Progressive Law Review
Volume 7 No. 1 April 2025
University of Bandar Lampung
(e-ISSN) 2716-2141, progrresivelawreview.ubl.ac.id

LEGAL FRAMEWORK FOR INTEGRATING CROP AND LIVESTOCK FARMING WITH SUSTAINABLE DEVELOPMENT IN INDONESIAN LAWS

Received: November 10, 2025 Accepted: November 15, 2025 Online Published: November 24, 2025

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Abstract: This article analyzes the legal framework governing crop-livestock integration in Indonesia and it's alignment with sustainable development principles. Although the Food Law, the Livestock and Animal Health Law, and the Evironmental Protection and Management Law recognize sustainability and the use of local resources, they don't provide operational guidance for integrating crops and livestock. The research finds regulatory fragmentation: livestock manure is legally treated as waste rather than a soil nutrient, forage production is not mandated within livestock enterprises, and extension services operate under separate sectoral structures. Comparative analysis of Malaysia, Thailand, and India demonstrates that successful integration that support nutrient cycling and smallholder autonomy. This research purposes three core elements for legal reform: recognizing livestock manure as an agricultural resource, requiring forage production plans, and unifying agricultural extension under a single village-level farming plan. Strengthening these provisions would create a cohesive legal basis for sustainable crop-livestock systems and reinforce food security for smallholder farmers.

Keywords: Environmental Protection; Integrating Crop; Legal Framework; Livestock Farming

I. INTRODUCTION

Integrating crops and livestock creates a unified production system. Crop residues become feed. Livestock manure becomes organic fertilizer. This cycle maintains soil fertility, reduces input costs, and protects environmental quality. This approach also enhances land efficiency and reduces ecological pressure. Various studies show that

crop-livestock integration supports long-term production stability through reciprocal relationships between soil, plants, and animals.[1] This system is more than just an agronomic technique; it's a strategy for building food security and sustainability at the smallholder farmer level.

Indonesia's agricultural structure is dominated by smallholder farms with limited land and small-scale livestock ownership. Traditional integration patterns have long been practiced in villages, using crop residues as feed and returning manure to the soil. However, decades of production intensification programs have encouraged a sharp separation between crop and livestock farming. Chemical fertilizers replaced organic fertilizers. Manufactured feed replaced local feed sources. These changes increased production costs and reduced soil health, especially in resource-limited areas.[2] As a result, farmers became increasingly dependent on external inputs and lost the ecological functions that had previously been built up.

Policy fragmentation reinforces this separation. Food crop policies focus on production and fertilizer availability. Livestock policies focus on animal health and food safety of animal origin. Environmental policies focus on waste management. These three policy domains operate independently. There is no legal framework that unites the functions of feed, organic fertilizer, and soil conservation. Livestock manure is more often treated as waste than as a productive resource. Faishal shows that a legal understanding that separates waste from production eliminates rural economic value.[3] Buckingham affirms that food policy needs an integrated, cross-sectoral approach for the production chain to work efficiently.[4]

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[1] Guillaume Martin, et al., 2016. *Crop-Livestock Integration Beyond the Farm Level: A Review*. Agronomy for Sustainable Development 36, no. 53, p. 1 - 21, https://doi.org/10.1007/s13593-016-0390-x.

[2] C. Devendra, 2002. *Crop–Animal Systems in Asia: Implications for Research*. Agricultural Systems 71, no. 1–2, p. 169 - 177, https://doi.org/10.1016/S0308-521X(01)00042-7.

[3] Achmad Faishal & Suprapto, 2022. *Laws and Regulations Regarding Food Waste Management as a Function of Environmental Protection in a Developing Nation.* International Journal of Criminal Justice Sciences 17, no. 2, p. 223 - 237.

[4] Donald E. Buckingham, , 1994. *A Recipe for Change: Towards an Integrated Approach to Food Under International Law*. Pace International Law Review 6, p. 285 - 321, https://doi.org/10.58948/2331-3536.1141.

Technical studies of integration have been widely proven. Devendra shows increased productivity through the integration of ruminants with annual crops.[5] Sekaran et al. emphasize strengthening household food security through local feed and organic fertilizer.[6] Shanmugam et al. link integration with increased production, family nutritional quality, and environmental sustainability.[7] In Indonesia, integration practices are seen in various regions, such as South Sulawesi, which shows increased household income.[8] Integrated systems are also proven to be more cost and labor-efficient, but adoption rates are still low due to a lack of policy incentive support.[9] Nengsi highlights the importance of policy support to strengthen integrated, village-based agro-complex systems.[10]

A research gap emerges in the legal aspects governing integration. The Food Law, the Livestock Law, and the Environmental Protection and Management Law contain ideas of sustainability but do not provide operational guidance on how integration should be implemented. Azoulai shows that integration through law requires coordinating guidelines that connect different institutions in a single direction of purpose.[11] Olawuyi emphasizes the importance of a legal framework that unites interconnected sectors so they do not work separately. Without a clear legal basis,

[5] C. Devendra, 2011. *Integrated Tree Crops-Ruminants Systems in South East Asia: Advances in Productivity Enhancement and Environmental Sustainability*. Asian-Australasian Journal of Animal Sciences 24, no. 5, p. 587 - 602, https://doi.org/10.573/ajas.2011.r.07.

[6] Udayakumar Sekaran, et al., 2021. *Role of Integrated Crop-Livestock Systems in Improving Agriculture Production and Addressing Food Security – A Review*. Journal of Agriculture and Food Research 5, p. 1 - 10, https://doi.org/10.1016/j.jafr.2021.100190.

[7] P.M. Shangunam, et al., 2024. *Crop–Livestock-Integrated Farming System: A Strategy to Achieve Synergy between Agricultural Production, Nutritional Security, and Environmental Sustainability*. Frontiers in Sustainable Food Systems 8, p. 1 - 14, https://doi.org/10.3389/fsufs.2024.1338299.

[8] Syamsu Bahar, et al., 2021. *Livelihood Impacts of the Cattle Management Practices in Mixed Crop-Livestock Farming Systems in South Sulawesi, Indonesia*. IOP Conference Series: Earth and Environmental Science, p. 1 -9, https://doi.org/10.1088/1755-1315/653/1/012005.

[9] Fanny Widadie & Agustono, , 2015. *Comparison of Integrated Crop-Livestock and Non-Integrated Farming Systems for Financial Feasibility, Technical Efficiency and Adoption (Case of Farmers in Gunung Kidul Regency, Yogyakarta, Indonesia)*. Journal of ISSAAS (International Society for Southeast Asian Agricultural Sciences) 21, no. 1, p. 31 - 45.

[10] Sri Wahyuni Nengsi, 2025. *Integration of Farming-Livestock Systems in Sustainable Agrocomplex Development in Indonesia*. Journal of Agro Complex Development Society 2, no. 1, p. 11 – 18, https://doi.org/10.62012/agrocomplex.v2i1.12.

[11] Loïc Azoulai, 2016. *'Integration through Law' and Us*. International Journal of Constitutional Law 14, no. 2, p. 449 - 463, https://doi.org/10.1093/icon/mow024.

forage programs, soil conservation, and livestock manure management do not meet at the implementation level.[12]

The impact of system separation is evident in the field. Soil loses organic matter. Local feed sources decline due to cropping patterns that do not provide biomass. Livestock waste causes water pollution. Asai et al. show that integration works effectively when there is an institutional structure that unites production actors in a single network.[13] Afandi emphasize the importance of combining local resources to strengthen input independence. This condition is relevant for millions of smallholder farm households in Indonesia who face fluctuations in input prices and output markets.[14]

This study aims to analyze the legal construction governing the integration of crop-livestock systems in Indonesian laws and regulations. The focus of the study is on identifying provisions that support, hinder, or are not yet clearly structured. The analysis is carried out to see the consistency between laws, government regulations, ministerial regulations, strategic programs of ministries, and regional policies. This study also assesses how inter-ministerial coordination takes place in practice and how this affects the implementation of integration at the smallholder farmer level.

The ultimate goal is to formulate directions for updating the legal construction that encourages crop-livestock integration as a strategy for food security and sustainable development. The research results are expected to strengthen the normative basis for low-waste food production that favors smallholder farmers.

II. RESEARCH METHODS

This research employs doctrinal legal research. The focus is on the norms, principles, and regulatory structure within the legal system. This research examines

[12] Damilola Olawuyi, 2020. *Sustainable Development and the Water-Energy-Food Nexus: Legal Challenges and Emerging Solutions*. Environmental Science and Policy 103, p. 1 - 9, https://doi.org/10.1016/j.envsci.2019.10.009.

[13] Masayasu Asai, et al., 2018. *Critical Factors for Crop-Livestock Integration Beyond the Farm Level: A Cross-Analysis of Worldwide Case Studies*. Land Use Policy 73, p. 184 - 194, https://doi.org/10.1016/j.landusepol.2017.12.010.

[14] Ahfandi Ahmad, 2022. *Pengelolaan Produksi Pangan Melalui Sistem Hybridization Pertanian*. Pasaman: CV Azka Pustaka.

the legal formulations as written in regulations and the relationships between provisions.

Primary legal materials consist of the Food Law, the Livestock and Animal Health Law, the Environmental Protection and Management Law, and the Sustainable Agricultural Cultivation System Law. Secondary legal materials include journal articles, research reports, policy guides, and literature discussing crop-livestock integration, sustainable agriculture, and food policy governance.

The search for legal materials is carried out systematically. First, collecting relevant regulations according to the hierarchy of laws and regulations. Second, compiling a list of legal issues related to crop-livestock integration. Third, reading and grouping provisions that support, hinder, or do not regulate the relationship between crops and livestock.

The approaches used consist of a statutory approach, a conceptual approach, and a comparative law approach. The statutory approach is used to identify the linkages between regulations in the food crop, livestock, and environmental sectors. The conceptual approach is used to understand the meaning of system integration, nutrient cycles, and sustainable development in the context of food policy. The comparative law approach is used to assess Indonesia's position by looking at crop-livestock integration system policies in Malaysia, Thailand, and India. These three countries were chosen because they have small-scale agricultural development patterns with regional institutional support. Comparisons are made to see incentive structures, forms of inter-agency coordination, and how the state gives small farmers a role in the production cycle.

The analysis is carried out through grammatical and systematic interpretation. Grammatical interpretation is carried out by reading the text of the regulations according to the direct meaning of the words. Systematic interpretation is carried out by looking at the relationships between articles within one law and the relationships between regulations across sectors. The analysis proceeds sequentially. First, identifying relevant provisions. Second, assessing the suitability between regulations. Third, determining points of inconsistency or regulatory gaps. Fourth, formulating directions for updating the legal construction that supports the integration of crop-livestock systems.

III. ANALYSIS AND DISCUSSION

a. Law, Crop-Livestock Systems, and Sustainable Agricultural Development

Crop-livestock systems are an important foundation for sustainable agricultural development. Ates et al. show that smallholder farmers need production systems that integrate crops and livestock to maintain income, food security, and the ecological condition of the land.[15] In this system, crop residues function as feed and livestock manure becomes organic fertilizer, so the flow of nutrients returns to the soil. The effect is to reduce dependence on chemical fertilizers and manufactured feed, while maintaining long-term productivity. However, these benefits do not arise automatically, but require institutional support and consistent land management. Institutional support is key to sustainability in field practice.

Institutional support relates to how this system provides real benefits to smallholder farmers. Tarawali et al. affirm that crop-livestock integration only plays a role in poverty alleviation if policies and markets favor smallholder farmers.[16] Without such bias, the potential for integration is not converted into increased household income. Taifouris and Martín add that institutional support needs to include the determination of location and system design so that the absorption of livestock waste by the land is balanced.[17] Environmental balance is an overarching consideration in every production decision.

Environmental balance demands a system that maintains soil health, water availability, and biomass conservation. Lemaire et al. emphasize that sustainable crop-livestock systems must maintain soil organic matter content and water absorption capacity.[18] Reddy adds that integration provides opportunities to increase income without increasing pressure on natural resources, as long as crop

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[15] S. Ates, et al., 2018. *Sustainable Development of Smallholder Crop-Livestock Farming in Developing Countries*. IOP Conference Series: Earth and Environmental Science 142, p. 1 - 11, https://doi.org/10.1088/1755-1315/142/1/012076.

[16] Shirley Tarawali, et al., 2011. *Pathways for Sustainable Development of Mixed Crop Livestock Systems: Taking a Livestock and Pro-Poor Approach*. Livestock Science 139, no. 1 - 2, p. 11–21, https://doi.org/10.1016/j.livsci.2011.03.003.

[17] Manuel Taifouris & Mariano Martín, 2022. *Integrating Intensive Livestock and Cropping Systems: Sustainable Design and Location*. Agricultural Systems 203, p. 1 - 13, https://doi.org/10.1016/j.agsy.2022.103517.

[18] Gilles Lemaire, et al., 2014. *Integrated Crop–Livestock Systems: Strategies to Achieve Synergy between Agricultural Production and Environmental Quality*. Agriculture, Ecosystems & Environment 190, p. 4 - 8, https://doi.org/10.1016/j.agee.2013.08.009.

rotation and land management are carried out regularly.[19] Wright et al. then highlight that sustainability also depends on the availability of stable feed throughout the year.[20]

Feed availability determines whether integration can survive changing seasonal conditions. Veysset et al. show that production costs can be reduced when local feed is available.[21] Paul et al. describe the provision of forage as a critical point in the sustainable development of livestock.[22] Ryschawy et al. affirm that mixed systems are only profitable when farmers control production inputs, not when they have to buy feed or fertilizer.[23] This shows the close relationship between production and the policy structure governing farmers' access to resources.

The policy structure determines the direction of implementation of crop-livestock systems in practice. Currently, crop, livestock, and environmental regulations operate independently. Wei et al. show that China's success in managing livestock manure as fertilizer occurred because of explicit policies ordering local governments and business actors to utilize manure as a source of soil nutrition, not waste.[24] Ghimire et al. affirm that control over the nitrogen cycle is only possible when there are clear institutional arrangements.[25] The necessity of designing an integrative legal framework arises from the need to unite these sectors.

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[19] Parvatha Reddy, 2016. *Integrated Crop–Livestock Farming Systems* in Sustainable Intensification of Crop Production (Springer Singapore, 2016), p. 357 - 370, https://doi.org/10.1007/978-981-10-2702-4_23.

[20] Iain A. Wright, et al., 2012. *Integrating Crops and Livestock in Subtropical Agricultural Systems*. Journal of the Science of Food and Agriculture 92, no. 5, p. 10 - 15, https://doi.org/10.1002/jsfa.4556.

[21] Patrick Veysset, et al., 2014, *Mixed Crop–Livestock Farming Systems: A Sustainable Way to Produce Beef? Commercial Farms Results, Questions and Perspectives*. Animal 8, no. 8 (2014): 1218 – 1228, https://doi.org/10.1017/S1751731114000378.

[22] Birthe K. Paul, et al., 2020. *Improved Feeding and Forages at a Crossroads: Farming Systems Approaches for Sustainable Livestock Development in East Africa*. Outlook on Agriculture 49, no. 1, p. 13 - 20, https://doi.org/10.1177/0030727020906170.

[23] Julie Ryschawy, et al., 2012. *Mixed Crop-Livestock Systems: An Economic and Environmental-Friendly Way of Farming?*. Animal 6, no. 10, p. 1722 - 1730.

[24] Yujie Wei, et al., 2025. *Exploring the Role of Energy Transition in Shaping the CO2 Emissions Pattern in China's Power Sector*. Scientific Reports 15, no. 1, p. 1 - 26, https://doi.org/10.1038/s41598-025-99021-9.

[25] Rajan Ghimire, et al., 2015. *Long-Term Crop Residue and Nitrogen Management Effects on Soil Profile Carbon and Nitrogen in Wheat–Fallow Systems*. Agronomy Journal 107, no. 6, p. 2230 - 2240, https://doi.org/10.2134/agronj14.0601.

An integrative legal framework is needed to make crop-livestock systems not just a technical choice, but a production model that becomes mainstream. Schneider calls for a legal framework that unites food, agriculture, and sustainability in one normative system.[26] Howes et.al., assesses that the law must give preference to sustainable practices, not just increased outputs.[27] Hamilton places the law as a determinant of the direction of land governance and a protector of the position of small farmers in the production system.[28] This integrative legal framework shows three main elements: a nutrient cycle based on local resources, a policy structure that favors small farmers, and an institutional mechanism that ensures the relationship between crops and livestock remains stable in the long term. These three elements become the foundation of the analysis regarding the legal construction of the integration of crop-livestock systems in sustainable agricultural development in Indonesia.

b. Fragmentation and Disharmony in the Regulation of Crop-Livestock Integration

A study of the four laws governing food, livestock, animal health, and environmental protection shows that the relationship between crops and livestock has been recognized in principle, but has not been translated into operational integration mechanisms. In Law 18 of 2009 concerning Livestock and Animal Health, the implementation of livestock can be carried out "separately and/or through integration with food crop cultivation, horticulture, plantations, fisheries, forestry, or other fields" as stated in Article 2 paragraph (1) of Law Number 18 of 2009. This provision is the first normative basis that recognizes that crop-livestock integration is a legitimate form of livestock business. However, this provision is declarative because it is not followed by a formulation of procedures, division of authority, or technical standards for the application of integration at the farmer level. This law emphasizes more on aspects of animal health, disease control, regulation of seeds and seedlings, and product safety. When Law 41 of 2014 amended Law 18/2009, the emphasis was further directed at strengthening veterinary and biosecurity authorities to support food security of animal origin. As a result, the logic that

[26] Susan A. Schneider, 2010. *A Reconsideration of Agricultural Law: A Call for the Law of Food, Farming, and Sustainability*. William & Mary Environmental Law & Policy Review 34.

[27] Michael Howes, et al., 2017. *Environmental Sustainability: A Case of Policy Implementation Failure?*. Sustainability 9, no. 2, https://doi.org/10.3390/su9020165

[28] Hossein Azadi, et al., 2023. *Smart Land Governance: Towards a Conceptual Framework*. Land 12, no. 3, https://doi.org/10.3390/land12030600.

develops is more to view livestock from the perspective of animal health control, not from the perspective of agroecological integration that connects livestock and soil through the nutrient cycle.

Second, Law 18 of 2012 concerning Food shows basic ideas regarding food sovereignty, food independence, and food security that must be realized by utilizing local resources Article 2 and Article 3 of Law Number 18 of 2012. Farmers are placed as the main actors in food provision. However, this law does not mention crop-livestock integration as a production strategy encouraged by the state. When food production is understood as an activity that must increase availability and diversification, the relationship between crops and livestock does not enter as part of the logic of designing a production system. In other words, this law opens space for integration but does not provide operational guidelines, incentives, or policy preferences that give a special position to the integration system.

Third, Law 32 of 2009 concerning Environmental Protection and Management regulates the principles of sustainability and ecological balance in the management of resources Article 2 and Article 3 of Law Number 32 of 2009. This is very much in line with the principle of crop-livestock integration which relies on the repeated flow of nutrients between livestock and soil. However, this law categorizes livestock manure primarily as waste that must be controlled and prevented from potential pollution Article 1 numbers 20–23 of Law Number 32 of 2009. There is no norm that explicitly recognizes livestock manure as a source of organic fertilizer that can and should be utilized in agriculture. Thus, the environmental legal framework is more inclined towards controlling impacts than optimizing the function of the nutrient cycle. This creates a normative barrier for farmers in utilizing livestock manure in agricultural land systematically, because the orientation of the law places the waste aspect under supervision, not under productive utilization.

Fourth, from the perspective of institutional coordination, there is no arrangement that unites crop extension workers, livestock extension workers, and environmental supervisors in one farm business plan. The crop sector is in a different directorate from the livestock sector, while the environmental authority is in another ministry. This institutional separation results in a separation of ways of thinking: crop extension workers focus on chemical fertilizers, livestock extension workers focus on animal health, and environmental supervisors focus on waste control. In practice, the integration system at the small farmer level is hampered not because of a lack of

technical knowledge, but because there is no legal framework that requires or encourages the alignment of these functions.

Fifth, from the perspective of incentive structures and the position of small farmers, there are no articles in these four laws that provide fiscal incentives, organic input subsidies, waste processing fee exemptions, or price protection for farmers who implement integration systems. The role of farmers is recognized as the main actor, but that role is not strengthened in the form of financing support or market access. Thus, small farmers are left to choose between a system that is low-cost but requires coordination (integration), and a system based on expensive manufactured inputs but is easier to access.

From this overall analysis, it is clear that crop-livestock integration is recognized in principle, but is not yet present in the operational level. There is recognition, but there are no implementing regulations. There is space, but there is no mechanism. To make the integration system an architecture of production that supports food security and ecological sustainability, new legal formulations are needed that include the classification of livestock manure as an agricultural resource, the preparation of integrated farming business standards, cross-ministerial coordination mechanisms, and incentives for small farmers as core actors in the production cycle.

For more clarity, the following is a description of the regulation of the crop-livestock system integration as shown in Table 1 below:

Table 1: Regulatory Framework for Crop-Livestock System Integration in Indonesia

Regulation	Main Legal Issue	Provisions Supporting Integration	Provisions Limiting Integration	Unregulated Aspects	Implication for Smallholders
Law No. 18 of 2009 on Livestock and Animal Health (as amended by Law No. 41 of 2014)	Integration is recognized but not operationalized	Article 2(1) permits livestock production integrated with crop cultivation	Emphasis on veterinary control directs policy toward disease management rather than nutrient cycling	No procedures for integrated farm planning. No standard for manure use as fertilizer. No joint	Smallholders must organize integration independently. No technical or institutional support

				extension guidelines	
Law No. 18 of 2012 on Food	Integration is not defined as a food production strategy	Articles 2 and 3 promote self sufficiency and use of local resources	Focus on availability and distribution. Production systems are not specified	No incentives for organic fertilizer or local forage. No recognition of integrated systems as priority	Integrated systems remain voluntary. No structural support in food policy
Law No. 32 of 2009 on Environmental Protection and Management	Manure is classified as pollution risk	Sustainability principles in Articles 2 and 3 provide conceptual basis for nutrient cycling	Articles 1(20) to 1(23) classify livestock waste as potential pollution, not as a soil nutrient source	No legal basis for manure based fertilization. No management standards for farm scale nutrient loops	Farmers risk sanctions when applying manure. Ecological soil regeneration lacks legal foundation
Institutional Coordination	Responsibilities are fragmented across sectors	Farmers are recognized as key actors in food supply (Law No. 18 of 2012 Article 20)	Livestock, crops, and environmental extension services operate through separate administrative chains	No integrated extension structure. No unified farm planning mandate	Farmers receive inconsistent or conflicting guidance. Integration remains ad hoc
Economic and Incentive Structure	No incentive for adoption of integrated systems	-	Subsidies favor chemical fertilizers and commercial feed inputs	No credit schemes or price guarantees for integrated farm outputs. No communal grazing land arrangements	Integrated systems face higher coordination costs and lower policy support

Source: Primary and secondary legal materials, processed by the author (2025)

The legal framework acknowledges the importance of food, livestock, and the environment but fails to integrate them into a unified crop-livestock system. This results in: integration remaining a practical knowledge at the farmer level rather

than a state policy; livestock manure being viewed as waste rather than a strategic resource; extension and agricultural development programs operating separately and sectorally; and small farmers lacking economic incentives to implement integrated systems.

c. Comparing Corp-Livestock Integration in Malaysia, Thailand, and India

Malaysia promotes crop-livestock integration through village-based policies. Ngah and Kamarudin's study describes this as a "kampung" (village) farming model, which relies on strong connections between farm families, land, and animals. The government sees small farmers as the key players.[29] Their "mixed farming" program links the production of rice, corn, and forage crops with raising cattle or goats. Livestock manure is used as organic fertilizer, and crop leftovers are used as animal feed. This approach is supported by village-level forage seed production, as shown by Tufail et al., which makes households more self-sufficient in animal feed.[30] These policies are backed by coordinated extension services, with agricultural and livestock extension workers working together in the same service units at the district level. The government provides communal grazing land for farmer groups. This system keeps production costs down and maintains soil fertility. Ahmad and Nasir note that the success of integration in Malaysia depends on consistent institutions and uninterrupted policy support from both the central and local governments. Integration in Malaysia is consistent because the institutional structure centralizes planning at the state level but puts implementation at the village level, creating a seamless relationship between the central and local governments.[31]

Thailand takes a different approach. The government promotes integration through the feed industry and dairy cooperatives. This system encourages farmers to develop forage crops in a planned way, independent of the seasons, by planting drought-resistant, high-quality grasses. The government provides forage varieties,

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[29] Ibrahim Ngah & Khairul Hisyam Kamarudin, 2019. *Malaysia: The State of/in Village Agriculture*, in *Asian Smallholders in Comparative Perspective*, p. 145 - 180, https://doi.org/10.2307/j.ctvrxk2k6.9.

[30] Muhammad Shoaib Tufail, et al., 2025. *Empowering Smallholder Farmers by Integrating Participatory Research and Establishing Village-Based Forage Seed Enterprises to Enhance On-Farm Productivity and Local Seed Supply*. Seeds 4, no. 3, p. 1–26, https://doi.org/10.3390/seeds4030040.

[31] D.M. Raisa, et al., 2024. *Analysis of Strategic Programs in Planning and Developing Cattle-Oil Palm Integration System*. IOP Conference Series: Earth and Environmental Science 8, no. 4, p. 693 – 700, https://doi.org/10.1088/1755-1315/1364/1/012012.

silage-making facilities, and low-interest financing. Cooperatives collect milk and meat for marketing, and the guaranteed purchase by the cooperatives is a major incentive for farmers. Thailand also uses land zoning for livestock to prevent pollution. Livestock manure is managed through simple anaerobic fermentation at the household level. Chuanrum and Shrestha show that this helps control land degradation and maintain crop diversity.[32] Extension workers operate within defined production corridors, which speeds up the flow of information. Integration happens not because of legal requirements, but because the rural economic structure provides direct incentives for farmers.

India has a more complex situation. Most farmers manage small plots of land. Livestock serves as a social asset, a source of labor, and a source of fertilizer. Crop-livestock integration has a long tradition in India. The government strengthens this pattern through organic fertilizer and composting policies. The "organic compost village" program provides tools for processing manure. Gupta, Rai, and Risam (2012) state that crop-livestock integration is a resource conservation strategy that maintains environmental sustainability. State governments develop integration programs tailored to their specific agroecological conditions. In dry regions, integration emphasizes forage management and water conservation. In wet regions, the focus is on crop rotation and legumes as ground cover. India also has microcredit systems for households that raise livestock. These loans are not just for buying livestock, but also for planting forage and improving animal housing. Ghosh, Azhahianambi, and de la Fuente note that strong integration also helps control pests and parasites in ruminants.[33] Integration in India relies on local institutions such as panchayats (village councils) and women's self-help groups.

These three countries show different patterns. Malaysia emphasizes integration through formal institutions and centralized extension services. Thailand emphasizes integration through cooperatives and market guarantees. India emphasizes integration through rural social programs and strengthening the capital of small farmers. Wright et al. (2012) conclude that integration in various

[32] Ritdecha Chuanrum & Rajendra P. Shrestha, 2024. *Role of Integrated Farming Systems in Land Degradation Control and Plant Diversity Enhancement: A Case of Northeast Thailand*. Farming System 2, no. 3, p. 1 - 8, https://doi.org/10.1016/j.farsys.2024.100086.

[33] S. Ghosh, et al., 2006. *Control of Ticks of Ruminants with Emphasis on Livestock Farming Systems in India: Present and Future Possibilities for Integrated Control*. Experimental and Applied Acarology 40, no. 1, p. 49 - 66, https://doi.org/10.1007/s10493-006-9022-5.

subtropical regions always relies on ecological suitability and the availability of forage.[34]

However, there are three important commonalities: First, all countries prioritize forage as the foundation of integration. Second, all systems return livestock manure to the soil to maintain fertility. Third, institutional coordination is crucial for success when extension workers, cooperatives, and local institutions move in the same direction.

To further illustrate, crop-livestock integration in Malaysia, Thailand, and India can be described in Table 2 below:

Table 2: Crop-Livestock Integration in Malaysia, Thailand, and India

Country	Basis of Implementation	Integration Pattern	Institutional and Extension Structure	Government Support Mechanisms	Manure and Feed Management	Economic / Market Orientation	Outcomes for Smallholder Farmers
Malaysia	Village-based smallholder agriculture	Mixed farming combining rice, maize, forage crops with cattle or goats	Agricultural and livestock extension officers work under the same district service unit	Provision of communal grazing land and district-level integrated planning	Livestock manure used as organic fertilizer; crop residues used as feed	Cost reduction through locally sourced inputs	Maintained soil fertility, stable production, reduced dependency on external inputs
Thailand	Cooperative-led dairy and feed industry	Planned forage production using drought-tolerant improved varieties	Extension services aligned along production corridors linked to cooperatives	Forage seed distribution, silage facilities, soft credit schemes as priority	Household-level anaerobic fermentation of manure; structured forage rotation	Guaranteed purchase of milk and meat through cooperatives	Stable income, secure market access, strengthened local feed autonomy
India	Community-based management through village institutions (panchayats, self-help groups)	Forage production, legume rotations, and compost application tailored to agroecological zones	Local institutions coordinate labor, fodder distribution, and composting	Organic compost programs, microcredit schemes for livestock and forage cultivation	Manure processed into compost and applied back to soil	Household-level diversified livelihood strategy, reduced cash expenditure	Sustainable nutrient cycling even on small landholdings, strengthened local resilience

Source: Primary and secondary legal materials, processed by the author (2025)

[34] Iain A. Wright, et al., *Ibid*.

The lessons from these comparisons become relevant when linked to Indonesia's legal framework. The principle of utilizing local resources is actually stated in Law 18/2012 concerning Food, which affirms food self-sufficiency as a national goal (Articles 2–3), but this law does not position crop-livestock integration as a state-directed production strategy. On the livestock side, Law 18/2009 does recognize that livestock businesses can be carried out through integration (Article 2 paragraph 1), but this recognition is not accompanied by technical mechanisms that guarantee the availability of forage, communal grazing land, or integrated extension services as in Malaysia. Even after the amendment through Law 41/2014, the orientation of livestock policy increasingly emphasizes biosecurity and disease control, rather than the nutrient cycle that is at the core of integration.

Furthermore, Law 32/2009 concerning Environmental Protection and Management classifies livestock manure as potentially polluting waste (Article 1 numbers 20–23), in contrast to Malaysia, Thailand, and India, which treat manure as an agricultural resource. As a result, the practice of organic fertilization in integration in Indonesia does not have strong legal legitimacy.

Thus, Indonesia has the principles but lacks the operational architecture. Crop-livestock integration in other countries succeeds because institutions and policies are directed to converge, while in Indonesia, the law still separates these production sectors. To make integration a national development strategy, the state needs to establish rules that explicitly change the position of manure from waste to a resource, stipulate forage production as a mandatory component of farming businesses, and unite extension services in a single coordination channel.

d. Legal Construction of Crop-Livestock System Integration Based on Sustainable Development

Crop-livestock integration is a production system that unifies the function of crops as providers of forage and livestock as producers of organic fertilizer. This relationship forms a nutrient cycle that maintains soil fertility and reduces dependence on chemical fertilizers. At the smallholder farmer level, this system reduces production costs, stabilizes income, and strengthens production independence. Sustainable agricultural development demands a system that does not separate land, livestock, and nutrients, but rather places them in a functional relationship.

The legal framework in Indonesia has not provided an operational basis for this relationship. Law No. 18 of 2012 concerning Food establishes food self-sufficiency as a goal (Articles 2–3), but does not formulate the type of production system needed to achieve it. There are no provisions regarding the obligation to provide local forage feed or the utilization of organic fertilizer from livestock manure. Food self-sufficiency stops at the statement of the goal, not at the design of how to achieve it.

Law No. 18 of 2009 concerning Livestock and Animal Health does mention integration with crops (Article 2, paragraph 1), but does not provide business procedures, land use regulations, or extension coordination. The amendment through Law No. 41 of 2014 reinforces the orientation towards animal health. This orientation is important for product safety, but makes livestock policy centered on disease control, not on restoring soil fertility. As a result, the relationship between livestock pens and land remains outside the attention of the law.

Law No. 32 of 2009 concerning Environmental Protection and Management classifies livestock manure as potentially polluting waste (Article 1, numbers 20–23). Livestock manure is not recognized as a source of soil nutrients. This has a direct impact on the interpretation of environmental supervision. Field officers often assess livestock pens as a source of risk. Organic fertilization activities do not obtain legal legitimacy. The nutrient cycle, which is the core of integration, does not receive normative support.

A comparison of practices in other countries provides a picture of the basic needs of integration. Malaysia implements integration through extension units that are in one channel at the district level. Small farmers plant forage and raise livestock in one village business plan. Thailand implements integration through cooperatives. The certainty of sales of milk and meat encourages farmers to plant forage in a planned manner. India implements integration through village institutions. Livestock manure is processed into compost and reused on the land. These three countries show that integration works when land, forage, livestock, fertilizer, and markets are in a clear sequence.

From here, the needs of legal construction can be structured through three basic principles.

The first principle is that livestock manure must be recognized as an agricultural resource. The law must no longer place it as valueless waste. Law No. 32 of 2009 needs to be revised by including an explicit norm regarding the use of livestock manure as organic fertilizer in farming systems. This affirmation provides a basis for local governments in establishing standards for the management of livestock-based organic fertilizer. It also changes the orientation of environmental supervision from pollution control to nutrient cycle management.

The second principle is that forage production must be a mandatory component in livestock businesses. Law No. 18 of 2009 needs to be clarified by adding a provision that every livestock rearing business must be accompanied by a forage feed production plan. This provision provides a basis for extension coordination. Crop extension workers and livestock extension workers will work in one planting plan. This prevents dependence on manufactured feed, which increases costs and severs the relationship between livestock and land.

The third principle is that agricultural extension must be under one command of the production plan. It is not enough to only unite institutions within the bureaucratic structure. Unification must occur in the field work plan. This can be regulated through a government regulation that orders crop extension workers and livestock extension workers to prepare one village-level farming business plan. This plan becomes the basis for crop rotation, forage planting, manure processing, and production recording.

In addition to these principles, the legal construction requires incentive support. Fertilizer subsidies need to be directed towards organic fertilizer based on village production. Farm business credit needs to be given to businesses that combine crops and livestock. Local governments need to establish communal grazing land. Markets for livestock products need to be built through cooperatives or village-owned enterprises. These instruments can be included in the revision of the implementing regulations of Law No. 18 of 2012.

With these updates, integration no longer depends on the initiative of farmers individually. Integration becomes a production design based on clear legal norms. Land, livestock, and nutrients move in one cycle. Small farmers obtain a stable economic base. Soil fertility is maintained. Dependence on external inputs decreases. Agricultural development no longer proceeds separately between crops,

livestock, and the environment. Development moves as a measurable and sustainable unity.

IV. CONCLUSION

This article affirms that crop-livestock integration forms a nutrient cycle that maintains soil fertility and reduces production costs at the smallholder farmer level. This system aligns with the direction of sustainable agricultural development, but the current legal framework in Indonesia does not provide an adequate operational basis. The Food Law only states the goal of self-sufficiency. The Livestock and Animal Health Law recognizes integration without implementation guidelines. The Environmental Protection and Management Law views livestock manure as waste, not a resource. This fragmentation causes crops, livestock, and the environment to operate under separate policies.

The legal construction requires three basic principles. First, livestock manure must be recognized as an agricultural resource. The revision of Law 32 of 2009 needs to include provisions for the utilization of organic waste as fertilizer in farming enterprises. This affirmation provides direction for organic fertilizer processing standards at the village level. Second, forage production must be a mandatory component in livestock enterprises. The revision of Law 18 of 2009 needs to include the obligation of a forage production plan. This unites crop and livestock planning. Third, agricultural extension must be under one work plan for village farming enterprises. Implementing regulations need to instruct crop extension workers and livestock extension workers to work in a single coordination channel.

This research is still at the normative stage. The analysis has not yet assessed how implementing regulations work at the field level. Subsequent research needs to be empirical, focusing on villages or sub-districts that have implemented integration. That research needs to observe coordination between agencies, farmer responses to incentives, and the effectiveness of single-channel extension. This step is important so that legal changes do not remain just ideas, but move into stable and sustainable production practices.

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