature on sustainability-based policy and genetic resource conservation. The collected data served as the empirical basis for formulating alternative policy recommendations to strengthen conservation outcomes.

Data validity and reliability were ensured through methodological triangulation across interviews, observations, surveys, and document analysis. This triangulation approach facilitated cross-verification of information and enhanced the credibility of research findings. The combination of multiple data collection techniques provided a holistic understanding of policy implementation, stakeholder roles, and institutional challenges in the conservation of livestock genetic resources in Bali Province.

RESULT AND DISCUSSION

Condition of Local Livestock Genetic Resources in Bali Province

The results of this study indicate that Bali Province possesses a high diversity of local livestock genetic resources with strategic value from genetic, socio-cultural, and economic perspectives. Local livestock genetic resources function not only as biological assets but also as foundations for food security, cultural identity, and sustainable livestock development. Within the sustainability framework, these resources play a crucial role in maintaining ecosystem stability, enhancing adaptability to environmental change, and supporting resilient smallholder livestock systems (Ciptadi et al., 2023; Triwanto, 2024).

Field identification, combined with analysis of regional policy documents, reveals that several local livestock genetic resources in Bali are currently categorized as vulnerable to critically endangered. Anthropogenic pressures, particularly land-use conversion, production intensification, and the dominance of imported or improved breeds, have significantly accelerated genetic erosion. These findings are consistent with studies conducted in other regions of Indonesia, which demonstrate that production-oriented livestock development without integrated conservation strategies results in the systematic degradation of local genetic resources (Desheri, 2020; Nuraini et al., 2022; Sutriana, 2025).

Table 1. Status And Key Issues of Local Livestock Genetic Resources in Bali Province

Livestock Resource	Genetic	Sustainability Status	Main Issues
Bali Cattle		Genetically vulnerable	Genetic degradation due to uncontrolled crossbreeding
White Taro Cattle		Critical	Extremely limited population and weak policy support
Gembrong Goat		Critically endangered	Population fewer than 15 individuals in native habitat
Bali Pig		Under pressure	Genetic upgrading with imported pig breeds
Bali Duck		Declining	Land-use conversion and competition with hybrid ducks
Bali Local Chicken		Genetically degraded	Crossbreeding with commercial improved breeds

Bali cattle represent a nationally important genetic resource characterized by high adaptability and reproductive efficiency. However, the study demonstrates that the primary threat to Bali cattle is not population decline but genetic dilution resulting from uncontrolled crossbreeding practices. This process gradually undermines the distinctive genetic traits that enable Bali cattle to thrive under marginal conditions and compromises their long-term sustainability (Abadi et al., 2025; Widiarta et al., 2021).

More alarming conditions are observed in White Taro cattle and Gembrong goats. Their minimal populations, habitat isolation, and limited institutional and policy support have placed these genetic resources in a critical

conservation category. These findings reinforce the urgency of implementing location-based conservation strategies and strengthening legal and institutional frameworks to protect endemic livestock genetic resources, as emphasized in ecosystem-based conservation and local wisdom-oriented studies (Suarna et al., 2017; Isnandar et al., 2021; Apriliana et al., 2025).

Non-ruminant local livestock, including Bali pigs, Bali ducks, and Bali local chickens, face substantial pressure from intensive production systems and market preferences favoring fast-growing hybrid or imported breeds. Unregulated genetic upgrading and crossbreeding practices have resulted in the gradual loss of phenotypic and genetic distinctiveness. Similar patterns have been reported in the management of local genetic resources across Indonesia, where short-term economic considerations often outweigh long-term sustainability concerns (Edorita & Zulwisman, 2021; Susanto, 2020; Yasminingrum, 2023).

The findings confirm that the principal threat to local livestock genetic resources in Bali Province is not species extinction per se, but rather genetic erosion and the loss of genetic authenticity. This condition is exacerbated by weak integration between conservation policies, livestock development planning, spatial governance, and local economic systems. Without strengthened sustainability-based policy frameworks and ecosystem-oriented management approaches, Bali's local livestock genetic resources risk losing their strategic value as genetic capital, cultural heritage, and drivers of sustainable regional development (Indrayati et al., 2021; Dewi et al., 2023; Panga et al., 2025).

Policy Framework for the Protection of Livestock Genetic Resources

Document analysis demonstrates that a multilayered regulatory framework at the international, national, and regional levels formally supports the protection of livestock genetic resources in Bali Province. The Convention on Biological Diversity, ratified through national legislation, provides the primary normative foundation for biodiversity conservation, including genetic resources, and is further reinforced by national laws governing conservation, livestock development, and environmental protection. Alignment with global sustainable development commitments is reflected in national policies that integrate biodiversity conservation into the Sustainable Development Goals agenda, thereby positioning genetic resource protection as part of long-term development objectives (Ciptadi et al., 2023; Indrayati et al., 2021; Yasminingrum, 2023).

Empirical evidence from interviews and field observations, however, reveals a persistent gap between policy norms and operational implementation at the local level. Regional regulations in Bali, including the governor's and provincial bylaws, emphasize the preservation of local biological resources and spatial planning to support ecological sustainability. These instruments provide an important legal basis for conserving local livestock genetic resources, particularly those closely linked to Balinese culture and traditional production systems. Practical implementation remains limited by the absence of specific operational guidelines, dedicated conservation programs, and measurable performance indicators focused explicitly on livestock genetic resources, rather than biodiversity in general (Dewi et al., 2023; Isnandar et al., 2021).

Table 2 summarizes the principal regulatory instruments governing livestock genetic resource protection in Bali Province and highlights their respective policy focus areas. The table illustrates that existing regulations tend to address conservation in a broad sense, with livestock genetic resources embedded implicitly within wider environmental, spatial, and agricultural policy frameworks. Fragmentation across sectors and administrative levels reduces policy coherence and weakens institutional coordination, particularly in translating conservation mandates into concrete breeding control, population management, and genetic monitoring mechanisms (Abadi et al., 2025; Panga et al., 2025).

Table 2. Main Regulatory Framework for the Protection of Livestock Genetic Resources in Bali Province

Regulatory Level	Policy Instrument	Regulatory Focus	Implications for Livestock Genetic Resources
International	United Nations Convention on Biological Diversity (UNCBD)	Biodiversity conservation and sustainable use of genetic resources	Provides global legal and normative foundation for livestock genetic resource protection
National	Law No. 5/1990 on Conservation of Living Natural Resources and Ecosystems	Conservation of biodiversity and ecosystems	Establishes national legal basis for protection of animal genetic diversity
National	Law No. 41/2014 amending Law No. 18/2009 on Livestock and Animal Health	Livestock development and animal health management	Regulates livestock systems but lacks specific operational mechanisms for genetic conservation
National	Presidential Regulation No. 111/2022 on the Implementation of SDGs	Integration of sustainable development goals	Aligns livestock genetic conservation with national sustainability targets
Regional (Province)	Bali Governor Regulation No. 29/2020 on Preservation of Local Biological Resources	Protection of local biological and genetic resources	Supports conservation of culturally significant local livestock breeds
Regional (Province)	Bali Provincial Regulation No. 8/2015 on Provincial Spatial Planning and Zoning	Spatial planning and land-use regulation	Indirectly safeguards grazing areas and habitats essential for local livestock

Field-based findings further indicate that competing development priorities, including land-use change, tourism expansion, and agricultural intensification, influence policy implementation. These pressures often override conservation considerations, resulting in limited enforcement of genetic

protection measures and insufficient incentives for farmers to maintain local breeds. Similar implementation challenges have been reported in other regions, where weak integration between conservation policy and local economic systems constrains the effectiveness of genetic resource protection (Edorita & Zulwisman, 2021; Susanto, 2020).

The empirical findings confirm that the policy framework for protecting livestock genetic resources in Bali Province is normatively adequate but operationally fragmented. Strengthening policy integration across governance levels, clarifying institutional roles, and embedding livestock genetic conservation within sustainable rural development and circular economy approaches are critical to improving policy effectiveness. Such integration would enhance policy responsiveness to local socio-cultural contexts while ensuring the long-term sustainability of Bali's unique livestock genetic resources (Apriliana et al., 2025; Widiarta et al., 2021; Widiarta et al., 2025).

Driving and Inhibiting Factors in the Conservation of Livestock Genetic Resources

Results of the Force Field Analysis indicate that the sustainability of livestock genetic resource conservation in Bali Province is shaped by the interaction between reinforcing socio-institutional forces and constraining structural-economic pressures. Four dominant driving factors were identified, as summarized in Table 3, with a total driving force score of 3.832. This relatively high cumulative score reflects strong endogenous capacities that can be strategically leveraged to support conservation-oriented policies.

Table 3. Driving Factors for the Conservation of Livestock Genetic Resources in Bali Province

Code	Driving Factors	Score
D1	Availability of regulatory instruments for livestock genetic resource protection	1.053
D2	Local wisdom and Balinese customary culture supporting livestock conservation	1.053
D3	Community preference for local livestock products	0.674
D4	Traditional livestock attractions (makepung, gerumbungan)	1.053
Total Driving Force		3.832

The availability of regulatory instruments for genetic resource protection is a key institutional driver. Although existing regulations are not yet fully specific to livestock genetic conservation, their presence provides a legal and normative foundation for conservation initiatives. Regulatory support plays a critical role in legitimizing conservation actions and encouraging stakeholder compliance, particularly when aligned with sustainable livestock development strategies (Abadi et al., 2025; Dewi et al., 2023). Regulatory frameworks also serve as an entry point for integrating livestock genetic conservation into broader environmental and agricultural governance systems (Indrayati et al., 2021; Yasminingrum, 2023).

Local wisdom and Balinese customary culture emerge as an equally strong driving factors, as indicated by the identical score shown in Table 3. Traditional

values embedded in adat institutions, ritual practices, and communal norms have historically contributed to the preservation of local livestock breeds as cultural assets rather than purely economic commodities. This socio-cultural embeddedness strengthens community-based conservation and aligns with ecosystem-based and participatory conservation approaches documented in other genetic resource contexts (Apriliana et al., 2025; Isnandar et al., 2021). Cultural attachment to local breeds also reinforces intergenerational transmission of conservation practices and enhances social legitimacy.

Community preference for local livestock products represents an important, albeit relatively weaker, market-based driver. Demand for local breeds such as Bali pigs and indigenous chickens is closely linked to culinary traditions and religious ceremonies, thereby sustaining the continuity of breeding. Similar dynamics have been reported in studies on local commodity-based economic development, where consumer loyalty to indigenous products contributes to resource sustainability (Susanto, 2020; Kariasa et al., 2023). Traditional livestock attractions, including *makepung* and *gerumbungan*, further strengthen conservation incentives by integrating livestock genetic resources into cultural tourism and local identity formation (Suarna et al., 2017). Conversely, the analysis also identifies significant inhibiting factors, with a total restraining force score of 3.333, as presented in Table 4. These inhibiting factors primarily reflect structural and economic constraints that weaken policy implementation and conservation effectiveness.

Table 4. Inhibiting Factors for the Conservation of Livestock Genetic Resources in Bali Province

Code	Inhibiting Factors	Score
R1	Weak legal protection for genetic integrity of local livestock	1.333
R2	Market dominance of hybrid livestock breeds	0.333
R3	Limited land availability and feed resources	1.333
R4	Animal welfare constraints on traditional livestock attractions	0.333
Total Restraining Force		3.333

Weak legal protection specifically addressing livestock genetic integrity constitutes the most prominent barrier. Existing regulations tend to emphasize general conservation objectives or livestock productivity, leaving genetic purity and breed protection insufficiently regulated. Comparable legal gaps have been documented in other regions, resulting in accelerated genetic erosion driven by unregulated crossbreeding practices (Desheri, 2020; Edorita & Zulwisman, 2021). Market dominance of hybrid livestock breeds further constrains conservation efforts by displacing local genetic resources within production systems and market chains. This condition reflects broader structural challenges in aligning conservation objectives with short-term economic incentives, as highlighted in studies on sustainable livestock systems and agribusiness development (Panga et al., 2025; Widiarta et al., 2021). Land and feed constraints exacerbate these challenges, particularly for smallholder farmers affected by land-use conversion and shrinking grazing areas, consistent with broader findings on environmental degradation and agricultural sustainability (Ciptadi et al., 2023; Triwanto, 2024).

Additionally, implementing animal welfare standards in traditional livestock attractions creates regulatory and ethical dilemmas that may restrict cultural practices if not addressed through adaptive, context-sensitive policy instruments (Widiawati et al., 2023).

The balance between driving and inhibiting factors demonstrates that conservation of livestock genetic resources in Bali Province remains feasible but institutionally fragile. Strengthening policy specificity, enhancing economic incentives for local breeds, and formally integrating socio-cultural drivers into governance frameworks are essential to tipping the balance toward sustainable conservation. Integrating these drivers into circular economy and community empowerment approaches is expected to further enhance resilience and ensure the long-term viability of Bali's local livestock genetic resources (Azzara et al., 2025; Widiarta et al., 2025).

Force Field Analysis and Policy Implications

The Force Field Analysis (FFA) provides an integrative assessment of the balance between driving and inhibiting forces shaping the conservation of livestock genetic resources in Bali Province. As illustrated in Figure 1, the cumulative strength of driving factors (3.832) exceeds that of inhibiting factors (3.333), indicating that the current policy context lies within a potential reinforcement zone rather than a policy crisis condition. This finding suggests that existing socio-institutional and cultural capacities remain sufficiently strong to support conservation initiatives, provided that policy interventions are appropriately targeted and operationalized (Abadi et al., 2025; Widiarta et al., 2021).

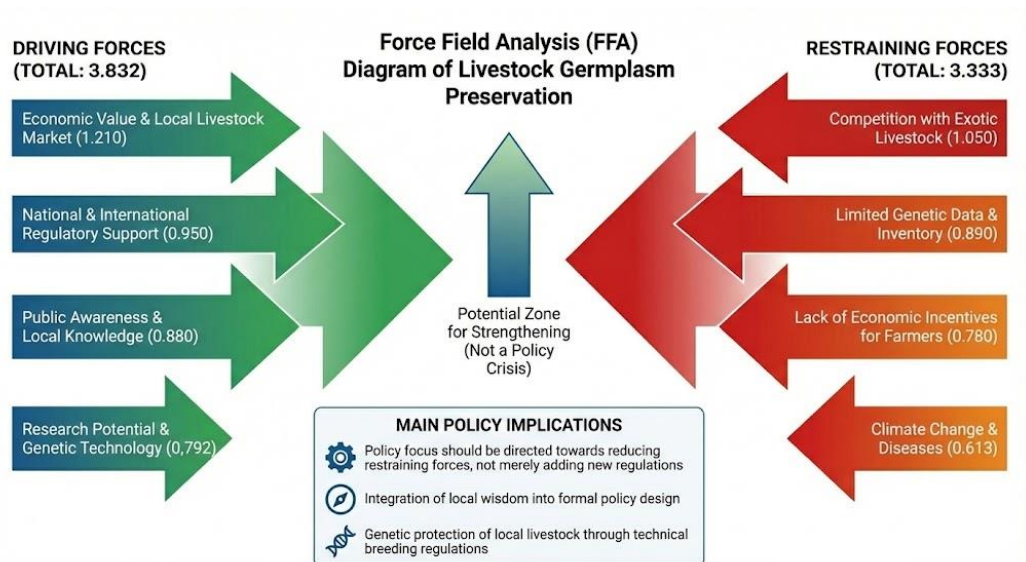


Figure 1. Force Field Analysis (FFA) Diagram of Livestock Genetic Resource Conservation

The predominance of driving forces reflects the synergistic role of regulatory legitimacy, socio-cultural attachment to local livestock breeds, and the integration of traditional practices within local economic and cultural systems. Regulatory availability, although not yet fully specific to genetic conservation, provides a foundational legal framework that legitimizes conservation actions and aligns them with sustainable livestock development agendas (Dewi et al., 2023; Indrayati et al., 2021). At the same time, the strong influence of local wisdom and customary institutions underscores the importance of culturally embedded conservation mechanisms, which have been widely recognized as effective in sustaining genetic resources through community-based and participatory approaches (Apriliana et al., 2025; Isnandar et al., 2021).

Despite this favorable configuration, the relatively narrow margin between driving and inhibiting forces indicates a fragile equilibrium. Structural and economic constraints, such as weak genetically specific legal protection, land-use pressures, and the market dominance of hybrid livestock, pose persistent risks to the long-term sustainability of local genetic resources. Similar patterns have been documented in other regions, where insufficiently regulated crossbreeding and market-driven productivity imperatives accelerate genetic erosion of indigenous livestock breeds (Desheri, 2020; Panga et al., 2025).

From a policy standpoint, the key implication is that policy focus should be directed toward reducing inhibiting factors rather than merely expanding regulatory instruments. The introduction of additional regulations without strengthening enforcement capacity and aligning them with the economy may exacerbate implementation gaps. Effective policy intervention, therefore, requires improving institutional coordination, enhancing incentives for maintaining local breeds, and addressing land and feed constraints faced by smallholder farmers (Ciptadi et al., 2023; Triwanto, 2024).

Another critical implication concerns the formal integration of local wisdom into policy design. Balinese customary norms and cultural practices have historically functioned as informal governance systems that support livestock genetic conservation. Institutionalizing these mechanisms within formal policy frameworks can enhance policy legitimacy, strengthen community compliance, and reduce resistance at the implementation level (Suarna et al., 2017; Yasminingrum, 2023).

Furthermore, protecting livestock genetic integrity requires the development of technically oriented breeding regulations. Existing policies tend to emphasize general conservation and livestock productivity, while operational guidelines governing controlled breeding, genetic monitoring, and breed certification remain limited. The absence of such technical instruments increases vulnerability to uncontrolled crossbreeding and genetic dilution (Abadi et al., 2025; Widiawati et al., 2023).

The FFA results demonstrate that conservation of livestock genetic resources in Bali Province remains feasible but strategically sensitive. Strengthening policy specificity, embedding socio-cultural drivers into formal governance structures, and developing technical breeding regulations are essential to shifting the balance decisively in favor of sustainable conservation.

Integrating these measures with circular economy principles and community empowerment strategies may further enhance the resilience and long-term viability of local livestock genetic resources (Azzara et al., 2025; Widiarta et al., 2025).

CONCLUSIONS AND RECOMMENDATIONS

This study concludes that Bali Province possesses significant livestock genetic resources with high ecological, socio-cultural, and economic value; however, their sustainability is increasingly threatened by genetic erosion rather than population extinction. Existing policy frameworks at international, national, and regional levels provide normative support for conservation, yet remain operationally fragmented and insufficiently focused on genetic integrity. The Force Field Analysis demonstrates that driving forces, particularly local wisdom, cultural institutions, and regulatory legitimacy, slightly outweigh inhibiting forces, placing conservation policy within a reinforcement zone rather than a crisis condition. Nevertheless, weak, genetically specific legal instruments, land-use pressures, and the dominance of hybrid livestock systems create a fragile equilibrium that risks long-term degradation if left unaddressed.

Policy implementation should prioritize reducing structural and economic inhibiting factors rather than introducing additional general regulations. The development of technical regulations governing controlled breeding, genetic monitoring, and the certification of local livestock breeds is essential to prevent genetic dilution. Sustainability-based policies should formally integrate Balinese customary institutions and local wisdom as co-governance mechanisms to enhance legitimacy and compliance. Conservation strategies should be embedded within circular-economy and community-empowerment frameworks to strengthen economic incentives for farmers while maintaining genetic authenticity. Cross-sectoral coordination among livestock, spatial planning, tourism, and environmental agencies is necessary to ensure coherent and effective policy implementation

FURTHER STUDY

This research still has limitations so further research is needed on the topic of Strengthening Sustainability-Based Policies for the Protection and Conservation of Livestock Genetic Resources to perfect this research and increase insight for readers and authors.

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