

Animal Waste Policy Innovation

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Abstract

Animal waste management in Kuningan Regency, especially in Cipari Village, faces serious challenges in the form of environmental pollution, low awareness of livestock farmers, and suboptimal existing policies. This study aims to analyze innovations in animal waste management policies with a participatory and collaborative approach. The method used is descriptive qualitative with data collection techniques through in-depth interviews, document studies, and field observations. The results of the study indicate that the implementation of policy innovations based on three main principles, namely creation of interactive value, distributed co-creation, and mass collaboration, has encouraged multi-party involvement in overcoming waste problems. The findings show real collaboration between livestock farmers, local governments, academics, and the private sector, which results in the practice of processing waste into organic fertilizer and biogas. However, implementation is still hampered by the lack of incentives, technological infrastructure, and coordination between institutions. Therefore, the strategy for increasing policy effectiveness is directed at institutional integration, ongoing education, incentives for small farmers, and strengthening waste management cooperatives. This study provides a conceptual contribution to collaborative and practical governance for the development of environmentally friendly agriculture.

Keywords: Policy innovation, animal waste, waste management, collaboration, kuningan regency

INTRODUCTION

Cigugur District in Kuningan Regency is an area with great potential in developing dairy cattle farming, supported by the availability of extensive green land, a suitable tropical climate, and mountainous topography that is ideal for raising dairy cattle. One of its main areas, Cipari Village, recorded a cattle population in the Fisheries and Animal Husbandry Service of Kuningan Regency in 2024, as a dairy cattle farming center with a population of around 7,000-8,000, which is the main source of income for the local community and plays an important role

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in food security and employment absorption. However, behind this positive contribution, there are serious problems related to the management of animal waste that is not optimal. Animal waste that is not managed properly often causes water and air pollution, causes unpleasant odors, and has the potential to become a source of disease due to the development of vectors such as flies and mosquitoes (Tim PKM-M Stikes Banyuwangi, 2019). This condition often triggers social conflicts and public complaints, especially in downstream areas affected by river pollution due to animal waste.

The problem of animal waste in Kuningan Regency is also exacerbated by the lack of an effective waste management system among livestock farmers, so that animal waste is often just piled up in empty land or simply thrown away. This negative impact not only threatens environmental quality, but also hinders efforts to develop environmentally friendly agriculture and ecosystem sustainability. In fact, the potential of animal waste as a raw material for organic fertilizer is very large and can be used to reduce the use of chemical fertilizers, support sustainable agriculture, and increase the economic value of the community.

In the context of policy, the Kuningan Regency Government has issued a number of regulations that support environmental protection and sustainable agricultural development, such as Regional Regulation Number 7 of 2014 concerning Protection and Management of the Regional Environment, and Regional Regulation Number 5 of 2022 concerning Regional Food Development which emphasizes the use of environmentally friendly technology and the development of organic fertilizers. However, the implementation of these policies at the field level still faces various obstacles, ranging from limited technology, low awareness of farmers, to minimal collaboration between stakeholders.

Furthermore, the policies in Kuningan Regency that encourage the integration of waste management with community economic empowerment programs are still very limited. There are no specific policies that explicitly support the establishment of waste management cooperatives or marketing systems for waste derivative products.

In line with the development of science, various innovations have been developed to overcome the problem of animal waste management. Research and programs from various higher education institutions, such as students from Universitas Gadjah Mada (UGM) hold training for the community to raise awareness of the importance of waste management (Putri, 2023). And the Center for Research on Cultural Products and the Environment of the Bandung

Institute of Technology (PP-PBL ITB), shows that cow dung waste can be processed into products of economic value such as organic fertilizer, raw materials for environmentally friendly products, and alternative building materials (Pratiwi, 2024). As well as the program for processing animal waste into organic fertilizer by BRIN which increases environmental efficiency (Humas BRIN, 2024). Technological innovations, such as creating an animal waste loosener from the Banjarmasin State Polytechnic and the use of eco-enzymes, have proven their effectiveness in increasing the efficiency of livestock waste management (Sarwono, 2024).

An interesting innovation in the utilization of cow dung waste is an air freshener made from cow dung by Indonesian students. This product reduces waste while providing health benefits by producing a safe, fresh aroma, thus changing people's views on animal waste (Jandris Sky, 2024). Policy innovation is a key element in responding to changes and challenges in society in a more effective and efficient manner (Nur et al., 2024). In addition, collaboration between government, academics, and the community has proven to be able to produce sustainable solutions that not only reduce pollution, but also improve the welfare of farmers (PISA 2015 Results and Focus, 2016).

Policy innovation is a response to the complexity of public problems that cannot be solved only with conventional administrative approaches. According to Walker in Wahid, (2015), policy innovation is a policy that is new to the country that adopts it, regardless of how long or widely the policy has been implemented elsewhere. In the context of animal waste management, policy innovation includes interactive value creation between government, society, and the private sector (Hilgers & Ihl, 2010; in Navarro, 2016). This approach is in line with the concept of *New Public Governance* which emphasizes collaborative and participatory governance in policy making (Dickinson, 2016, in Safaria & Yulianti, 2023). The United Nations (2006) also states that innovation in the public sector leads to the development of new policies and procedures to address public policy problems effectively and creatively. Thus, policy innovation is not only a technical solution tool, but also a strategic approach in building sustainable governance.

This study uses a participatory and collaborative approach to encourage policy innovation in animal waste management. Principles such as *creation of interactive value*, *distributed co-creation*, and *mass collaboration* (Hilgers & Ihl, 2010, in Navarro, 2016) are used as analytical foundations. This approach is very relevant to the conditions of Kuningan Regency

which has high agricultural and livestock potential, but faces environmental challenges from livestock waste that has not been optimally managed. Within the framework of *public sector innovation*, innovation as a form of institutional adaptation to changing social and environmental dynamics (Mulgan & Albury, in Kardiati, 2022). The emphasis on multi-stakeholder participation is in accordance with the global trend of collaborative governance as also discussed by PISA which emphasizes the importance of involving all stakeholders in an inclusive and transparent public policy process (PISA 2015 Results and Focus, 2016).

Analysis of policy innovation in animal waste management in Cipari Village, using three main principles of policy innovation, namely creation of interactive value, distributed co-creation, and mass collaboration. This approach aims to explore how local stakeholders (local government, livestock farmers, NGOs, and residents) can jointly formulate and implement waste management policies that are not only technically effective, but also socially acceptable and supported.

By referring to up-to-date and relevant primary references, this literature review emphasizes the urgency and uniqueness of the study in examining policy innovation as an innovative solution for animal waste management, which at the same time opens up new insights for the development of policies that are more inclusive and responsive to community needs and local environmental conditions.

This research was conducted in Cipari Village, Cigugur District, Kuningan Regency. The purpose of the study was to analyze the implementation of animal waste management through innovative policies, identify implementation barriers, and formulate strategies to improve the effectiveness of animal waste management. This study is important and urgent, considering the urgency of creating a clean and healthy environment, increasing agricultural productivity, and community welfare. The uniqueness of this study lies in the integrative approach that combines policy analysis, technological innovation, and multi-party collaboration, so that it is expected to provide a real contribution to realizing environmentally friendly agriculture and sustainable development in Kuningan Regency. Innovation in animal waste management policies is not only a solution to environmental problems, but also opens up opportunities for local economic development and improving the quality of life of the community. This research is expected to be a reference for local governments and other stakeholders in formulating more effective and sustainable policies in the fields of animal husbandry and the environment.

RESEARCH METHODS

This study uses a descriptive qualitative method as a technique for collecting, processing, and analyzing data to examine innovations in animal waste management policies in Kuningan Regency. The data sources used come from primary and secondary data. Primary data were obtained through in-depth interviews with stakeholders directly related to animal waste management, such as the Fisheries and Animal Husbandry Service, the Food Security and Agriculture Service, the Environmental Service, and livestock communities in Cipari Village. Secondary data were collected through literature studies and analysis of relevant policy documents as supporting documents.

The data collection period was carried out over a period of eight months, starting from the beginning of 2025. Research informants included all stakeholders and actors in animal waste management in the study area, with a purposive sampling technique to determine samples that truly represent the role and influence in animal waste management. The collected data is then presented thematically and systematically to facilitate analysis and drawing conclusions.

The data analysis technique uses qualitative analysis procedures that include data reduction, data presentation, and data verification systematically to produce a deep and comprehensive understanding of the needs and innovations of animal waste management policies. This method was chosen so that the analysis can be sharp and able to provide applicable policy recommendations and have a positive impact on animal waste management in the study area.

RESULTS AND DISCUSSION

Policy innovation is inseparable from the beginning of the problem of cow dung. The volume of animal dung is an important indicator in measuring the potential amount of waste produced by the livestock population in an area. The results of the study showed the main problems in cattle farms in Cipari Village, Cigugur District, namely, first, the high frequency and volume of cow dung accumulation that is not processed or handled properly. Second, there are still many farms that still dispose of cow dung in empty land or water channels without processing. Third, the intensity of the odor in the area around the farm that is complained

about by the local community. And fourth, the number and type of insects or flies that breed around the accumulation of cow dung

Estimates of the volume of cow manure per cow in one day can be produces 10-30 kg of waste (Hambali *et al* . 2007; Mira, 2016). And the results of the study based on the data obtained, the volume of cow dung per cow in one day in Cipari Village, Cigugur District reached 16 kilograms (kg). This results in environmental pollution due to cow dung which can be predicted by the number of cows (heads) multiplied by 16 kg of dung produced. The amount of cow dung can be seen in Table 1.

Table 1. Amount of Animal Waste

No	Subdistrict	Number of Beef Cattle (heads)	Number of Dairy Cows (heads)	Total Number (tail)	Amount of Animal Waste (Kg) (Population x 16 kg)
1.	Dharma	374	0	374	5,984
2.	Kadugede	119	0	119	1,904
3.	The Archipelago	105	0	105	1,680
4.	Ciniru	83	0	83	1,328
5.	Send	40	0	40	640
6.	Selajambe	158	0	158	2,528
7.	Subang	1,664	0	1,664	26,624
8.	Cilebak	3,082	0	3,082	49,312
9.	The Ciwaru	931	0	931	14,896
10.	The Karangkencana	962	0	962	15,392
11.	Cibingbin	5.324	0	5.324	85,184
12.	Cibeureum	805	0	805	12,880
13.	Luragung	857	0	857	13,712
14.	Cimahi	6,526	0	6,526	104,416
15.	Cidahu	1.171	0	1.171	18,736
16.	Kalimanggis	114	0	114	1,824
17.	Ciawigebang	289	0	289	4.624
18.	The Climbing	159	0	159	2,544
19.	Lebakwangi	327	0	327	5.232
20.	Maleber	4.947	0	4.947	79,152
21.	The Garawangi	164	0	164	2,624
22.	The Great Sindang	183	0	183	2,928
23.	Brass	161	91	252	4.032
24.	The Gugur	330	7,054	7,384	118,144
25.	Kramatmulya	122	26	148	2,368
26.	Implementation	335	76	411	6,576

No	Subdistrict	Number of Beef Cattle (heads)	Number of Dairy Cows (heads)	Total Number (tail)	Amount of Animal Waste (Kg) (Population x 16 kg)
27.	Japara	358	0	358	5,728
28.	Cilimus	377	47	424	6,784
29.	Cigandamekar	229	8	237	3,792
30.	Mandirancan	134	0	134	2.144
31.	The Five-Fold	217	0	217	3.472
32.	The rice fields	65	1	66	1,056
Total		30,712	7.303	38,015	608,240

Source: BPS, Kuningan Regency (2025)

Based on the data in table 1, it shows that the total population of beef cattle and dairy cattle in the research area reached 38,015 with an estimated production of animal waste of 608,240 kg per year. The sub-district with the largest cattle population, such as Cigugur with a total of 7,384 cattle, produces the most significant animal waste, which is around 118,144 kg. The large amount of animal waste is a major concern in waste management, because if not managed properly, it can have a negative impact on the environment and public health.

Effective animal waste management requires policy innovation that empowers collaboration between stakeholders at the sub-district and regional levels. Moreover, with the variation in cattle populations between sub-districts, policies must be able to adjust management strategies that are responsive to local characteristics. Therefore, it is important to implement policy innovation principles that include interactive value creation, distributed collaboration, and mass collaboration to mobilize ideas and resources widely. The goal is to ensure that animal waste management is not only sustainable but also brings social and economic benefits to communities around livestock areas.

Creation of Interactive Value

Policy innovation in animal waste management is currently a crucial need to maximize the social, economic, and environmental value of livestock waste produced. In this context, the principle of *Creation of Interactive Value* become an important foundation, where active collaboration between stakeholders ranging from government, society, to the private sector, creates social and public value. This shows a collaboration that not only produces more responsive and contextual policies, but also strengthens community involvement as an integral part of animal waste management.

Interactive value creation from the results of interviews on the existence of a manure processing training program facilitated by the Kuningan Regency Agriculture and Food Security Service together with farmer and livestock groups, the government provides technical training, while livestock farmers provide raw materials and labor. The form of value creation is the result of training, namely farmers and livestock farmers and related agencies have succeeded in processing animal waste into organic fertilizer that can be sold. So that it can generate a minimum income of IDR 500,000 per month.

Innovation in animal waste management policies in Kuningan Regency shows a commitment to creating interactive value, both in terms of social value, this policy seeks to improve the quality of life of the community by reducing the negative impacts of animal waste, such as unpleasant odors and water pollution. Through the animal waste processing program into biogas or organic fertilizer, livestock communities can reduce their dependence on expensive chemical fertilizers and fossil fuels, thereby increasing income and welfare. In addition, education on sanitation and livestock waste management also increases awareness of the importance of a clean and healthy environment.

Public value, policy innovation contributes to the achievement of sustainable development goals at the district level. Reducing greenhouse gas emissions from animal waste, improving soil quality through organic fertilizer, and providing alternative energy sources (biogas) are real examples of public value generated. The local government, in this case, acts as a facilitator that creates a policy ecosystem that supports sustainable practices, not just as a regulator.

the Creation of Interactive Value principle in Animal Waste Policy Innovation is clearly visible through collaborative mechanisms between the government, livestock communities, and the private sector. This creates public value in the form of sustainable waste management and improving the quality of the environment. The government acts as a facilitator of policies and regulations, while the community is the main implementer of management at the field level, with technological support and funding from the private sector. Thus, this interactivity strengthens the social legitimacy and sustainability of the policy.

Therefore, interactive value is realized through cross-actor involvement such as farmers, local governments, NGOs, and the private sector. As explained by Dickinson (2016, in Safaria & Yulianti, 2023), the effectiveness of public policy increases if social dialogue is systematically

facilitated. The principle of *Creation of Interactive Value* emphasizes that public value (social and public value) is not only created by the government, but through active interaction and collaboration between the government, society, and the private sector. This is in line with the concept of " *New Public Governance* " which emphasizes participatory governance in policy formulation. This concept also reflects a shift from the traditional focus of public administration on the production of public services to a focus on the use/consumption of services and the creation of value for users/citizens (Osborne et al., 2016).

This interactive value creation is directly related to the theories of Public Value Creation (Moore, 2025) and Co-production (Brandsen & Honingh, 2016). This principle signifies a fundamental shift from the traditional "public value" paradigm, where value is created for the public (often top-down, as seen in previous New Public Management models), to the "co - created public value" paradigm, where value is created together with the public (Torfing & Ferlie, 2021).

Distributed Co-Creation

Distributed co-creation based on research results, can be seen from the involvement of many parties in the animal waste innovation chain, starting from the use of fertilizer by farmers, to the distribution of fermentation results to farmer groups. In the perspective of *distributed co-creation*, the process of developing innovative policies is no longer top-down but distributed, allowing all stakeholders to contribute from design to evaluation. The distribution of results and responsibilities fairly fosters a sense of ownership and encourages ongoing support for the policy.

The principle of *distributed co-creation* is manifested in the involvement of various actors at various levels in the formulation and implementation of animal waste management policies. First, multi-stakeholder involvement, this innovation is not only driven by local governments, but also involves farmers, farmer groups, academics, civil society organizations, and the private sector. For example, farmers actively participate in problem identification, processing technology trials, and dissemination of best practices.

Second, sharing of knowledge and resources, local knowledge from farmers on the characteristics of animal waste and their needs is combined with technical knowledge from academics and research institutions. Local governments provide regulatory frameworks and

financial support, while the private sector may play a role in providing technology or marketing derivative products. This process creates a distributed knowledge network, enabling solutions that are more relevant and adaptive to the local context.

Distributed co-creation emphasizes that the policy innovation process should not be centralized, but rather should involve collective contributions from all parties fairly. This ensures that benefits and responsibilities are evenly distributed, so that social legitimacy and policy sustainability can be maintained. This entire process is able to produce innovative solutions that are adaptive to local conditions and technological developments. This is in accordance with Navarro, (2016) those who state that *distributed co-creation* enables policy acceleration through the collective use of cross-institutional resources.

This principle is deeply rooted in the Public Sector Innovation literature that emphasizes the role of multi-actors (Torfing & Ferlie, 2021) and *Co-creation in Government*. This concept differentiates itself from co-production by focusing on opening up the government value chain to stakeholders, effectively outsourcing some of the work of design and service delivery to constituents. This implies a significant break from the traditional bureaucratic model where policy design and implementation are internal government functions. By distributing co-creation, governments effectively "outsource" some of the work of innovation to citizens and other stakeholders, leveraging diverse expertise and resources. This leads to solutions that are more responsive to local needs and accelerate development (Bommert, 2010).

Mass Collaboration

The principle of mass collaboration is seen in the scale and scope of participation and interconnectivity between individuals and groups in this policy innovation. First, wide-scale participation, namely efforts to disseminate innovative animal waste management practices involving the participation of large numbers of farmers in various villages or sub-districts. Training programs, workshops, and technical assistance are designed to reach a wider audience, encouraging collective adoption of new technologies and practices.

Second, networking and joint learning, namely the formation of farmer groups or cooperatives that focus on animal waste management is an indication of mass collaboration. These groups serve as a platform for sharing experiences, solving common problems, and

developing innovative solutions collectively. Local governments and other relevant parties can facilitate this networking through regular forums or digital communication platforms.

Massive collaboration is represented through the integration of educational and technological programs such as *KoheKu* which expands citizens' digital participation. This model raises awareness and builds collective support for policies. This finding supports the opinion of the United Nations (2006) which emphasizes the importance of public sector innovation based on broad participation to build policy legitimacy and overcome social resistance.

Mass collaboration to inspire the public sphere, expanding the scope of participation by involving the massive mobilization of ideas, resources, and energy from various elements of society. This mass collaboration model inspires public spaces to become places for inclusive dialogue and innovation, opening up opportunities for the creation of policies that are relevant, effective, and socially significant. Through broad participation, innovation can be accelerated, and policies become more easily adapted to changes in social dynamics and community needs. Specifically in the management of animal waste, the application of these three principles helps optimize the management of livestock waste which has so far been an environmental problem, while also opening up opportunities for the use of waste as an economic resource that is beneficial to the wider community.

The concept of *Mass Collaboration* underlines the importance of broad participation from various actors to accelerate the birth of relevant innovations. This mass participation can be realized through community activities, public discussion forums, or mobilization of creative resources to support the progress of animal waste management policy innovations, which ultimately drive positive social and economic impacts for the community. This concept is very relevant to the concept of Network Governance (*Provan & Kenis, 2007*) and Open Innovation in the public sector (*Bommert, 2010*).

In addition to addressing technical waste issues, this approach encourages the birth of policies that are more inclusive and adaptive to the local context. Thus, the results of this study not only contribute to environmental policy practices at the regional level, but also offer theoretical contributions in the development of a multi-stakeholder participation-based policy innovation framework.

Comparison of Livestock Waste Management Policies

Comparison with other regions aims to assess the uniqueness, success, and adaptation potential of the collaborative livestock waste management model in Kuningan Regency. Case studies from various regions such as Ngawi, Ciamis, Tulungagung, Lembang, and Kaubun show that multi-party collaboration, waste processing into biogas or fertilizer, and the active role of government and communities are important elements in successful waste management. Each region has a different approach according to the local context, such as the existence of cooperatives, the form of collaboration (formal or semi-formal), and technical support or training. This provides a context that enriches the analysis of the strengths and weaknesses of the approach applied in Kuningan.

The Kuningan model stands out because it combines policy innovation principles such as interactive value creation, mass collaboration, and distributed co-creation with digital integration through the “KoheKu” program. The success of the Karya Nugraha Jaya Cooperative reinforces that cooperative approaches to waste management are already proven in the region. From this comparison, Kuningan can learn important lessons such as the importance of formalizing collaboration (as in Ngawi), diversifying funding (as in Tulungagung), and strengthening internal group commitment (as in Kaubun). The analysis concludes that the Kuningan model can be widely replicated, not as a fixed blueprint, but as a set of flexible and contextual collaborative principles to address livestock waste issues sustainably in other regions.

Implementation of Animal Waste Management Through Innovative Policies

Animal waste management in Kuningan Regency is currently receiving increasing attention as part of efforts to maintain environmental quality and utilize the economic potential of cattle waste. Innovative policies are implemented with a collaborative approach involving local governments, livestock communities, and the private sector as strategic partners in waste management. Local governments act as regulatory facilitators and incentive providers, such as allocating funds for waste management programs based on environmentally friendly technology. In addition, community involvement through discussion forums and technical training is an important part of increasing awareness and capacity for independent waste management at the sub-district and village levels.

Collaboration in animal waste management policy innovation in Kuningan follows a cyclical and iterative path, reflecting the dynamic nature of collaborative governance. The process begins with the identification of waste problems by farmers in the field, which are then responded to by the local government with support from academics and potential private sector involvement. The government, through relevant agencies, facilitates training, infrastructure provision, and the establishment of a regulatory framework. Academics channel technical expertise and research results to optimize waste processing methods. Farmers, as the main actors in the field, implement the solutions taught, provide feedback, and independently form groups or cooperatives to facilitate mass collaboration and knowledge distribution. The private sector can enter at the stage of providing technology or assisting in marketing waste-derived products. This entire process is continuously refined through regular coordination forums that allow for policy alignment, minimization of duplication of tasks, and unification of visions among stakeholders.

Innovative approaches also include the use of more efficient and environmentally friendly waste processing technologies, such as biogas installations to convert cow dung into renewable energy that can be used directly by farmers and the surrounding community. This model not only reduces environmental pollution, but also creates new economic and social value through diversified waste utilization. Simultaneously, this policy innovation encourages broad participation and collaboration between various stakeholders, so that waste management becomes more adaptive, sustainable, and inclusive.

However, the implementation of this innovative policy faces various obstacles. First, limited infrastructure and processing technology are still the main problems, considering that most farmers do not yet have access to fermentation equipment or adequate storage space (Sarwono, 2024). Second, the low level of environmental literacy and technical knowledge of farmers results in minimal awareness of the value of cohe as an economic and ecological resource (Putri, 2023). Third, coordination between agencies such as the Environmental Service, the Agriculture Service, and livestock cooperatives is still sectoral and not integrated into an integrated management system.

Barriers to Policy Implementation

The implementation of animal waste management policy innovation in Kuningan Regency faces various obstacles that are quite complex and affect the effectiveness of achieving sustainable livestock waste management goals. The first major obstacle is the limited human resources at the local government and livestock community levels. Many policy implementers do not yet have the technical capacity and in-depth knowledge of modern waste management technology and the principles of policy innovation, so that implementation in the field is less than optimal.

Second, economic barriers are a significant factor, especially for small farmers who have not been able to invest in environmentally friendly waste processing tools or technologies. Limited financial support and inadequate incentive mechanisms have caused most waste management to still be carried out in conventional ways that have a negative impact on the surrounding environment.

Third, coordination between related government agencies and stakeholders is still not harmonious and integrated. There are often overlapping tasks and a lack of effective collaboration, which slows down the process of formulating and implementing innovative policies at the sub-district and village levels. Furthermore, there are obstacles in the supervision and enforcement system, where the lack of strict control mechanisms causes waste management violations to often go undetected or not followed up firmly.

Fourth, the level of participation of livestock farmers in the policy process is still limited due to low awareness and understanding of the importance of sustainable waste management. The lack of effective education and socialization programs also hampers behavioral change towards better waste management practices.

Although there are waste management policy steps, there are several important policies that have not been optimally implemented in Kuningan Regency. First, there is still no tax incentive policy or special financial support for small farmers to invest in environmentally friendly waste processing technology, so that waste management is often limited to conventional methods that have a negative impact on the environment.

Second, there is no strict regulation and integrated monitoring system regarding the disposal of cow dung waste, especially in areas with dense livestock populations that are prone

to causing water and soil pollution. This results in a lack of control over the environmental impacts of waste that has not been managed properly.

Third, policies that encourage the integration of waste management with holistic community economic empowerment programs are still very limited. There are no policies that specifically support the formation of waste management cooperatives or marketing systems for waste derivative products such as organic fertilizers and biogas that can improve the welfare of livestock farmers.

Fourth, the lack of sustainable education and socialization policies to increase awareness and active participation of livestock farmers in environmentally friendly waste management is also an obstacle to the success of this innovation.

As a solution to these obstacles, strategies to increase the effectiveness of animal waste management can be formulated in three main approaches. First, integration of policies between agencies through the establishment of a Task Force for monitoring and handling the impacts of animal waste, consisting of cross-agency, academics, and representatives of farmers. Second, expansion of environmental education based on community participation, to increase the capacity of farmers in processing techniques and marketing processed animal waste products. Third, providing fiscal and non-fiscal incentives for innovative farmers, in the form of awards or capital assistance for equipment, which aims to create a demonstrative effect and encourage replication by other communities.

Formulation of Strategy to Increase the Effectiveness of Animal Waste Management

Animal waste management, especially cow dung, is a major challenge in Kuningan Regency that requires a comprehensive and innovative formulation of effectiveness improvement strategies. This strategy must integrate a number of vital aspects that support each other so that the impact of waste management is optimal, both in terms of environment, social, and economy.

The first strategy is to build a solid coordination structure between various stakeholders, such as local governments, related agencies (agriculture, environment, health), livestock groups, academics, and the private sector. The establishment of a regular coordination forum is essential to align policies, minimize duplication of tasks, and unify the vision in animal waste

management. Clear institutions will allow for effective division of tasks and responsibilities and continuous monitoring of policy implementation progress.

The second strategy, increasing human resource capacity is a top priority so that innovative policies can be implemented well in the field. Training and education programs on modern waste processing technology, its benefits, and the principles of policy innovation must be carried out intensively for government officials and livestock farmers. Continuous education for the community is also needed to increase their awareness and active participation in proper and environmentally friendly waste management.

The third strategy, to encourage the adoption of sustainable waste processing technologies such as composting or biogas, this strategy emphasizes providing financial incentives to farmers, especially small farmers. The form of incentives can be in the form of subsidies for purchasing waste processing equipment, easy access to credit, or tax cuts. In addition, facilitating technology investment through partnerships with the private sector and financial institutions will help accelerate the implementation of environmentally friendly technologies.

The fourth strategy is to prioritize the formation of cooperatives or business entities that focus on managing animal waste into value-added products such as organic fertilizer, biogas, and alternative animal feed. With the support of policies and technical assistance, waste processing products can be marketed widely, increasing livestock farmers' incomes and reducing waste that is disposed of unmanaged. Strengthening cooperatives in areas such as Cipari is an important strategy to encourage mass collaboration and empowerment of livestock farmers in managing livestock waste productively. Although initial documents have indicated the formation of livestock farmer groups or cooperatives, the model or concrete steps in the strengthening strategy have not been explained in detail. Based on practices in similar areas, an effective cooperative model includes five main elements: market access and capital, ongoing technical training, adoption of waste processing technology, strengthening internal institutions, and integrating waste management with improving livestock farmers' economy. The success of the Karya Nugraha Jaya Cooperative in Kuningan is proof that cooperatives are not only organizational entities, but also dynamic mechanisms that are able to transform waste into economic assets through collective innovation, technology adoption, and strengthening member commitment. With technical support, financial access, and strong

governance, cooperatives play a strategic role in sustainable rural development that synergizes environmental and economic goals.

The fifth strategy, Kuningan Regency needs to design the development of waste management infrastructure, including communal biogas installations, centralized waste collection sites, and other environmentally friendly waste processing facilities. In addition, an integrated and integrated monitoring system must be produced to ensure that the implementation of policies is in accordance with environmental regulations and standards. Effective monitoring also includes enforcing sanctions against violations to ensure compliance by all parties.

The final strategy, the socialization program must be a permanent agenda by involving various media and interesting communication methods so that important messages about waste management can be widely accepted by all levels of livestock farming communities. This campaign also functions to change behavior and build a culture of caring for the environment as part of everyday life.

The strategy of increasing the effectiveness of waste management through institutional integration strategies is a key pillar in increasing the effectiveness of animal waste management in Kuningan Regency. This strategy is realized through the formation of a cross-sector *Task Force* involving representatives from government agencies, academics, and farmers to ensure a comprehensive approach. In addition, a regular coordination forum was formed between stakeholders such as local governments, farmer groups, academics, and the private sector to align policies, avoid duplication of tasks, and create a clear and sustainable institutional structure. Thus, the division of roles and monitoring of policy implementation can run more effectively.

More than just a bureaucratic structure, this institutional integration aims to build adaptive and learning-oriented collaboration. The emphasis on unifying visions and ongoing monitoring processes demonstrate that this approach is dynamic and responsive to the complexity of environmental issues. The involvement of various actors allows for the exchange of perspectives and knowledge that enriches the policy-making process. This strategy reflects the principle of collaborative governance that creates interactive spaces for parties to learn from each other and innovate. The biggest challenge is to ensure that these forums truly

become active collaborative platforms, not just formalities or one-way channels for conveying directives.

According to the Center for Governance Innovation, Deputy for State Administration Innovation (2014) To initiate, implement, and manage state administration innovation, innovators must realize that a good understanding and mastery of various skills and knowledge are prerequisites. Thus, with these prerequisites, policy innovation will have a strategic impact.

Although there are several policies for managing animal waste in Kuningan Regency, there are still important shortcomings in the policy aspects that have not been implemented adequately. This is the finding of this study, first, the local government has not developed a financial incentive policy specifically aimed at small farmers to support investment in environmentally friendly waste processing technology, so that waste management is often still carried out in conventional ways that are less efficient and have a negative impact on the environment. In addition, regulations related to integrated and systematic supervision of cow dung waste disposal also do not exist, as a result, controlling the impact of waste on water and soil quality in areas with dense livestock populations is difficult to enforce optimally. Policies that encourage waste-based economic empowerment, such as the formation of waste management cooperatives and marketing mechanisms for waste derivative products such as organic fertilizers and biogas, are also still very limited.

Finally, ongoing education and socialization programs to increase awareness and participation of farmers in sustainable waste management have not been designed and implemented systematically, so that changes in pollution prevention behavior and optimal waste utilization have not been maximized. All of these policy shortcomings are major challenges that must be addressed so that the management of cow manure waste in Kuningan Regency can be more effective, sustainable, and provide broader socio-economic benefits.

Research on livestock waste management and policy innovation has been widely conducted in various parts of the world, showing a variety of approaches and challenges that are relevant for comparison with findings in Kuningan Regency.

A study by Lin et al. (2025) in China highlights the evolution of livestock waste resource utilization policies and their impact on pollution reduction. This study emphasizes the importance of policies that encourage waste treatment facilities and manure utilization on

farmland, as well as a strong legal system for waste management. Their findings suggest that targeted policies can significantly reduce pollutant emissions from livestock waste. This is in line with our findings in Kuningan Regency which identified that the lack of optimal policies is a barrier, but differs in terms of policy implementation which is still hampered by incentives and infrastructure. In China, the focus on integrating intensive livestock farming with crop cultivation and centralized service platforms is key to success.

Solehudin and Solehudin (2024) examined the role of human resource support in digital-based innovation for livestock waste processing in Karyamulya Village, Karawang. This study found that human resource assistance is critical for successful adoption and integration of digital technology. They proposed a comprehensive mentoring model to improve innovation efficiency at the village level. This context is relevant to our findings on the lack of technology infrastructure and awareness of farmers in Kuningan, suggesting that human resource support and digital innovation can be a solution to overcome these obstacles, as in Karawang. Integration of digital technology for livestock waste processing can increase the economic value of waste and environmental sustainability.

Muchlis and Nurcholis (2018) discussed the development of sustainable livestock farming in the Merauke border area, focusing on the environmental and social aspects of the local community. This study emphasizes the efficiency of using feed ingredients from agricultural waste and policy support through innovation and technology. Similar to the case of Merauke which optimizes agricultural waste as animal feed, research in Kuningan also found great potential for animal waste as raw material for organic fertilizer and biogas. Both studies underline the importance of policy-supported innovation and technology for sustainability.

Salam et al. (2023) explored insect-based technologies, specifically Black Soldier Fly larvae (BSFL), for organic waste management and animal feed in South and East Asian countries. The study showed varying public acceptance of BSFL technology, but it was generally considered an acceptable feed supplement. Their findings highlight the limitations of current waste management policies that lack large-scale organic waste valorization. While our study did not specifically address BSFL technology, the concept of waste valorization and the lack of policies supporting optimal waste utilization are highly relevant. Our study also found that waste processing into organic fertilizers and biogas is still hampered by a lack of

incentives and infrastructure, which could be improved with new technological innovations as discussed by Salam et al.

D'Agaro et al. (2022) discuss the application of new technological tools and Life Cycle Analysis (LCA) in sustainable livestock production. They introduce the concept of Agriculture 4.0 that integrates mechanical innovation and information and communication technology (ICT) to reduce greenhouse gas emissions from livestock and increase the biological potential of production. Although our study focuses on policy innovation and collaboration, D'Agaro et al.'s study provides a technological framework that can complement the efforts in Kuningan, especially in terms of reducing environmental impacts and increasing efficiency through advanced technologies such as LCA and precision farming. The lack of technological infrastructure that we found can be addressed by adopting the "Agriculture 4.0" approach described in this study.

Based on the research results and discussion, the overall results can be seen in table 2 below.

Table 2. Synthesis of Findings

Problem	Related Policies	Obstacle	Solution/Innovation
Accumulation of animal waste and pollution	Regional Regulation No. 7 of 2014	Lack of awareness and technology	Animal waste processing training, processing equipment subsidies
There are no incentives for small farmers	Not specifically regulated in the regulations	High costs for technology	Recommendation: fiscal incentives and special subsidies for small farmers
Lack of collaboration	Implementation is still sectoral	Weak inter-agency coordination	Formation of a Task Force across departments, cooperatives, academics
Limited education of farmers	Socialization is not yet comprehensive	Lack of environmental literacy	Digital-based livestock farmer socialization, education and training

The implementation of this study has several limitations that researchers need to note, especially related to access to quantitative data, regional coverage, and source representation. Limitations include the absence of measurable data on waste volume, pollution levels, health impacts, and detailed information on the number and characteristics of farmers involved, due to limited data in source documents. In addition, the study's limited focus on the Kuningan Regency area, without an in-depth discussion of implementation variations in other sub-regions or villages, limits the generalizability of the findings. Source representation may also

not have included all stakeholder perspectives in a balanced manner. Acknowledgement of these limitations is important to maintain scientific integrity, prevent overgeneralization, and provide clear direction for further research, especially the need for a mixed approach to fill the gaps in quantitative data and enrich the understanding of the impact of policy innovations more comprehensively.

CONCLUSION

This study concludes that innovation in animal waste management policies in Kuningan Regency has great potential to address livestock waste problems sustainably, but still faces a number of implementation obstacles. The policy innovation approach based on interactive value, distributed co-creation, and mass collaboration has proven to be able to encourage cross-actor participation, increase the social and economic value of waste, and strengthen policy legitimacy. The involvement of farmers in training, integration of waste processing technologies such as biogas, and the formation of knowledge networks and cooperatives are real practices of an inclusive policy innovation model.

However, the effectiveness of this policy innovation is still hampered by the lack of financial support for small farmers, the unavailability of an integrated waste monitoring system, and weak education and cross-sector coordination. Therefore, strategies to increase the effectiveness of waste management must be directed at institutional integration, providing incentives, strengthening technological infrastructure, and developing comprehensive educational policies. With this approach, waste management policies not only solve environmental problems, but also create new economic opportunities and strengthen local food security.

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