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Enhancing small ruminant farm efficiency: Evidence-based management strategies from Cagayan, Philippines

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Abstract

This study on enhancing small ruminant farm efficiency: evidence-based management strategies for small ruminant farms, specifically sheep (ovine) and goats (caprine) has an objective to assess the small ruminant farms in the three (3) Districts of Cagayan, Philippines. Small ruminants provide an essential role in the livelihoods of many farmers, therefore enhancing productivity is necessary for food security and economic stability. The study indicates important areas for improvement, including as feeding management, breeding system, health management, and farm management strategies. Surveys and questionnaires were used to collect data, which revealed varied results in farm performance associated with the use of certain management strategies. The researchers strongly emphasize the significance of education and support for farmers to effectively implement these management strategies.

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Introduction

Raising ruminants is very popular among Filipinos because it requires low capital investment and it fits backyard farm conditions. Ruminants require minimum maintenance because they basically feed on leaves, grasses, fodder trees, and hay which are locally available in the community. Ninety-nine percent of the country's total small ruminants are raised in small-hold or backyard farm units (Cerna and Abao, 2022).

Small ruminant production systems are also classified into backyard and commercial. Small ruminants in the Philippines consist almost entirely of goat and sheep. Goats represent a large proportion of the country's small ruminant population. Due to the lack of regular population surveys, the inventory of goat and sheep in the country is not well established. However, some studies have estimated the sheep population at about 30,000 to 35,000 head, or roughly 1-2% of the goat population. Almost one hundred percent of the country's small ruminant population is kept in backyard farm units (Cerna and Abao, 2022).

Cagayan is a province of the Philippines situated within the Cagayan Valley Region in the northeast of the Luzon Islands. It is divided into 3 districts, namely District 1, District 2, and District 3. It has 29 equally competitive and progressive municipalities. Municipalities under District 1 include Alcala, Aparri, Baggao, Buguey, Camalaniugan, Gattaran, Gonzaga, Lal-Lo, Santa Ana, and Santa Teresita. Municipalities under District 2 are Abulug, Allacapan, Ballesteros, Calayan, Claveria, Lasam, Pamplona, Piat, Rizal, Sanchez Mira, Santa Praxedes, and Sto. Niño, while the 3rd District includes Amulung, Enrile, Iguig, Peñablanca, Solana, Tuao, and Tuguegarao City. The province is a vast expanse of plains and valleys surrounded by mountains. It has abundant natural resources and rich agriculture. Agriculture remains the dominant activity throughout the province, playing an important role in the livelihoods of Cagayanos, specifically livestock, which adds stability to farm incomes, food security, and farming systems.

Small ruminants include sheep and goats, which are among the most economically important livestock, playing a part in the livelihood of resource-poor farmers because they are small animals requiring a small initial investment. Both small ruminants are major sources of food of animal origin that is available for human consumption. And as the human population increases, it should also be coupled with an increase in livestock production to meet the demand for food needed by people. The livestock industry was one of the strongest growths in Philippine agriculture from 1986 to 2000 (Philippine Statistics Authority). At the farm level, livestock rising is a major activity in rural areas. For a large proportion of smallholder households engaged in livestock rising, the activity is the primary source of income (UPLB-IFPRI Livestock Household Survey, 2000). As of January to December of 2017, the livestock industry shared 16.67 percent of the total agricultural output that was released just this year (2018) by the Philippine Statistics Authority, a 2.0 percent increase from the previous survey. The increasing percentage means that the livestock industry is progressing, and it calls for greater attention from the authorities to ensure the quality of goods produced by the industry.

Empirical to the given data, several gaps regarding specific management practices can be identified, which include integrated management approaches, climate resilience and adaptation, precision livestock farming technologies, socioeconomic and institutional factors, organic and alternative management practices, and longitudinal studies and impact assessment. Addressing these gaps could lead to a deeper understanding and more effective management strategies for farmers.

Materials and methods

Study design

The data collected from the survey were analyzed using descriptive statistics (percentage and tabulations).

Sampling

Small ruminant farms in the three (3) Districts of Cagayan, Philippines that were registered at the

Philippine Statistical Agency (PSA) were gathered as supporting data in the study and are included within the article.

Data collection

A survey in the form of questionnaire-interview method was used in the study. Respondents were either the small ruminant farm owner, caretaker or farm veterinarian. Survey forms contain questions on the farm's profile (population, species of small ruminants and type of farm system) and management practices (housing, feeding, water, breeding and herd health).

Results and discussion

The number of small ruminant farms in the three Districts of Cagayan is shown in Table 1. Out of the 127 registered farms as per record from the Philippine Statistical Agency, showed that there were 48 operational farms at the time of study. The decrease in the number of operational farms (48) were possibly due to the typhoons that hit the province (DOST – PAGASA Annual Report on Philippine Tropical Cyclones, 2017; 2018). Furthermore, results show that there are more registered small ruminant farms in District 3 (54.33%) and similarly there are more operational farms in District 3 (41.67%). Statistical analysis showed no significant difference in relation to number of small ruminant farms to registered and operational by District wherein Chi Square Test = 6.5917, P value = 0.1591 and Chi Square Test = 6.5917, P value = 0.1591 at 95% CI, respectively.

Table 1. Population of small ruminant farms in the three Districts of Cagayan

Districts	Number of small ruminant farms	
	Registered (2016)	Operational (2018-2019)
1	35 (27.56%)	16 (33.33%)
2	23 (18.11%)	12 (25.00%)
3	69 (54.33%)	20 (41.67%)
Total	127 (100.00%)	48 (100.00%)

Table 2 presents the herds of goat (caprine) and sheep (ovine) in the three Districts of Cagayan. Results show that there were more caprine (56.18%) reared than ovine (43.82%) in the province. Similar report of Hosseini *et al.* (2018), that Asia is the home of the goat about 60% of the 1 billion world goat population. And had been claimed that domestication of wild goats began in Asia more than 100 centuries ago. Goats in Asia are reared by small-scale farmers, who raised goats for nutrition, food security, and socio-economic status (Devendra and Liang, 2012). Results also show that District 2 (34.52%) reared more small ruminants in the province than District 3 (34.42%) and District 1 (31.06%). There are a number of reasons for the preponderance of small ruminant farmers in Cagayan's District 3.

Table 2. Herds of goat (caprine) and sheep (ovine) reared in the three Districts of Cagayan

District	Species		Total
	Caprine	Ovine	
1	229 (22.65%)	85 (8.41%)	314 (31.06%)
2	140 (13.85%)	209 (20.67%)	349 (34.52%)
3	199 (19.68%)	149 (14.74%)	348 (34.42%)
Total	568 (56.18%)	443 (43.82%)	1011 (100.00%)

These DOST-PCAARD-funded projects concentrates on developing technology-based goat production and providing small ruminant businesses with business incubation and technical support (CVSRRC, 2010). Statistical analysis showed no significant difference in relation to ovine and caprine distribution by District wherein Chi Square Test = 6.5917, P value = 0.1591 (caprine) and Chi Square Test = 6.5917, P value = 0.1591 (ovine) at 95% CI.

Table 3a. Farm system used in the three Districts of Cagayan

Districts	Farm system		Total
	Semi-intensive	Extensive	
1	16 (33.33%)	0 (0.00%)	16 (33.33%)
2	9 (18.75%)	3 (6.25%)	12 (25.00%)
3	20 (41.67%)	0 (0.00%)	20 (41.67%)
Total	45 (93.75%)	3 (6.25%)	48 (100.00%)

In terms of farm system, Table 3a shows that 45 (93.75%) small ruminant farms used semi-intensive system as compared to extensive system 3 (6.25%). Also, most farms in District 3 used semi-intensive system (44.44%) and only District 2 showed result of small ruminant farms using extensive system. This shows that majority of the small ruminant farmer in Cagayan raised in small-hold or backyard farm units with a limited pasture area (Cerna and Abao, 2022).

Table 3b. Housing management practiced in the three Districts of Cagayan

Districts	Housing management: Orientation		Total
	East-West	North-South	
1	16 (33.33%)	0 (00.00%)	16 (33.33%)
2	12 (25.00%)	0 (00.00%)	12 (25.00%)
3	14 (29.17%)	6 (12.50%)	20 (41.67%)
Total	42 (87.50%)	6 (12.50%)	48 (100.00%)

Table 3b. Continued

Districts	Housing management: Type of floor			Total
	Concrete	Wood	None	
1	2 (4.17%)	14 (29.17%)	0 (00.00%)	16 (33.33%)
2	4 (8.33%)	8 (16.67%)	0 (00.00%)	12 (25.00%)
3	2 (4.17%)	6 (12.50%)	12 (25.00%)	20 (41.67%)
Total	8 (16.67%)	28 (58.33%)	12 (25.00%)	48 (100.00%)

Table 3b. Continued

Districts	Housing management: Type of roof		Total
	Galvanized	Hut	
1	15 (31.25%)	1 (2.08%)	16 (33.33%)
2	2 (4.17%)	10 (20.83%)	12 (25.00%)
3	20 (41.67%)	0 (00.00%)	20 (41.67%)
Total	37 (77.09%)	11 (22.91%)	48 (100.00%)

The semi-intensive system, combining grazing with stall-feeding, is favored by small ruminant farmers due to its practicality for those with limited pasture. It maximizes land use efficiency, allows better control over feed and animal health, and reduces labor. This system also mitigates risks from environmental hazards and seasonal fluctuations in pasture quality, making it suitable for areas like District 3, where land is more constrained and environmental conditions vary (Devendra, 2007; Kassahun and Solomon, 2010; Sejian *et al.*, 2021). This approach enhances productivity by providing flexibility in managing feed resources. Statistical analysis showed no significant difference in relation to farm system by District wherein Chi Square Test = 6.5917, P value = 0.1591 (semi - intensive) and Chi Square Test = 3.8191, P value = 0.1481 (extensive) at 95% CI.

Based on housing management, Table 3b results show that the most common house orientation is East West (87.50%) compared to North South (12.50%). This orientation allows buildings to minimize direct sun exposure on the longer sides during the hottest parts of the day, reducing heat gain and providing a cooler environment for livestock. Studies suggest that proper house orientation can significantly impact thermal comfort and energy efficiency, particularly in tropical climates where minimizing heat stress is crucial for animal health and productivity (Pradhan *et al.*, 2015). Elevated housing (52.08%) is more preferred than ground (47.92%) Elevated is preferred over ground-level housing due to its advantages in flood-prone or wet areas, which are common. Elevated structures help prevent water-related issues such as dampness, which can lead to diseases in livestock (Patbandha *et al.*, 2012). Wooden floor (58.33%) is most common; galvanized roof (77.08%) Wooden floors are also less likely to cause foot problems, which can be common with harder flooring materials (Thirunavukkarasu *et al.*, 2017) while galvanized roofs provide effective protection against harsh weather conditions such as heavy rains and intense sunlight, which are common in tropical regions. The reflective properties of galvanized steel also help in reducing the heat absorbed by the structure, maintaining a cooler interior is mostly preferred and wired fence (58.33%) are mostly used as it can withstand the wear and tear of constant exposure to animals (Schoenian, 2012). Statistical analysis indicated that none of the variables in the housing management, including orientation, type of floor, type of roof, and type of fence, showed significant associations with the 3 Districts wherein Chi Square Test = 3.8191, P value = 0.1481 (orientation); Chi Square Test = 6.5917, P value = 0.1591 (type of floor); Chi Square Test = 6.5917, P value = 0.1591 (type of roof); Chi Square Test = 6.5917, P value = 0.1591 (type of fence) at 95% CI.

Feeding management in the forty-eight (48) small ruminant farms are shown in Table 3c, the most common is free range (87.50%) and grasses (95.83%) are mostly fed compared to commercial feeds (4.17%). In terms of giving supplements, survey result shows that small ruminant farmers mostly do not give supplements (87.50%). Free-range grazing, adopted by 87.50% of small ruminant farmers, is favored due to its economic

efficiency and alignment with the natural foraging behavior of animals. This practice allows small ruminants to obtain diverse natural food sources while reducing the financial burden of supplemental feeding, which can be prohibitively expensive. Free-range systems also enhance the overall well-being of animals by promoting exercise and supporting digestive health, as it closely mirrors the animals' innate grazing habits (Devendra and Thomas, 2002). The high dependence on grasses (95.83%) as the primary feed source reflects the abundant availability and affordability of forage in rural and semi-rural areas, making it a sustainable option. In contrast, commercial feeds, although nutritionally formulated, are often inaccessible due to higher costs. Forage-based diets are more suitable for the ruminant digestive system, promoting natural fiber intake and maintaining gut health (Ranjhan, 2001). Moreover, 87.50% of farmers do not provide supplemental feeds, likely due to the widespread belief that diverse natural grazing provides sufficient nutrition. Economic limitations also play a crucial role, as smallholder farmers often lack the resources to invest in supplements. While research has demonstrated that supplements can enhance growth and reproductive performance, their use is typically deprioritized in traditional farming systems due to their associated costs (Savadogo *et al.*, 2000). Statistical analysis indicated that none of the variables in the feeding management including feeding system, types of feeds and giving of supplements showed significant associations with the 3 Districts, wherein Chi Square Test = 6.5917, P value = 0.1591 at 95% CI.

Table 3b. Continued

Districts	Housing management: Type of fence				Total
	Wood	Concrete	Wires	None	
1	16 (33.33%)	0 (00.00%)	0 (00.00%)	0 (00.00%)	16 (33.33%)
2	0 (00.00%)	2 (4.17%)	8 (16.67%)	2 (4.17%)	12 (25.00%)
3	0 (00.00%)	0 (00.00%)	20 (41.67%)	0 (00.00%)	20 (41.67%)
Total	16 (33.33%)	2 (4.17%)	28 (58.33%)	2 (4.17%)	48 (100.00%)

Table 3c. Feeding management practiced in the three Districts of Cagayan

Districts	Feeding management: Feeding system			Total
	Free Range	Cut and Carry	Combination	
1	16 (33.33%)	0(00.00%)	0 (00.00%)	16 (33.33%)
2	6 (12.50%)	0(00.00%)	6 (12.50%)	12 (25.00%)
3	20 (41.67%)	0(00.00%)	0 (00.00%)	20 (41.67%)
Total	42 (87.50%)	0 (00.00%)	6 (12.50%)	48 (100.00%)

Table 3c. Continued

Districts	Feeding management: Type of feeds			Total
	Grass	Com Feeds	Combination	
1	16 (33.33%)	0 (00.00%)	0 (00.00%)	16 (33.33%)
2	10 (20.83%)	2 (4.17%)	0 (00.00%)	12 (25.00%)
3	20 (41.67%)	0 (00.00%)	0 (00.00%)	20 (41.67%)
Total	46 (95.83%)	2 (4.17%)	0 (00.00%)	48 (100.00%)

Table 3c. Continued

Districts	Feeding management: supplements		Total
	Yes	No	
1	5 (10.42%)	11 (22.92%)	16 (33.33%)
2	0 (00.00%)	12 (25.00%)	12 (25.00%)
3	1 (2.08%)	19 (39.58%)	20 (41.67%)
Total	6 (12.50%)	42 (87.50%)	48 (100.00%)

Table 3d. Water management practiced at the three Districts of Cagayan

Districts	Water management: Water source				Total
	Local Well	Tap Water	Bore hole	Mix	
1	16 (33.33%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	16 (33.33%)
2	2 (4.17%)	7 (14.58%)	3 (6.25%)	0 (0.00%)	12 (25.00%)
3	8 (16.67%)	11 (22.92%)	0 (0.00%)	1 (2.08%)	20 (41.67%)
Total	26 (54.17%)	18 (37.50%)	3 (6.25%)	1 (2.08%)	48 (100.00%)

Table 3d are results based on water management, survey result shows that most small ruminant farms used local wells (54.17%) as water source followed by tap water (37.50%), bore hole (6.25%) and combination (12.08%) of the three sources. The majority of small ruminant farmers rely on local wells (54.17%) for water due to their accessibility and cost-effectiveness, followed by tap water (37.50%), which is less popular because of higher utility costs; boreholes (6.25%) are used infrequently due to expensive drilling requirements, while 12.08% of farms utilize a combination of sources to ensure reliable water supply throughout the year, particularly during dry seasons (Damania *et al.*, 2017; Villholth, 2006; Alley and Alley, 2017; UNESCO, 2003). Statistical analysis showed that none of the variables in the water management showed significant associations with the 3 Districts, wherein Chi Square Test = 6.5917, P value = 0.1591 (both local well and tap water) and Chi Square Test = 3.8191, P value = 0.2231 (both bore hole and mix sources) at 95% CI.

Table 3e. Breeding management practiced in the three Districts of Cagayan

Districts	Breeding management		Total
	Inbreeding	Crossbreeding	
1	10 (20.83%)	6 (12.50%)	16 (33.33%)
2	3 (6.25%)	9 (18.75%)	12 (25.00%)
3	18 (37.50%)	2 (4.17%)	20 (41.67%)
Total	31 (64.58%)	17 (35.42%)	48 (100.00%)

Results show that the type of breeding practiced by small ruminant farmers were inbreeding and crossbreeding. Table 3e shows the survey results wherein inbreeding (64.58%) was mostly adapted than crossbreeding (35.42%). Small ruminant farmers might prefer inbreeding over crossbreeding for some advantages like genetic uniformity, predictability and preservation of traits, consistency, market demands and resource management (Vogt *et al.*, 1993; Kosgey, 2003; Cruz *et al.*, 2021; Never *et al.*, 2024). Statistical analysis showed no significant difference in terms of breeding management in the 3 Districts, wherein Chi Square Test = 3.8191, P value = 0.2231 at 95% CI.

Table 3f. Health management practiced in the three Districts of Cagayan

Districts	Health management: Prophylaxis		Total
	Yes	No	
1	16 (33.33%)	0 (0.00%)	16 (33.33%)
2	2 (4.17%)	10 (20.83%)	12 (25.00%)
3	0 (0.00%)	20 (41.67%)	20 (41.67%)
Total	18 (37.50%)	30 (62.50%)	48 (100%)

Table 3f. Continued

Districts	Health management: Deworming		Total
	Yes	No	
1	16 (33.33%)	0 (0.00%)	16 (33.33%)
2	6 (12.50%)	6 (12.50%)	12 (25.00%)
3	2 (4.17%)	18 (37.50%)	20 (41.67%)
Total	24 (50.00%)	24 (50.00%)	48 (100%)

Table 3f. Continued

Districts	Health management: Treatment		Total
	Yes	No	
1	0 (0.00%)	16 (33.33%)	16 (33.33%)
2	0 (0.00%)	12 (25.00%)	12 (25.00%)
3	0 (0.00%)	20 (41.67%)	20 (41.67%)
Total	0 (0.00%)	48 (100.00%)	48 (100 %)

Table 3f. Continued

Districts	Health management: Pest control		Total
	Yes	No	
1	3 (6.25%)	13 (27.08%)	16 (33.33%)
2	0 (0.00%)	12 (25.00%)	12 (25.00%)
3	0 (0.00%)	20 (41.67%)	20 (41.67%)
Total	3 (6.25%)	45 (93.75%)	48 (100%)

Herd health management in all the small ruminant farms are shown in Table 3f, results of the survey were, most small ruminant farmers do not practice prophylaxis (62.50%), treatment (100.00%) and pest control (93.75%). Result also shows that deworming practice was observed by half of the small ruminant farms surveyed. Herd health management is critical for sustaining animal welfare and productivity. It comprises

a wide range of procedures aiming at illness prevention, nutrition optimization, and general animal welfare. The results demonstrate a lack of regular health monitoring and disease management. An effective herd health management not only improves animal wellbeing, but it also increases farmers' production and profitability (Båge, 2020; Moliso *et al.*, 2024). Statistical analysis showed no significant difference in terms of herd health management in the 3 Districts including prophylaxis, deworming, treatment and pest control wherein Chi Square Test =6.5917, P value =0.1991 at 95% CI.

Conclusion

The study conducted in Cagayan, Philippines, on improving small ruminant farm efficiency through evidence-based management strategies emphasizes the importance of educated decision-making in boosting productivity and sustainability. Farmers may dramatically improve the performance of their small ruminant businesses by applying measures including optimum feeding practices, successful breeding programs, and integrated health management. The findings indicate that stakeholder participation, ongoing education, and access to appropriate resources are critical for creating a conducive climate for these projects. Overall, implementing these evidence-based strategies benefits not only individual small ruminant farms, but also the larger aims of food security and rural development. Future study should look into new methodologies and adaptive management techniques to ensure the long-term viability of small ruminant farming systems.

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