

Improving Farmers' Knowledge of Sheep Manure-Based Bokashi Fertilizer in Sukabumi: A Development Communication Approach

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Abstract. Sheep farming in Gegerbitung District, Sukabumi Regency, generates a significant amount of feces waste that is not optimally utilized. This study examines the role of development communication in improving farmers' knowledge regarding the innovation of processing sheep manure into bokashi fertilizer. The study aims to (1) assess farmers' knowledge levels on utilizing sheep manure before and after extension activities, (2) analyze differences in knowledge levels between pre- and post-extension periods, and (3) examine the relationship between farmers' characteristics and their knowledge improvement. This research employs a quantitative pre-test and post-test design involving 117 sheep farmers selected through purposive sampling from five farmer groups. Data were collected using structured questionnaires and analyzed using descriptive analysis, the Wilcoxon signed-rank test, and Spearman's rank correlation. The results indicate a significant increase in farmers' knowledge after the extension activities. The Wilcoxon test yielded a p-value of 0.000 ($p < 0.05$), confirming a significant difference in knowledge levels before and after the training. Spearman's correlation analysis showed a positive relationship between age and knowledge level ($rs = 0.190$, $p < 0.05$), while the number of livestock owned had a negative correlation with knowledge level ($rs = -0.314$, $p < 0.01$). These findings highlight the effectiveness of development communication in facilitating knowledge transfer among farmers. The study suggests that future extension programs, in addition to addressing labor and time constraints, should be tailored to the demographic characteristics of farmers to enhance the adoption of sustainable waste management innovations.

Keywords: Bokashi fertilizer, Development communication, Extension, Knowledge improvement, Sheep farming

Abstrak. Peternakan domba di Kecamatan Gegerbitung, Kabupaten Sukabumi, menghasilkan limbah feses dalam jumlah besar yang belum dimanfaatkan secara optimal. Penelitian ini menganalisis peran komunikasi pembangunan dalam meningkatkan pengetahuan peternak terkait inovasi pemanfaatan feses domba menjadi pupuk bokashi. Tujuan penelitian ini adalah untuk (1) mengevaluasi tingkat pengetahuan peternak sebelum dan setelah kegiatan penyuluhan, (2) menganalisis perbedaan tingkat pengetahuan sebelum dan sesudah penyuluhan, serta (3) menguji hubungan antara karakteristik peternak dengan peningkatan pengetahuan mereka. Penelitian ini menggunakan desain kuantitatif pre-test dan post-test, dengan melibatkan 117 peternak yang dipilih secara purposive dari lima kelompok ternak. Data dikumpulkan melalui kuesioner terstruktur dan dianalisis menggunakan analisis deskriptif, uji Wilcoxon signed-rank, dan korelasi rank Spearman. Hasil penelitian menunjukkan bahwa terdapat peningkatan signifikan dalam tingkat pengetahuan peternak setelah penyuluhan. Uji Wilcoxon menunjukkan nilai $p = 0,000$ ($p < 0,05$), yang mengindikasikan perbedaan yang signifikan sebelum dan setelah penyuluhan. Analisis korelasi Spearman menunjukkan hubungan positif antara usia dan tingkat pengetahuan ($rs = 0,190$, $p < 0,05$), sedangkan jumlah kepemilikan ternak memiliki hubungan negatif dengan tingkat pengetahuan ($rs = -0,314$, $p < 0,01$). Hasil ini menunjukkan bahwa komunikasi pembangunan efektif dalam meningkatkan pengetahuan peternak. Oleh karena itu, program penyuluhan di masa depan selain permasalahan tenaga kerja dan waktu, juga perlu disesuaikan dengan karakteristik demografi peternak untuk meningkatkan adopsi inovasi pengelolaan limbah berkelanjutan

Kata kunci: Komunikasi pembangunan, Penyuluhan, Peningkatan pengetahuan, Peternakan domba, Pupuk bokashi

Introduction

Development communication plays a crucial role in driving social, economic, and environmental transformation through the effective dissemination of information to

communities. According to Melkote and Singhal (2021), development communication encompasses actions aimed at social integration and transformation, focusing on individual and community empowerment through social

mobilization and advocacy. In the agricultural sector, development communication seeks to enhance the adoption of technological innovations that improve productivity and sustainability. Agricultural extension, as a form of development communication, plays a crucial role in improving farmers' knowledge, skills, and decision-making capacity, particularly in the adoption of sustainable agricultural innovations. Previous studies emphasize that effective extension programs do not merely transfer information but facilitate learning processes that enable farmers to understand, evaluate, and apply new practices according to their local contexts (Knierim et al., 2017; Knook et al., 2018). However, the effectiveness of extension services is highly dependent on the quality of communication, accessibility of information, and relevance of training materials to farmers' real conditions (Verschoor et al., 2025). In many developing agricultural systems, limitations in extension delivery often result in knowledge gaps that hinder the adoption of environmentally friendly technologies (Emeana et al., 2020).

Limited access to information and innovative technologies in livestock farming often prevents farmers from adopting environmentally friendly and sustainable production techniques. One of the primary challenges in Gegerbitung District, Sukabumi Regency, is the low utilization of sheep manure waste as a potential resource for organic fertilizer production. Despite the district having a sheep population of 10,090 (BPP Gegerbitung, 2023), the waste remains largely unutilized, with most farmers still relying on chemical fertilizers. This reliance not only increases production costs but also adversely affects environmental sustainability.

Organic fertilizers have gained increasing attention due to their potential to improve soil fertility, reduce environmental degradation, and enhance farmers' welfare. Empirical studies demonstrate that the adoption of organic fertilizers is influenced by farmers' education

level, access to extension services, and availability of relevant knowledge (Abebe & Debebe, 2019; Muluneh et al., 2022). Beyond agronomic benefits, organic fertilizer adoption has also been associated with improved farm income, market participation, and household welfare, indicating that knowledge improvement through extension may generate broader socio-economic impacts (Belete & Gebru, 2025; Oyetunde et al., 2021). Research on sheep manure composting shows that microbial-assisted composting significantly improves compost quality, reduces phytotoxicity, and increases its suitability as organic fertilizer for crop production (Zha et al., 2024; Zhang et al., 2024; Zhou et al., 2025). Bokashi fertilizer, produced through anaerobic fermentation of organic waste using effective microorganisms (EM), represents a practical, economical, and locally adaptable innovation for managing livestock waste, as microbial inoculation during composting enhances decomposition efficiency, nutrient availability, and compost maturity (Hidalgo et al., 2022; Lew et al., 2021).

Bokashi enhances soil fertility by supplying essential macronutrients such as nitrogen (N), phosphorus (P), and potassium (K), which support plant growth (Safira, 2012, as cited in Rusnani et al., 2021). Development communication refers to the use of communication to facilitate social development (Rogers, 1976). The development communication approach is used to convey agricultural and livestock innovations in a clear, relevant, and understandable manner, thereby increasing farmers' knowledge. Extension activities represent one form of development communication, in which change agents help farmers understand new technologies and practices, including waste management and its utilization. In this regard, extension activities on processing sheep manure into bokashi fertilizer serve as a development communication strategy to increase farmers' knowledge and awareness

of sustainable waste management. Previous studies have highlighted the benefits of bokashi in improving soil quality and crop yields (Sobari, 2020; Supandji et al., 2022). However, research that explicitly analyzes the effectiveness of extension programs as a development communication strategy in enhancing farmers' knowledge of sheep manure waste management remains scarce. Furthermore, the relationship between farmers' socioeconomic characteristics and their adoption of this innovation has not been extensively explored. This underscores the need for research that integrates a development communication approach with socioeconomic analysis to enhance the adoption of waste management technologies.

This study aims to (1) assess farmers' knowledge levels on utilizing sheep manure before and after extension activities, (2) analyze differences in knowledge levels before and after extension activities, and (3) examine the relationship between farmers' characteristics and their knowledge of this innovation. Using descriptive analysis and the Wilcoxon test, this research is expected to contribute scientifically to the formulation of effective development communication strategies in the livestock sector.

This study provides a novel contribution not by introducing a new development communication approach, but by applying an existing one within the specific context of an extension program on processing sheep manure into bokashi fertilizer. Specifically, it evaluates farmers' knowledge levels before and after extension activities, and it analyzes the relationship between farmers' characteristics, such as education level, farming experience, and livestock ownership, and their knowledge levels. The findings are expected to provide practical guidance in designing more effective development communication programs to support livestock sector sustainability.

Materials and Methods

Research Location and Period

This study was conducted in Gegerbitung District, Sukabumi Regency, an area with significant potential for sheep farming. The location was purposively selected due to its high sheep population and the existing challenge of low waste utilization for organic fertilizer production. The research was conducted from March to May 2024, covering the preparation, extension implementation, and data collection phases.

Research Design

This study employs a descriptive quantitative approach using a pre-test and post-test design. The primary objective is to evaluate changes in farmers' knowledge levels before and after extension activities on bokashi fertilizer production from sheep manure. A correlation analysis was also conducted to examine the relationship between farmers' characteristics and knowledge levels.

The extension intervention was designed as a participatory training activity combining lectures, discussions, and practical demonstrations. Participatory extension and on-farm demonstrations have been widely recognized as effective approaches for enhancing farmers' understanding and learning outcomes, particularly when introducing new agricultural technologies (Adamsone-Fiskovica et al., 2021; Knook et al., 2018).

Population and Sample

The research population comprised sheep farmers in Gegerbitung District who were members of livestock farmer groups. There were 254 farmers in 21 farmer groups. A purposive sampling method was applied, selecting 117 respondents from five farmer groups (Tani Hutan Sejahtera, Tani Diva, Tani Kutamandiri 1, Tani Kutamandiri 3, and Tani Kutamandiri 5) based on their sheep ownership. This selection

ensured representation from active livestock farmer groups within the study area.

Data Collection Instruments

Data were collected using structured questionnaires that had been validated through reliability and validity tests. The questionnaires included indicators of farmers' knowledge of the fundamentals, benefits, and production processes of bokashi fertilizer. Additionally, demographic data such as age, education level, farming experience, and livestock ownership were gathered.

Data Analysis

Data were analyzed using IBM SPSS Statistics version 25 and Microsoft Excel to support data visualization. The analysis included:

1. Descriptive Analysis: To describe respondent characteristics and knowledge distribution before and after the extension activities.
2. Wilcoxon Signed-Rank Test: To assess differences in knowledge levels before and after the training, given that the data did not meet normality assumptions.
3. Spearman Rank Correlation Analysis: To identify relationships between farmers' characteristics (age, education, experience, and livestock ownership) and their knowledge levels.

Conceptual Framework

This study assumes that development communication through extension programs can enhance farmers' knowledge. The conceptual framework links inputs (farmers' characteristics and extension activities), processes (training and discussions), and outputs (farmers' knowledge improvement).

Hypotheses

Farmers' knowledge levels

H_0 : There is no significant difference in farmers' knowledge levels before and after bokashi fertilizer training.

H_1 : There is a significant difference in farmers' knowledge levels before and after bokashi fertilizer training.

Relationship between farmers' characteristics and their knowledge levels

H_0 : There is no relationship between farmers' characteristics and their knowledge levels.

H_1 : There is a relationship between farmers' characteristics and their knowledge levels.

The extension activities in bokashi fertilizer training aimed to provide farmers with comprehensive guidance and practical training on the production and utilization of bokashi fertilizer. Through participatory learning sessions, farmers received technical information, demonstrations, and advisory support to enhance their understanding and adoption of sustainable waste management practices.

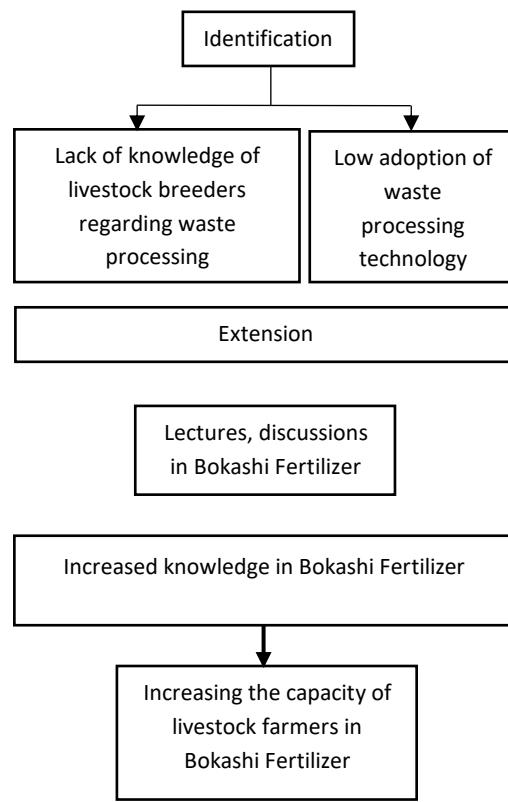


Figure 1 Research Thinking Framework in Bokashi Training

Table 1. Respondent Characteristics

Category	Number of Farmers	Percentage (%)
Age		
23-29	14	12
30-36	13	11
37-43	13	11
44-50	41	35
51-57	23	20
58-64	9	8
65-71	4	3
Total	117	100
Education		
Elementary School	50	43
Junior High School	45	38
Senior High School	22	19
Total	117	100
Farming Experience		
< 5 years	44	38
5-10 years	60	51
>10 years	13	11
Total	117	100
Number of Sheep Owned		
<5 heads	46	40
5-10 heads	54	46
11-15 heads	12	10
>15 heads	5	4
Total	117	100

Results and Discussion

Characteristics of Farmers

The study involved 117 respondents, all of whom were sheep farmers in the Gegerbitung District. The characteristics analyzed included age, education level, farming experience, and livestock ownership, as shown in Table 1.

The age distribution of farmers indicates a predominance of productive age groups. The majority (35%) are between 44 and 50 years old, followed by those aged 51–57 (20%). The younger age group (23–29 years) accounts for only 12%, reflecting the limited participation of young farmers in sheep farming.

Regarding education, most farmers have only completed elementary school (43%), while 38%

have attained junior high school education, and only 19% have completed senior high school. This relatively low level of education may affect their ability to adopt new technologies, such as processing sheep manure into bokashi fertilizer. Consequently, extension programs play a crucial role in enhancing their understanding of waste management innovations.

Most farmers have 5–10 years of experience (51%), while 38% have less than 5 years of experience. Only 11% have more than 10 years of experience. This suggests that while many farmers possess moderate experience, a significant portion is still in the early to mid-stages of livestock management.

Regarding livestock ownership, most farmers (46%) own 5–10 sheep, followed by those with

fewer than five sheep (40%). Only a small proportion own 11–15 sheep (10%) or more than 15 (4%). This distribution highlights that sheep farming in this area is predominantly small to medium-scale, requiring targeted interventions to optimize waste management practices and technology adoption.

The data in Table 1 indicate that sheep farmers in Gegerbitung District are predominantly middle-aged, with basic education, moderate farming experience, and small-scale livestock ownership. These demographic characteristics serve as a foundation for designing extension programs tailored to farmers' specific needs, thereby increasing the adoption of innovative waste management practices, such as converting sheep manure into bokashi fertilizer.

Farmers' Knowledge Level

This study assessed farmers' knowledge levels before and after extension activities on processing sheep manure into bokashi fertilizer. The results indicate a significant improvement in their understanding of the innovation.

Knowledge Level Before Extension (Pre-test)

Before the extension activities, the majority of respondents (73%) were classified as having "insufficient knowledge" (scoring 1–5), indicating a low initial understanding of bokashi fertilizer processing. Only 27% of respondents fell into the "sufficient knowledge" category (scoring 6–10). This low knowledge level was likely due to limited access to information and a lack of prior training opportunities.

Knowledge Level After Extension (Post-test)

Following the extension program, all respondents (117 individuals, 100%) fell into the "sufficient knowledge" category, with scores ranging from 6 to 10. None remained in the

"insufficient knowledge" category. This improvement reflects that the extension activities successfully enhanced farmers' understanding of the concept, benefits, and process of bokashi fertilizer production.

The difference between pre-test and post-test results demonstrates that extension program had a significant impact on increasing farmers' knowledge levels. This indicates that lecture-based and discussion-oriented extension methods used in this study effectively introduced technological innovations to farmers.

The significant increase in knowledge levels highlights the importance of development communication through extension programs in empowering farmers to adopt new technologies. With improved knowledge, farmers are expected to implement waste management practices independently, promoting sustainable and environmentally friendly livestock farming.

The significant increase in farmers' knowledge after the extension program indicates that development communication through structured training effectively enhances understanding of bokashi fertilizer production. This finding aligns with previous studies showing that targeted extension activities improve farmers' cognitive capacity and readiness to adopt sustainable practices (Muluneh et al., 2022; Mwaura et al., 2021).

Difference in Knowledge Levels Before and After Extension

According to Hastari et al. (2020), the Wilcoxon signed-rank test is a non-parametric statistical method often used as an alternative to the paired sample t-test. This test determines whether there is a significant difference between two paired samples. The results of the Wilcoxon test are presented in Table 3.

Table 2. Knowledge Levels Before and After Extension

Category	Score	Number of Farmers	Percentage (%)
Pre-test			
sufficient knowledge	6-10	32	27
insufficient knowledge	1-5	85	73
Total		117	100
Post-test			
sufficient knowledge	6-10	117	100
insufficient knowledge	1-5	-	-
Total		117	100

Tabel 3. Wilcoxon test results for the knowledge aspect

Test Statistics ^a		Post-test – pre-test
Z		-9.497 ^b
Asymp. Sig. (2-tailed)		.000

Note: a. Wilcoxon Signed Ranks Test; b. Based on negative ranks

Extension programs are a practical development communication approach to enhancing farmers' knowledge of new technologies. Using the Wilcoxon test, this study analyzed the difference in farmers' knowledge levels before and after the extension program. The analysis results indicated a significant difference, providing several key findings for discussion.

The Z value of -9.497 in the Wilcoxon Signed Ranks Test indicates a very strong and consistent change between the pre-test and post-test scores. The negative sign of the Z value shows that the majority of respondents had higher post-test scores compared to their pre-test scores. In other words, the knowledge level of the respondents increased significantly after the extension program or intervention.

The Wilcoxon test yielded a significance value of 0.000 ($p < 0.05$), indicating a statistically significant difference in farmers' knowledge before and after the extension activities. This means that the improvement in knowledge did not occur by chance; rather, it was truly the

result of the extension activities implemented. This confirms that the extension program effectively improved farmers' knowledge.

Before the extension program, 73% of respondents had "insufficient knowledge" of bokashi fertilizer. The lack of information and access to training contributed to this knowledge gap. However, after the extension program, all respondents demonstrated a significant increase in knowledge, placing them in the "sufficient knowledge" category. The combination of lecture-based delivery and interactive discussions proved effective in enhancing farmers' comprehension of the topic. Active participation in discussions also contributed positively to this outcome.

Relationship Between Farmers' Characteristics and Knowledge Aspects

This study examines the relationship between farmers' characteristics and knowledge levels after the extension program. The correlation results are presented in Table 4.

Table 4. Correlation between Farmers' Characteristics and Knowledge Aspects

Farmers' Characteristics	Knowledge Level (rs)
Age	0.190*
Education	-0.025
Farming Experience	0.084
Number of Livestock	-0.314**

Note: *Significant correlation at $p < 0.05$; **Significant correlation at $p < 0.01$; r_s = Spearman's rank correlation coefficient

Based on Table 4, the Spearman rank correlation test indicates a significant positive correlation between age and knowledge level, with a Spearman coefficient of $r_s = 0.190$ at a significance level of $p < 0.05$. This suggests a weak positive relationship between age and knowledge level, implying that as farmers age, their knowledge increases slightly.

Older individuals may have more life experience and opportunities to learn from hands-on practice, enhancing their knowledge, particularly in a practical or work-based context. However, since the correlation is weak (r_s close to 0), the effect of age on knowledge level is not substantial. Other factors, such as formal education, training, or personal interest, may more significantly determine knowledge levels.

The Spearman rank correlation test also shows a significant negative correlation between the number of livestock owned and knowledge level, with a coefficient of $r_s = -0.314$ at $p < 0.01$. This indicates that as the number of livestock increases, farmers tend to have lower knowledge levels.

This negative correlation could indicate that farmers managing larger herds may have less time, access, or opportunity to enhance their knowledge through formal education, training, or learning activities. The knowledge measured in this study is likely more theoretical or managerial, whereas those managing large herds may rely more on practical experience than theoretical knowledge. Managing more livestock requires substantial time and energy, which may reduce the time available for further education through reading, attending training, or formal learning.

Given these findings, knowledge development programs and training sessions should be tailored to accommodate older farmers and those managing large livestock herds. More discussion-based learning may benefit older farmers, while practical, flexible training sessions may be more effective for those with larger herds.

The correlation between age and knowledge level aligns with the findings of Kurnia et al. (2019), Waris et al. (2019), Sritiasni and Labatar (2017), and Putri et al. (2021). According to Mulyawati et al. (2016), age influences physical ability, cognitive processes, and the capacity to adopt innovations in managing farming businesses. Younger farmers tend to be more enthusiastic and eager to acquire new knowledge, leading them to adopt innovations faster despite having less farming experience.

However, the negative correlation between livestock ownership and knowledge level does not align with previous studies by Kurnia et al. (2019), Putra et al. (2016), and Hendrawati et al. (2018). These studies found a positive correlation between livestock ownership and knowledge of innovation implementation. Therefore, the results of this study suggest that such correlations may be context-dependent.

The correlation between farmers' characteristics—such as number of livestock owned, education level, and time availability—and post-training knowledge scores suggests that resource endowment influences learning outcomes. Similar patterns have been reported in studies on organic fertilizer adoption, where household resources and farming intensity shape farmers' ability to absorb and apply new

information (Abebe & Debebe, 2019; Ayanwale et al., 2025).

The findings reveal a significant improvement in farmers' knowledge levels following the extension program. This is consistent with Notoatmodjo (2010), who stated that both formal and informal information sources contribute to short-term knowledge enhancement and have the potential to drive behavioral change. This study also supports Risna et al. (2020), who found that extension programs effectively increase farmers' understanding of production technologies, similar to the impact observed in the bokashi fertilizer training in this study. These results further align with the study by Hastari et al. (2020), which found that extension activities significantly improve farmers' knowledge of agricultural technology.

Additionally, this study underscores the importance of development communication, as discussed by Melkote and Singhal (2021). Development communication, particularly in agriculture and waste management, plays a crucial role in empowering local communities to adopt sustainable innovations. In this context, extension programs serve as a social mobilization mechanism, enabling farmers to participate actively in environmentally friendly farming practices.

Broader Implications for Related Fields

Improved knowledge enables farmers to adopt waste processing technologies, which not only benefit them economically but also support environmental sustainability in the areas of community-based waste management, sustainable agriculture, farmer empowerment through extension programs, and environmental impact reduction. This study makes an essential contribution to research on community-based waste management. Transforming sheep manure into bokashi fertilizer reduces waste and enhances its economic value for farmers. This aligns with the

study by Balitbangtan (2006), which emphasizes the importance of livestock waste processing in supporting sustainable agriculture.

From a technical perspective, the improved understanding of bokashi fertilizer among farmers is supported by scientific evidence demonstrating that EM-based composting enhances nutrient stabilization and compost maturity. Studies on manure biostabilization and sheep manure composting confirm that microbial inoculation accelerates decomposition processes and improves fertilizer quality (Hidalgo et al., 2022; Zhang et al., 2024; Zhou et al., 2025).

Using organic fertilizers such as bokashi supports agricultural sustainability by improving soil fertility and reducing dependency on chemical fertilizers. These findings are consistent with the study by Sobari (2020), which demonstrated the effectiveness of bokashi fertilizer in enhancing plant growth, thereby directly benefiting agricultural productivity.

Improved knowledge of organic fertilizer production may contribute to broader economic and environmental benefits. Previous research indicates that organic fertilizer adoption is associated with increased market participation and household welfare, reinforcing the importance of extension programs in promoting sustainable agriculture (Belete & Gebru, 2025; Culas et al., 2025; Oyetunde et al., 2021).

This study also contributes to the literature on farmer empowerment through extension programs (Tuckey, 2022). By strengthening farmers' capacity to manage local resources, this research highlights the potential of development communication in addressing socio-economic issues in rural areas.

From an ecological perspective, processing sheep manure waste into bokashi fertilizer helps mitigate environmental pollution caused by livestock waste, as outlined in the guidelines by Kementan (2015). Thus, this study provides a

practical example of applying sustainability principles locally.

Conclusions

It could be concluded from the results that farmer's financial and children's desires positively and significantly affect farmers' commitment to children's education directly and indirectly through farmer's interest and motivation to send their children to school. Farmers' knowledge of educational services could increase their interest and motivation to send their children to school, indirectly affecting their commitment. The government needs to disseminate education programs and scholarships to farmer's families to increase their knowledge about programs and the farmer's children's desire to go to school. The hope is that education can increase the productivity and income of farming families, thereby increasing the family's welfare in the future. The limitation of this study is that the respondents are farmers who are not specifically explained, and the scale of ownership is very diverse. The researcher also did not consider the current conditions regarding the education of the children of farmers. The authors recommend the research based on the perspective of livestock farmers' children regarding this topic so that information about the education of livestock farmers' children becomes more holistic.

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