

DEVELOPMENT OF CONCENTRATE-COMBINED SILAGE TECHNOLOGY FOR SUSTAINABLE WASTE MANAGEMENT AND ENHANCED GOAT PRODUCTIVITY IN KAHURIPAN URBAN VILLAGE

Dwi Wijayanti ^{1*}, Anita Dwy Fitria ², Missi Hikmatyar ¹, Kusuma Agdhi Rahwana ¹, Rini Nuranisa ¹, Ashila Rahmani Kamila ¹, Fazril Septian ¹, Yuda Yudis Triyawan ¹

¹ Universitas Perjuangan Tasikmalaya

Jl. Pembela Tanah Air No 177, Kahuripan, Tawang, Tasikmalaya, West Java, Indonesia, 46115, Indonesia

² Universitas Siliwangi

Jl. Mugarsari, Tamansari, Tasikmalaya, West Java, 46196, Indonesia

Email: wijyantidwi12@gmail.com

Abstract

The sustainability of small ruminant farming in developing regions is often constrained by feed scarcity during the dry season, low animal productivity due to unbalanced nutrition, and ineffective agricultural waste management. This program addressed these challenges by implementing a concentrate-combined silage technology within the Farmers Group (Poktan) and Women Farmers Group (KWT) in Kahuripan Urban Village. The primary objective was to transform abundant local corn stover into high-quality, stable animal feed. A quasi-experimental (pretest-posttest) design was employed to evaluate the intervention's effectiveness. Results indicated a statistically improvement in the participants' knowledge regarding nutrition and silage technology (2.84 and 2.7 for KWT and Poktan, respectively). The resulting silage, enriched with concentrate, demonstrated optimal fermentation success, confirmed by achieving a pH range of 3.8 and favorable physical characteristics. Crucially, the introduction of this enriched silage into the feeding regimen of goats at Poktan led to a higher Average Daily Gain (ADG) compared to the traditional forage-only diet, thereby enhancing livestock productivity and resolving the problem of nutrient deficiency. This technology offers a sustainable, dual-benefit strategy by simultaneously converting agricultural by-products into a reliable feed source, ensuring year-round feed security, and improving the economic viability of small-scale goat farming.

Keywords: Silage, Concentrate, Vegetable Waste, Corn Stover, Goat Productivity, Feed Security

INTRODUCTION

Increasing livestock production, especially goats, is an important priority in agricultural development in Indonesia. However, the sustainability of the livestock sector is often hampered by the availability of quality feed and suboptimal management of agricultural/household waste. In Kahuripan Urban Village, this challenge is evident in two

main community groups: the Women Farmers Group (KWT) and the Farmers Group (Poktan). In the KWT, there is a significant issue related to the accumulation of vegetable waste generated from post-harvest or household activities. This waste, which is rich in nutrients but perishable, is often discarded without being utilized, causing sanitation and environmental problems. Meanwhile, in Poktan, agricultural practices leave large amounts of corn stalks (corn stalks and leaves) after harvest, which are also not fully utilized. The use of vegetable waste and corn stalks as animal feed can be a dual solution to address environmental issues and feed availability (Nath et al., 2023).

The feed problem in Poktan is exacerbated by the fact that goat farmers still rely heavily on fresh forage as their main feed. This single feed pattern results in an unbalanced nutritional intake, especially energy and protein, which directly impacts low livestock productivity (growth rate and milk production) (Garg et al., 2013). Furthermore, dependence on forage becomes critical during the dry season, when forage availability decreases dramatically, causing feed scarcity and potentially triggering economic losses for farmers (Henry et al., 2018; Tinsley et al., 2019). Therefore, feed preservation technology is needed that can provide high-quality and consistent feed throughout the year, as well as utilize local waste resources. In response to this problem, silage making was identified as the most relevant technology. Silage is fermented feed preserved under anaerobic conditions, effective for storing high-nutrient feed for long periods of time (Muck et al., 2020; Oliveira et al., 2022; Zemskova et al., 2022).

The main innovation in this activity is the combination of waste materials (corn stalks) with the addition of concentrate to the silage making process. The addition of concentrate aims to: (1) improve the fermentation process by providing an easily digestible energy substrate, and (2) increase the final nutritional content of silage, especially protein and energy, so that the resulting feed becomes a complete feed or a more balanced supplement feed for goats. Based on this background, this community service aims to apply silage production technology with concentrate mixtures in Poktan and KWT in Kahuripan Urban Village, as an effort to increase the utilization of local waste, ensure year-round feed availability, and ultimately, increase goat productivity in the area.

IMPLEMENTATION METHOD

This program employs a quasi-experimental design with a one-group pretest-posttest approach, aiming to measure the effectiveness of the silage-making technology combined with concentrate application. The activity will be conducted at two distinct community groups in Kahuripan Urban Village: KWT and the Poktan.

Pre-Intervention Assessment (Pretest Phase)

The initial phase involves a comprehensive assessment to establish baseline data regarding the participants' knowledge and the existing livestock practices (Table 1).

Table 1. Assessment for pretest

Component	Instrument/Method	Objective
Knowledge and Perception	Structured Pretest Questionnaire	To quantify the current knowledge level of KWT and Poktan members regarding: (a) livestock nutrition, (b) feed preservation techniques (silage), and (c) utilization of agricultural/vegetable waste.
Technical Baseline	Direct Observation and Interviews	To document the current goat feeding regime (type of forage, amount, frequency), existing waste management practices (corn stover at Poktan), and assessment of current livestock productivity (body condition score, growth rate approximation).

Socialization and Theoretical Training (Phase I: Knowledge Transfer)

A focused socialization and training program will be executed to build the theoretical foundation for the intervention. Content: the training will cover the principles of ruminant nutrition, the crucial role of balanced energy and protein (provided by concentrate), the chemical and biological processes of anaerobic fermentation in silage, and standardized procedures for mixing waste materials (corn stover) with concentrate additives. Delivery: utilisation of interactive lectures, multimedia presentations, and group discussions to ensure comprehension and address local constraints.

Implementation of Silage-Making Technology (Phase II: Practical Application)

This phase focuses on the hands-on application of the technology by the participants themselves. Raw Material Preparation: vegetable waste will be collected, sorted, and chopped to an optimal length (1–3 cm). Corn stover will be collected, dried (if necessary), and chopped using a mechanical chopper. Concentrate addition and mixing: the chopped raw materials will be mixed with a predefined ratio of concentrate to ensure a high-quality fermentation process and enhanced nutritional profile (Figure 1). The mixture will be thoroughly homogenized (Soundharrajan et al., 2021).

Ensiling process: the mixture will be tightly compacted into sealed, airtight containers (plastic drums or bags) to establish and maintain strict anaerobic conditions as required for optimal fermentation (Koakoski et al., 2024). The containers will be labelled with the date of ensiling and stored for the minimum required fermentation period (typically 3–4 weeks) (Weiß et al., 2022).

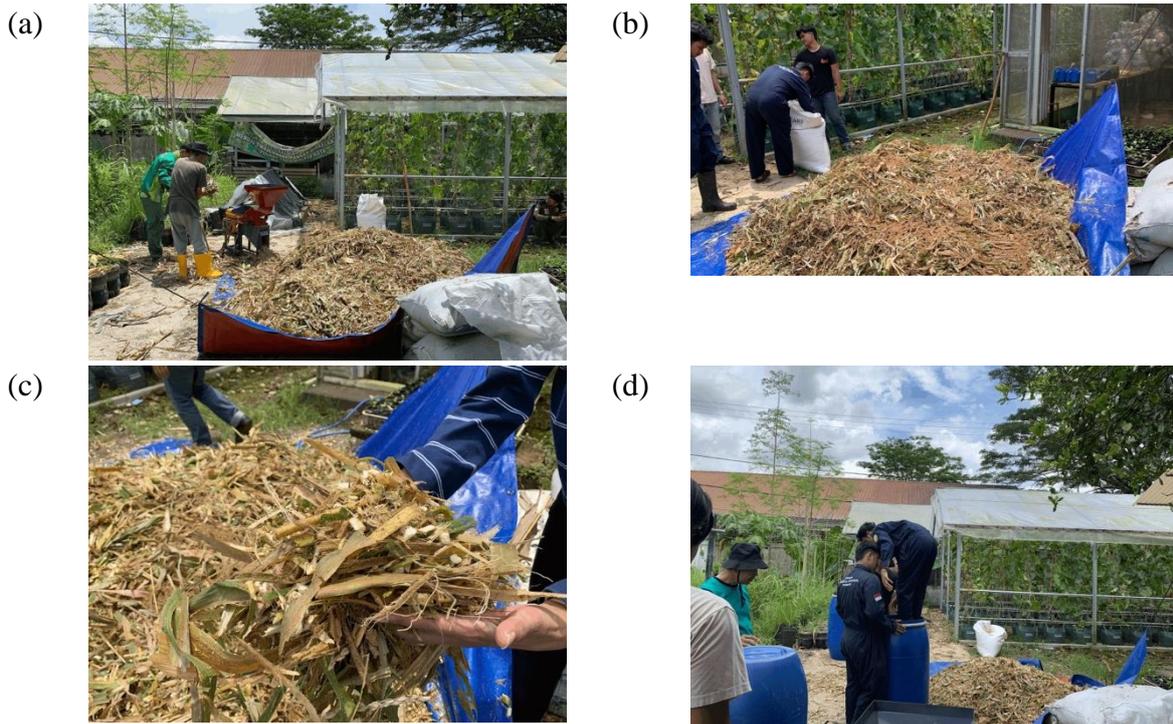


Figure 1. Production of silage combined with concentrate

Monitoring and Evaluation of the Process

Continuous monitoring and interim evaluation will be performed during and immediately after the fermentation period. Technical Monitoring: Checking the pH of the finished silage (target pH < 4.5), observing color, texture, and odour to assess the success of the fermentation process (Neira et al., 2024; Yu et al., 2024). Usage monitoring: documenting the rate and method of silage introduction into the goat diets at Poktan, replacing a portion of the conventional forage. Qualitative evaluation: structured interviews with key members of Poktan and KWT to identify any technical difficulties, required adjustments, and perceived benefits or limitations of the new feeding regime.

RESULTS AND DISCUSSION

Knowledge Improvement

The results of the knowledge test before (Pretest) and after (Posttest) the intervention are presented in Table 1. These data show the effectiveness of the socialization and training program in transferring knowledge about livestock nutrition and silage technology.

Table 1. Mean of Knowledge Improvement

Partner	Pretest (%)	Posttest (%)	Gain Score (%)
KWT Roay Lestari	70	98,4	28.4
POKTAN Tunas Harapan	71,5	98,5	27

[Source: Community service, 2025]

The results of the paired show a increase in knowledge among Poktan and KWT members regarding the basic principles of silage production and the role of concentrates in improving feed quality. This indicates that the socialization method applied has succeeded in changing the initial perceptions of participants, who previously relied solely on forage and viewed waste as useless, to an understanding that local waste can be converted into nutritious feed through silage technology (Garcia Rodriguez et al., 2024).

Silage Quality and Fermentation Success

Physical and Chemical Quality Parameters

Table 2 shows the results of the evaluation of silage quality produced by KWT participants and Poktan (from corn stalks) with the addition of concentrate. The pH value of the silage produced is 3.9. This low pH value confirms the success of the optimal anaerobic fermentation process, in which sugar is converted into lactic acid.

Table 2. Characteristics of Silage Quality Produced

Parameter	Silage from Implementation	Ideal Quality (Anas et al., 2024)
pH	3.9	3.8 – 4.2
Odor	Freshly acidic	Acidic, not foul/musty
Color	Yellowish green	Olive green
Texture	Dry, compact, and mold-free	Mold-free

[Source: Community service, 2025]

The addition of concentrate plays an important role as a source of water-soluble carbohydrates (WSC) needed by lactic acid bacteria (LAB) for rapid fermentation initiation, especially in vegetable waste with high water content (Anas et al., 2024). The concentrate helps address the low moisture WSC in Poktan corn stalks, resulting in silage with a pleasant odor for livestock (fresh/sweet acid) and good storage capacity (Ali & Tahir, 2021).

Impact on Goat Productivity

Increase in Average Daily Gain (ADG)

Table 3 presents a comparison of goat growth performance in the farmer group between the group that was only given forage (control) and the group that was given a combination of corn stover silage and concentrate (treatment). The goat group fed corn stover silage enriched with concentrate showed higher ADG values (48 g/day) compared to the control group (20 g/day).

Table 3. Average increase in ADG in goats fed silage with concentrate combinations

Test Group (30-day duration)	Mean (g/day)	Significancy
Forage Only (Control)	20	
Silage + Concentrate (Treatment)	48	P<0.05

[Source: Community service, 2025]

This increase in productivity was due to a more balanced nutritional intake from the concentrate-enriched silage. This silage provides more stable and digestible energy and

protein than single forage alone (Hassan et al., 2025), which directly addresses the nutritional deficiencies that have long been a constraint for farmers. Additionally, the availability of processed feed in the form of silage ensures feed availability in farmer groups, especially to address the threat of drought, thereby providing nutritional stability and better economic potential for farmers (Wróbel et al., 2025).

Utilization of Local Waste

The implementation of this technology has proven successful in utilizing vegetable waste from KWT and corn stalk waste from Poktan, which were previously discarded. This activity transforms waste into an economically valuable feed resource, while also reducing environmental problems in Kahuripan Urban Village.

CONCLUSION

In summary, the application of concentrate-combined silage technology serves as a sustainable, dual-purpose solution that simultaneously manages local agricultural waste and enhances the nutritional quality and security of goat feed, thereby boosting the productivity and resilience of livestock farming in Kahuripan Urban Village.

REFERENCES

- Ali, M. F., & Tahir, M. (2021). An Overview on the Factors Affecting Water-soluble Carbohydrates Concentration during Ensiling of Silage. *Journal of Plant and Environment*, 3(1), 63–80. <https://doi.org/10.33687/jpe.003.01.3702>
- Anas, S., Natsir, A., & Syahrir, S. (2024). Organoleptic Test Characteristics of Corn Stover Silage Added with Several Legumes. *Hasanuddin Journal of Animal Science (HAJAS)*, 6(2), 104–113. <https://doi.org/10.20956/hajas.v6i2.31778>
- Garcia Rodriguez, V., Vandestroet, L., Abeysekara, V. C., Ominski, K., Bumunang, E. W., McAllister, T., Terry, S., Miranda-Romero, L. A., & Stanford, K. (2024). Optimizing Silage Strategies for Sustainable Livestock Feed: Preserving Retail Food Waste. *Agriculture*, 14(1), 122. <https://doi.org/10.3390/agriculture14010122>
- Garg, M. R., Sherasia, P. L., Bhanderi, B. M., Phondba, B. T., Shelke, S. K., & Makkar, H. P. S. (2013). Effects of feeding nutritionally balanced rations on animal productivity, feed conversion efficiency, feed nitrogen use efficiency, rumen microbial protein supply, parasitic load, immunity and enteric methane emissions of milking animals under field conditions. *Animal Feed Science and Technology*, 179(1–4), 24–35. <https://doi.org/10.1016/j.anifeedsci.2012.11.005>
- Hassan, M., Rivelli, I., Yáñez-Ruiz, D. R., & Belanche, A. (2025). Use of cucumber waste silage as an alternative forage source for sheep. *Animal Feed Science and Technology*, 330, 116541. <https://doi.org/10.1016/j.anifeedsci.2025.116541>
- Henry, B. K., Eckard, R. J., & Beauchemin, K. A. (2018). Review: Adaptation of ruminant livestock production systems to climate changes. *Animal*, 12, s445–s456. <https://doi.org/10.1017/S1751731118001301>
- Koakoski, D. L., Bordin, T., Cavallini, D., & Buonaiuto, G. (2024). A Preliminary Study of the

- Effects of Gaseous Ozone on the Microbiological and Chemical Characteristics of Whole-Plant Corn Silage. *Fermentation*, 10(8), 398. <https://doi.org/10.3390/fermentation10080398>
- Muck, R. E., Kung, L., & Collins, M. (2020). Silage Production. In K. J. Moore, M. Collins, C. J. Nelson, & D. D. Redfearn (Eds.), *Forages* (1st ed., pp. 767–787). Wiley. <https://doi.org/10.1002/9781119436669.ch42>
- Nath, P. C., Ojha, A., Debnath, S., Sharma, M., Nayak, P. K., Sridhar, K., & Inbaraj, B. S. (2023). Valorization of Food Waste as Animal Feed: A Step towards Sustainable Food Waste Management and Circular Bioeconomy. *Animals*, 13(8), 1366. <https://doi.org/10.3390/ani13081366>
- Neira, L. M., Gonçalves, A. M., Buzollo, H., De Sandre, L. C. G., Do Nascimento, T. M. T., Coutinho, J. J. O., Pizauro Junior, J. M., & Carneiro, D. J. (2024). Effect of acid and fermented silage hydrolysis time on protein fractionation and digestibility for Nile Tilapia. *Animal Feed Science and Technology*, 318, 116126. <https://doi.org/10.1016/j.anifeedsci.2024.116126>
- Oliveira, M. W. D., Silva, J. D. B. D., Oliveira, T. B. A., Santos, D. D. F., Tenório, T. M., Soares, E. D. C., & Rocha, G. L. (2022). Dry matter accumulation and nutrient cycling by soil cover plants in an intensive corn silage production system. *Research, Society and Development*, 11(8), e45611831008. <https://doi.org/10.33448/rsd-v11i8.31008>
- Soundharrajan, I., Park, H. S., Rengasamy, S., Sivanesan, R., & Choi, K. C. (2021). Application and Future Prospective of Lactic Acid Bacteria as Natural Additives for Silage Production—A Review. *Applied Sciences*, 11(17), 8127. <https://doi.org/10.3390/app11178127>
- Tinsley, T. L., Chumbley, S., Mathis, C., Machen, R., & Turner, B. L. (2019). Managing cow herd dynamics in environments of limited forage productivity and livestock marketing channels: An application to semi-arid Pacific island beef production using system dynamics. *Agricultural Systems*, 173, 78–93. <https://doi.org/10.1016/j.agsy.2019.02.014>
- Weiß, K., Kroschewski, B., & Auerbach, H. U. (2022). The Influence of Delayed Sealing and Repeated Air Ingress during the Storage of Maize Silage on Fermentation Patterns, Yeast Development and Aerobic Stability. *Fermentation*, 8(2), 48. <https://doi.org/10.3390/fermentation8020048>
- Wróbel, B., Zielewicz, W., & Paszkiewicz-Jasińska, A. (2025). Improving Forage Quality from Permanent Grasslands to Enhance Ruminant Productivity. *Agriculture*, 15(13), 1438. <https://doi.org/10.3390/agriculture15131438>
- Yu, Y., Tian, H., Zhao, K., Guo, L., Zhang, J., Liu, Z., Xue, X., Tao, Y., & Tao, J. (2024). Rapid pH Value Detection in Secondary Fermentation of Maize Silage Using Hyperspectral Imaging. *Agronomy*, 14(6), 1204. <https://doi.org/10.3390/agronomy14061204>
- Zemskova, N. E., Kornilova, V. A., Meshcheryakov, A. G., & Penkin, P. V. (2022). Impact of Silo Twice biopreservative on haylage quality. *BIO Web of Conferences*, 52, 00051. <https://doi.org/10.1051/bioconf/20225200051>