

ASSESSMENT OF FARMERS' KNOWLEDGE, SKILLS, AND ATTITUDES IN BUFFALO FARMING IN NUEVA ECIJA, PHILIPPINES

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ABSTRACT

This study assessed the knowledge, skills, and attitudes of 211 buffalo farmers in Nueva Ecija regarding the programs implemented by the Philippine Carabao Center (PCC) and regarding various aspects of buffalo farming. Data were collected through face-to-face interviews using a pre-tested semi-structured questionnaire. Logistic regression was used to determine the factors influencing farmers' knowledge level. Results showed that while 43% of the farmers were aware of basic PCC services, like deworming and artificial insemination, awareness of other PCC programs was limited. Forty-two percent, 38% and 33% of the farmers have low knowledge levels, particularly on breeding and reproduction, feeds and feeding, and record keeping, respectively, whereas 33% and 26% of them have high knowledge levels related to animal health and milking, respectively. Regression analysis showed that herd size and distance from PCC are the factors significantly ($p < .05$) affecting farmers' knowledge level. Despite knowledge gaps, the results highlight a positive attitude of the farmers toward the programs of PCC, as well as toward aspects of buffalo farming. The farmers sought information from sources such as PCC technicians, digital platforms, and in-person trainings as the preferred channel of information. These highlight the need for accessible, inclusive, and multi-channel information dissemination strategies to enhance farmers' knowledge and skills on buffalo production.

Keywords: attitude, buffalo farmers, knowledge, Philippine Carabao Center

INTRODUCTION

Through Republic Act 7307, otherwise known as the Philippine Carabao Act of 1992, the Philippine Carabao Center (PCC) was established to promote, conserve, and develop the carabao as a source of milk, meat, hide, and draft power, to generate additional income and elevate the general well-being of rural farming communities. PCC works toward this goal through its Carabao Development Program using the Impact Zone Development Concept, which organizes smallholder farmer cooperatives to build viable carabao-based enterprises (CBEs) (PCC, 2023a). First operationalized in Nueva Ecija, these CBEs have since made the province a driver of local milk production, yielding 1.80 million liters of carabao milk in 2023 and 1.98 million liters in 2024 (Palacpac, 2010; PCC, 2023b; PCC, 2024).

To sustain CBEs in Nueva Ecija, PCC continuously delivers programs and services to

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improve buffalo management practices. However, the impact of these programs relies heavily on whether farmers actively receive, comprehend, and adopt the recommended technologies (Rizzo *et al.*, 2023). Measuring farmers' knowledge, skills, and attitudes (KSA) establishes essential information on their ability to adapt and implement recommended practices within local production settings (Rogers, 2003; Hoque *et al.*, 2016). Such evaluations are essential for determining how well extension activities actually reach intended audiences, identifying specific gaps in technical competence, and developing tailored training activities.

Despite its importance, the KSA of dairy buffalo farmers in Nueva Ecija has never been systematically documented. Field assessments remain mostly informal, with results being rarely integrated into planning reports for policy decisions. Furthermore, local empirical literature on farmer KSA remains limited and narrow in scope, with some focusing mainly on specific health issues -such as Surra management in the Southern Philippines (Escarlos *et al.*, 2016) and fasciolosis in Northern Luzon (Lugong *et al.*, 2024) – or evaluating limited media toolkits like small-scale video modules (Palacpac *et al.*, 2024).

To address these gaps, this study evaluated the farmers' KSA regarding PCC programs and buffalo management across Nueva Ecija. The study addressed four specific objectives such as: (1) establish farmers' socio-demographic profiles; (2) map their primary information sources; (3) measure KSA levels across key production areas; and (4) identify key determinants of farmer knowledge. These empirical findings provide PCC administrators and planners with actionable data to refine targeted policies and extension approaches. Directly tailoring extension work to local farmer needs maximizes training impact and builds lasting enterprise resilience.

MATERIALS AND METHODS

Location of the study

This research was conducted in the province of Nueva Ecija, found in the eastern part of Central Luzon. The province is 5,751.33 square kilometers, divided into four congressional districts, consisting of 27 municipalities and five cities. The province is dubbed the “Rice Granary of the Philippines” because a significant portion of its land area is devoted to rice cultivation (Provincial Government of Nueva Ecija, 2023).

Sampling and sample size

At the time of the study, records from the PCC indicated a total of 680 dairy buffalo farmers in Nueva Ecija. The sample size was calculated through the sample size calculator from Calculator.net (2023), with a 5% margin of error and a 95% confidence interval (CI), resulting in a minimum required sample of 246 respondents. However, due to budgetary and time constraints, only 211 respondents were interviewed, resulting in a slightly higher margin of error of 5.61%.

The respondents included were dairy buffalo farmers who owned at least one female buffalo used for milk production and had been profiled by the PCC. Due to budgetary and manpower limitations, convenience sampling was employed, wherein farmers available and willing to participate during data gathering activities were selected and interviewed for the study.

Data collection and analysis

A pre-tested semi-structured questionnaire was used to assess farmer respondents' knowledge, skills, and attitudes (KSA) levels regarding PCC programs and services and buffalo production practices (breeding, feeds/feeding, animal health, milking, and record keeping). The four-part questionnaire evaluated the following:

- (1) knowledge of PCC programs and services and buffalo production, with each correct response assigned one point, yielding maximum scores ranging from 10 to 20 depending on the topic. Scores were classified as Very Low, Low, Moderate, High, or Very High;
- (2) attitudes using a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree, interpreted as Very Negative to Very Positive);
- (3) self-rated skills in buffalo production using a five-point scale (1 = Very Low to 5 = Very High); and
- (4) current and preferred information sources.

The questionnaire was pre-tested with 15 dairy buffalo farmers. The Likert-scale items were tested for reliability using Cronbach's alpha; resulting coefficients (0.78 for attitude, 0.75 for skills) indicated good internal consistency (acceptable range: 0.70–0.90).

The survey was conducted through face-to-face interviews with informed consent, in compliance with the Philippine Data Privacy Act of 2012 (RA 10173). Data were analyzed in Microsoft Excel, using descriptive statistics (frequencies, means, and percentages) to summarize respondents' socio-demographic profiles alongside their KSA levels. Logistic regression was performed in SPSS version 26 to identify factors associated with farmers' knowledge of PCC programs and buffalo production. Determinants of skills and attitudes were not modeled separately, as knowledge was considered foundational to these components, consistent with the study's scope and resource constraints.

RESULTS AND DISCUSSION

Demographic, economic, and farm profile

The majority (87%) of the respondents were dairy buffalo farmers who participated in the Carabao-based Enterprise Development (CBED) program of the PCC, while 13% were buffalo farmers who did not participate in any project or program of the PCC. Most of the respondents were male (91%) and were married (Table 1). The high number of male respondents may be attributed to traditional gender roles and access to resources because in many societies, cattle and larger animals are usually owned by men, while smaller animals, such as goats and backyard poultry, which are kept near the house, are women's domain (IFAD, 2003; Bravo-Baumann, 2000). But this pattern differs from India and Nepal, where women perform the majority of dairy farming tasks (Bidhan *et al.*, 2024; Vijayalakshmy *et al.*, 2023; Devkota *et al.*, 2015).

In terms of educational attainment, only 11% of the respondents had finished college, and 3% completed a vocational course, while a considerable proportion (30%) completed high school. This suggests that most dairy buffalo farmers have limited formal education, which may constrain their access or pose challenges in utilizing modern information and communication technologies (ICT) for agriculture because higher educational attainment is

often linked with better technology use in agricultural production, market access, and digital advising (Amoussouhoui *et al.*, 2024; Shemfe and Modirwa, 2026).

Table 1. Socio-demographic characteristics of dairy buffalo farmers in Nueva Ecija (2024).

Particular	Count	Percentage
Gender	n= 211	
Male	192	91.00%
Female	19	9.00%
Civil Status		
Married	193	91.00%
Live-in Partner	8	4.00%
Single	5	2.00%
Widow/er	4	2.00%
Separated	1	1.00%
Educational Attainment (Highest degree earned)		
High school Graduate	64	30.00%
Elementary Graduate	52	25.00%
High school Level	29	14.00%
Elementary Level	24	11.00%
College Graduate	24	11.00%
College Level	7	3.00%
Vocational Graduate	9	4.00%
Availability of Own Cellphone		
With own cellphone	166	79.00%
Without cellphone	45	21.00%
Age (Average)	51	
Household size (average)	4	

Most dairy buffalo farmers (76%) were in their economically active years (22–60), while 24% were seniors (61–74) still engaged in farming. The average age was 51, which coincides with the result of Palacpac *et al.* (2024) and Dela Cruz & Dizon (2023), but is slightly younger than the national average of rice farmers (56) (PhilRice, 2022), indicating an aging farmer population in Nueva Ecija. This highlights the need for capacity-building efforts to engage younger generations and sustain agricultural productivity (Alcantara, 2025; Oustry, 2025). Households averaged four members, typically two males and two females, with only one male and one female actively involved in buffalo farming. On average, two members per household were still in school.

Using the income classification framework of the Philippine Institute for Development Studies (PIDS) (2024), most of the respondents (57%) were classified as poor, while only

two respondents qualified under the upper-income category, with one identified as upper middle-income and another as rich (0.05% each). This income distribution suggests that most dairy buffalo farmers operate under financial constraints, which may limit their ability to adopt modern technologies, invest in herd improvement, or access essential production inputs (Table 2).

Table 2. Household monthly income and average income of dairy buffalo farmers.

Income Class	Monthly Income	Count	Mean	%
Poor	Less than 10,957	121	5,743.39	57.00
Low Income	10,958-21,914	57	15,821.43	27.00
Low middle income	21,915-43,828	17	26,723.64	8.00
Middle income	43,829-76,699	12	53,645.83	6.00
Upper middle	76,700-131,484	1	98,750.00	0.50
Upper income	131,486-219,140	2	175,000.00	1.00
Rich	More than 219,141	1	250,000.00	0.50
TOTAL		211		

Farmers' sources of knowledge

Farmers identified PCC field technicians (35.5%) as their top and most trusted source of information on buffalo production and about PCC programs and services, followed by digital platforms (16.6%) and in-person trainings or seminars (10.4%) (Table 3). These channels were seen as the most useful and relevant, with farmers spending an average of 2-3 hours per consultation. This finding is consistent with Gumban and Baladjay (2025) stating that beneficiaries prefer in-person engagement with extension workers because farmers and fisherfolk better understand technologies when demonstrated directly, reflecting the belief that “seeing is believing”. This also reflects the vital role of field-based extension workers in having meaningful dialogue with clients while delivering timely, science-based knowledge.

Digital platforms, including YouTube and other online resources accessible via mobile phones, computers, or smart televisions, which offer a vast array of easily accessible information, make it a convenient and appealing option for many farmers. This preference highlights the growing relevance of digital media in agricultural information dissemination campaigns. Nevertheless, the use of digital platforms requires caution, as they are susceptible to the rapid spread of misinformation and unverified content.

Farmers must critically evaluate the credibility of the information they receive from various sources. As noted by Rasanjali *et al.* (2021), the accuracy, relevance, and depth of farmers' knowledge are largely influenced by the sources of information. Farmers who consistently engage in learning events facilitated by government agencies, agricultural training programs, and research institutions that offer science-based, up-to-date, and practical insights are more likely to adopt modern agricultural techniques, innovations, and best practices, leading to improved decision-making and overall productivity.

Structured in-person trainings and seminars ranked third among farmers' top information sources. As a traditional yet effective capacity-building method, they offer direct engagement with experts and hands-on learning (Cayabyab *et al.*, 2024). Interviews revealed that 77% of the respondents had attended an average of six PCC-facilitated trainings over

the past three years. Some farmers reported spending more than six hours participating in or seeking information through these sessions. This strong participation indicates a clear willingness to invest time in formal learning, particularly when sessions are practical, relevant, and accessible.

Table 3. Farmers' sources of information about PCC programs and buffalo production.

Source	First Priority			Second Priority		
	Count	%	Hours Spent	Count	%	Hours Spent
PCC Technicians	75	35.55	2-3	29	13.74	1-2
Digital Platforms	35	16.59	4-5	31	14.69	3-4
Trainings/Seminars	22	10.43	>6	7	3.32	5-6
Cooperative	19	9.00	2-3	55	26.07	<1
LGU Technicians	18	8.53	1-2	21	9.95	1-2
Family Member	17	8.06	2-3	7	3.32	2-3
Fellow Farmers	11	5.21	1-2	40	18.96	1-2
AI Technician	5	2.37	2-3	2	0.95	3-4
Radio	5	2.37	2-3	5	2.37	2-3
Veterinarian	2	0.95	2-3	-	-	-
Others	2	0.95	3-4	2	0.95	2-3
Printed Materials	-	-	-	2	0.95	2-3

In cases where the primary three sources of agricultural information were unavailable, 26.07% of farmers turned to their cooperatives for guidance. This is consistent with the statement of Tuna and Karantininis (2021) that cooperatives serve as an important information source for farmers, providing them access to relevant information for rural development. Additionally, 18.96% of respondents indicated that they rely on fellow farmers as alternative sources of information. This finding emphasizes the value of fostering knowledgeable and innovative farmers who can act as informal mentors, helping to spread useful practices and insights within the farming community.

Other sources of information mentioned by a smaller number of farmers include LGU technicians, family members, and AI technicians. Although these are not the primary preferences for the majority, their role in communication outreach should not be discounted.

Farmers' level of knowledge on PCC programs and various aspects of buffalo farming

The PCC, through its National Impact Zone Unit (NIZU), implements a wide range of projects and provides essential services to buffalo farmers in Nueva Ecija. The unit is responsible for delivering extension services across the province, which include project orientations, capacity-building activities, buffalo management training, and breeding programs such as artificial insemination, estrus synchronization, and bull entrustment. In addition, the unit conducts milk test days and offers animal health services, including deworming, vaccination, vitamin administration, and other advisory and extension support. The following sections highlight the farmers' levels of knowledge, attitude, and skills in

relation to PCC programs and services, as well as key areas of buffalo production.

Knowledge of PCC programs and services. Table 4 shows that many respondents have limited knowledge of the full range of PCC programs and services. Nearly half (43%) reported low awareness, typically recognizing only 2–3 services such as deworming, vaccination, and artificial insemination (AI), which are interventions most visible in the field. Those that had moderate knowledge were familiar with 4–5 services, including buffalo entrustment, while the respondents with high and very high knowledge were also aware of offerings like ear tagging, training, laboratory analysis, visitor assistance, and milk testing. Meanwhile, 13% had very low awareness, identifying only AI commonly provided by AI technicians from PCC, LGU, or village-based AI technicians. This suggests that farmers are more likely to recognize services to which they are directly exposed or that are regularly delivered within their communities. Extension efforts should then put greater emphasis on experiential approaches such as on-farm demonstrations and hands-on or practical learning sessions focusing on key services such as forage development, milk quality testing, recordkeeping, animal nutrition, and enterprise development, which are essential components of sustainable buffalo production.

Table 4. Level of knowledge of the respondents on PCC programs and services.

Knowledge Score	Adjectival Interpretation	Count	%
0-1	Very Low	27	13%
2-3	Low	91	43%
4-5	Moderate	68	32%
6-7	High	23	11%
8-10	Very High	2	1%
TOTAL		211	100%

Knowledge of breeding and reproduction. The majority (53%) demonstrated moderate knowledge on breeding, scoring 7–9 out of 16 points (Table 5). While most could identify signs of heat and the estrus cycle, many could not explain their practical significance in farm management. This may suggest that while farmers possess basic knowledge of reproductive indicators, they may lack the practical understanding needed to apply this knowledge effectively in breeding management. This gap may be contributing to the low reproductive efficiency rate in Nueva Ecija, pointing to the importance of learning sessions that focus on the practical application of breeding concepts. Nevertheless, discussions on the essential principles of breeding and reproduction and their importance should be incorporated, as these are a basic foundation for the effective implementation of practical reproductive management. Given the highly technical nature of breeding and reproductive concepts, a stepwise or progressive learning approach is likely to be more effective than delivering all information at once. This is particularly important given that a considerable proportion (42%) had low knowledge, generally aware of heat signs but struggled with concepts such as the estrus cycle, calving interval, and their importance. Similarly, 2% showed very low

knowledge, unable to name at least three heat signs or answer basic reproductive questions.

Table 5. Level of knowledge of the respondents on breeding.

Knowledge Score	Adjectival Interpretation	Count	%
0-3	Very Low	4	2%
4-6	Low	89	42%
7-9	Moderate	112	53%
10-12	High	5	2%
>12	Very High	1	0%
Total		211	100%

Only 2% exhibited high knowledge, and just one respondent achieved a very high score. This individual, a village-based AI technician, participated in over ten PCC-facilitated training that included comprehensive modules on breeding and reproduction—training required for the role. Most respondents attributed their knowledge to PCC or LGU technicians, fellow farmers, or personal experience. Notably, 64% identified technicians as their main source of information, highlighting the critical role of extension personnel in delivering technical knowledge on the service they provide.

Knowledge on feeds and feeding. The farmers’ level of knowledge on feeds and feeding management shown in Table 6 reflects that despite possessing basic knowledge on basic feeding concepts, many farmers still lack sufficient knowledge needed to implement optimal feeding practices. This is evident from the considerable percentage of respondents (38%) who demonstrated low knowledge, as they were able to give examples of improved forages but failed to answer other feeds and feeding-related questions correctly. Only 37% who were classified as having moderate to high knowledge knew the correct feed amount for a 500-kg caracow—a basic but crucial aspect of feeding. Their limited understanding of determining the appropriate feed requirement based on animal body weight may constrain improvements in animal nutrition and consequently may affect productivity and overall herd performance. Only 13% fell into the high knowledge category, who were aware of feed processing, colostrum feeding, and supplement provision, but their understanding lacked depth. These findings highlight the need to strengthen farmers’ technical capacity in this area through sustained mentoring, coaching, and capacity-building by PCC and other extensionists to address knowledge gaps and improve dairy buffalo productivity and sustainability in Nueva Ecija.

Knowledge of animal health. Table 7 shows that the majority of the respondents had a moderate to high level of knowledge when it comes to animal health. Notably, 10% exhibited very high knowledge, particularly in identifying common buffalo diseases and applying preventive measures such as deworming, vaccination, and vitamin supplementation, with a clear understanding of their importance. The farmers have a strong willingness to acquire knowledge in this area because they recognize that poor animal health can reduce herd productivity, increase costs, and, in severe cases, result in buffalo mortality that, in turn,

negatively affects the profitability and sustainability of their dairy enterprise. Some (19%) even attributed their knowledge to their own experiences and those of fellow farmers. The result may also suggest that PCC-led training programs and extension services have been instrumental in improving farmers' knowledge of buffalo health management, particularly since the majority (63%) reported acquiring knowledge from PCC-led capability-building activities or consultations with field extensionists.

Table 6. Level of knowledge of the respondents on feeds and feeding.

Knowledge Score	Adjectival Interpretation	Count	%
0-2	Very Low	12	6%
3-4	Low	80	38%
5-6	Moderate	91	43%
7-8	High	28	13%
>8	Very High	0	0%
Total		211	100%

Table 7. Level of knowledge of the respondents on animal health.

Knowledge Score	Adjectival Interpretation	Count	%
0-3	Very Low	2	1%
4-6	Low	26	12%
7-8	Moderate	92	44%
9-12	High	70	33%
>13	Very High	21	10%
Total		211	100%

Nevertheless, there are a few who demonstrate low to very low knowledge levels of animal health. They could name only 1–3 diseases and struggled to explain appropriate preventive measures, such as for liver fluke. Although they practiced deworming and vaccination, they lacked awareness of their significance, which may limit the adoption of good animal health management practices. Hence, capacity-building initiatives should emphasize the rationale behind disease prevention practices, ensuring that it will be delivered in a manner easy to grasp for farmers. Building farmers' understanding of preventive herd health management is likely to improve the consistent adoption of recommended practices, leading to reduced disease incidence, and enhance buffalo productivity and overall farm profitability (Pehan *et al.*, 2025).

Knowledge of milking and milk handling. The income of dairy buffalo farmers largely depends on the volume and quality of milk produced, making proper milking and

milk handling essential. Farmers must be well-informed on these practices to ensure high-quality yields and better market returns. The distribution of respondents according to their level of knowledge of milking and milk handling was relatively even, although only a few fell under the very high and very low knowledge levels (Table 8). Most of the respondents (74%) were actively milking their buffaloes, hence were knowledgeable on the methods of milking and on the pre- and post-milking protocols, highlighting the importance of practical experience in reinforcing knowledge. However, many were still not aware of milk testing and its importance because they rely on the quality testing conducted by milk collectors or consolidators. Consequently, their limited knowledge of milk testing may reduce their ability to negotiate higher prices based on milk quality and limit their capacity to ensure that the milk they produce meets quality and safety standards for public consumption.

Table 8. Level of knowledge of the respondents on milk and milk handling.

Knowledge Score	Adjectival Interpretation	Count	%
0-3	Very Low	13	6%
4-6	Low	50	24%
10-12	Moderate	74	35%
7-9	High	55	26%
>12	Very High	19	9%
Total		211	100%

On the other hand, those with very low knowledge were typically new to buffalo farming or relied on hired labor for milking, resulting in limited firsthand experience and understanding of essential procedures. This underscores the importance of targeted orientation and competency-based training for farmers, focusing on the newly engaged dairy farmers and hired laborers of large dairy farms.

Knowledge of record keeping. Nearly half (49%) of respondents demonstrated moderate knowledge of record keeping, while only 13% and 1% were found to have high and very high knowledge (Table 9). Farmers with moderate knowledge understood what data to record (e.g., milk yield, breeding, animal health) but could not fully explain its importance. In contrast, those with high knowledge recognized the value of such records for evaluating farm performance and tracking income and expenses. Notably, all respondents with moderate to very high knowledge practiced record-keeping, while 30% of those with low or very low knowledge did not. These farmers often relied on cooperatives or technicians to keep records, highlighting a common misconception that personal record-keeping is unnecessary, perceiving it as merely an additional farm task rather than a valuable farm management tool. This knowledge gap may likely hinder effective monitoring of farm performance, identifying production constraints, and making data-driven management decisions. This signifies the need for enhancing learning activities that reiterate what records to keep and provide emphasis through demonstrations on how farm records can be analyzed and utilized to improve overall farm productivity and profitability.

Table 9. Level of knowledge of the respondents on record keeping,

Knowledge Score	Adjectival Interpretation	Count	%
0-4	Very Low	9	4%
5-8	Low	70	33%
9-12	Moderate	103	49%
13-18	High	27	13%
>18	Very High	2	1%
Total		211	100%

Factors influencing the farmers' knowledge level

The results of the regression analysis indicate that among the predictor variables, the total number of animals owned and the distance from the PCC significantly influenced farmers' knowledge level on the various aspects of buffalo production and PCC programs and services ($P < 0.05$) (Table 10). This finding diverges from the study of Segnon *et al.* (2015) and Gal *et al.* (2025), which indicates that land tenure predicts farmers' level of knowledge in farming systems. The positive relationship between knowledge level and the total number of animals suggests that for every additional animal owned, the likelihood of having a higher level of knowledge increases by approximately 9.8%. This may be because farmers with more animals are more likely to view buffalo production as an enterprise rather than merely as animal rearing. Consequently, they tend to seek information to ensure farm success.

Table 10. Results of the logistic regression for level of knowledge of buffalo farmers.

Predictors	Coefficient	Std. Error	df	p-value	Exp(B)	95% Confidence Interval for Exp(B)	
Intercept	-0.879	1.696	1	0.604			
Age	-0.006	0.025	1	0.802	0.994	0.946	1.044
Total count of animal	0.098	0.051	1	0.056**	1.103	0.997	1.219
Distance to PCC (km)	-0.048	0.017	1	0.004**	0.953	0.922	0.985
Years in school	0.04	0.098	1	0.682	1.041	0.86	1.26
No. of household members still studying	-0.482	0.488	1	0.323	0.618	0.237	1.607
No. of years in farming	0.023	0.028	1	0.414	1.023	0.969	1.08

** - significant at the $\alpha = 5\%$ level

Moreover, farmers who owned more animals tended to be more actively engaged in buffalo production, gaining hands-on experience and broader exposure to various aspects of the enterprise. This trend was especially evident among progressive farmers managing larger

herds, many of whom demonstrated higher levels of knowledge and were occasionally invited to serve as resource persons in trainings and learning events. Their advanced knowledge contributed to improved farm management, leading to greater productivity and profitability. This, in turn, enhanced their economic capacity, enabling better access to training, extension services, and support mechanisms—creating a reinforcing cycle of knowledge and farm advancement.

Conversely, the negative correlation between knowledge level and distance from the PCC suggests that knowledge tends to decline as the distance from the PCC increases. Specifically, for every additional kilometer away from the PCC, the probability of having a higher level of knowledge decreases by approximately 4.8%. As one of the farmers' primary sources of information and one of the government agencies that provides the majority of buffalo-related services, the PCC plays a crucial role in knowledge dissemination. This highlights the critical role of accessibility to knowledge hubs and underscores the need for PCC to intensify outreach and learning activities in remote areas to ensure broader knowledge dissemination at lower cost to farmers.

Other variables, such as educational attainment, years of experience in buffalo farming, and age, while potentially relevant, did not show statistically significant influence. Contrary to expectations, formal education levels had no substantial effect on knowledge levels. This implies that technical or hands-on learning opportunities may play a greater role in knowledge development than general education. Likewise, the assumption that more farming experience equates to greater knowledge was not supported, suggesting that without continuous exposure to new techniques and training, experience alone may not lead to increased knowledge. Similarly, age did not emerge as a significant factor, implying that knowledge acquisition in this context is not age-dependent and that both younger and older farmers may have comparable access to information.

Attitude towards PCC services, buffalo care, and management

According to Ajzen (2005), attitudes reflect how individuals evaluate an object—whether positively, negatively, or neutrally—based on three interconnected elements: emotions (affect), beliefs or knowledge (cognition), and intended or actual behavior (conation). These evaluations develop through experience, making them both measurable and open to change (Pickens, 2005). Although attitudes cannot be directly observed, they can be understood through what people say and how they act (Schwarz, 2008). In the context of buffalo farming, a positive attitude among farmers toward its various aspects is likely to correspond with a greater willingness to adopt or implement the recommendations provided by the PCC. Conversely, a negative attitude may signify resistance or disinterest.

A large majority (72.4%) strongly agreed that PCC services are accessible, reflecting confidence in the agency's reach and responsiveness. However, a small portion (5.21%) expressed disagreement or uncertainty, particularly among farmers in remote areas.

Regarding the approachability of PCC personnel, 77.73% strongly agreed, indicating high satisfaction with staff behavior and communication. This highlights the essential role of extension workers in fostering farmer trust and participation. A small percentage (5%) of respondents expressed negative views regarding the approachability of PCC staff. The primary reason cited was the lack of engagement with PCC programs, including having no contact with or not being approached by PCC personnel. Farmers may have felt excluded from program benefits or had unmet expectations. Although minimal, such feedback

highlights the need for ongoing monitoring of service delivery and targeted improvements in staff training and communication, and program reach, particularly in underserved areas.

On the helpfulness of PCC programs, 89.10% strongly agreed, demonstrating widespread appreciation for the agency's support in training, technical assistance, and enterprise development. Nonetheless, a small minority expressed dissatisfaction or uncertainty, suggesting isolated gaps in program reach, content relevance, or delivery effectiveness. These cases underscore the importance of continuous program evaluation and tailored outreach.

Farmers also showed positive attitudes toward core buffalo management practices. For instance, 70.62% strongly agreed that heat detection is practical and feasible. This suggests familiarity with reproductive management, though a small percentage (0.94%) disagreed, potentially due to challenges in identifying heat signs.

In terms of record keeping, while many farmers do not practice it consistently, 84.36% strongly agreed that keeping milk production records is important. This indicates a recognition of its value, even if not widely implemented. A minority (2.84%) expressed disagreement, possibly due to limited training, perceived complexity, or minimal perceived benefits in small-scale operations. Additionally, 3.32% were uncertain, reflecting a potential knowledge gap.

Structured attitude questions on other practices—such as forage maintenance, disease prevention, and milking—also received mostly positive responses. Negative or uncertain answers were minimal (<6% and <12%, respectively), suggesting that these may stem from lack of experience or limited exposure or isolated negative experiences, highlighting areas where PCC can improve to further strengthen the effectiveness, accessibility, and impact of its programs.

Farmers' skills in buffalo care and management

Core management practices in buffalo farming include feeding, breeding, milking, and record-keeping, all of which require a combination of knowledge, skills, and appropriate decision-making by farmers. Feeding management focuses on providing nutritionally balanced rations at proper intervals to maintain optimal body condition score (BCS), making farmers' skills in BCS assessment and feed conservation practices, such as silage making, essential. Breeding management centers on accurate heat detection to ensure timely mating and shorter calving intervals, which depend on farmers' ability to recognize estrus signs. Milking management, whether manual or machine-assisted, requires proper pre-, during-, and post-milking practices to ensure milk quality and udder health. Lastly, record-keeping of production and financial data is a critical practice that enhances farm planning, monitoring, and decision-making. Collectively, these practices highlight the central role of farmers' knowledge and skills in achieving improved productivity and profitability in buffalo enterprises. This section presents the self-assessed competencies of farmers in key areas such as feeding, heat detection, body condition scoring, silage making, milking, milk testing, and record keeping.

The results in Table 11 show that in the areas of feeding, heat detection, and milking, 53–55% of the respondents rated themselves as having very high skill levels, while some (23–35%) considered their skills to be high. On the other hand, a significant percentage of respondents reported having very low skills in silage making (56.40%), milk testing (34.60%), and body condition scoring (27.01%). These low ratings may be attributed to the

limited adoption of such practices among farmers, which in turn could be influenced by the technical complexity associated with silage preparation (Balehegn *et al.*, 2022), milk testing, and body condition scoring, as well as inadequate training opportunities (Nyokabi *et al.*, 2021). These findings are consistent with the results reported by Casinillo *et al.* (2024) and Makarabbi *et al.* (2025), despite differences in study locations.

Table 11. Farmers’ self-assessed skills on buffalo care and management.

Rating	Feeding		Heat Detection		Body Condition Scoring		Silage Making		Milking		Milk Testing		Record Keeping	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
1	0	0	0	0	57	27.01	119	56.4	21	9.95	73	34.6	24	11.37
2	1	0.47	1	0.47	9	4.27	16	7.58	6	2.84	13	6.16	4	1.9
3	23	10.9	25	11.85	37	17.54	40	18.96	18	8.53	43	20.38	35	16.69
4	74	35.07	65	32.7	53	25.12	22	10.43	50	23.7	31	14.69	52	24.64
5	113	53.55	116	54.98	55	26.07	14	6.64	116	54.98	51	24.17	96	45.5
Mean	4.42		4.43		3.19		2.03		4.11		2.88		3.91	

Note: 1-very low; 2-low; 3-moderate; 4-high; 5-very high

The results indicate significant gaps in the knowledge and skills of buffalo farmers, particularly in areas such as body condition scoring, silage making, milking, milk testing, and record keeping, which are essential in improving farm performance. The results provide valuable guidance for PCC to target its capacity-building and extension efforts toward these identified gaps to strengthen the sustainability and profitability of CBEs.

CONCLUSION

The variation in socio-economic conditions, farm profiles, preferred information sources, and knowledge levels among dairy buffalo farmers in Nueva Ecija underscores the need for targeted, context-specific extension and capacity-building strategies. Recognizing these differences can improve the effectiveness of PCC extension programs. The influence of proximity to knowledge hubs and enterprise scale on farmers’ knowledge emphasizes the need to strengthen extension services for geographically distant and smallholder farmers through tailored strategies. Additionally, the generally positive attitudes toward PCC programs and buffalo production suggest that PCC should sustain responsive extension services that address farmers’ evolving needs.

RECOMMENDATIONS

The findings highlight the need for PCC to adopt diversified communication and information dissemination strategies based on farmers’ socio-economic characteristics, farm profiles, preferred information sources, and access to technology. A multi-channel extension approach blending digital platforms, field coaching, and targeted on-site training workshops should be established, with priority given to farmers in geographically remote areas. Training

and refresher programs should focus on pregnancy diagnosis, artificial insemination, milk production, animal health, and herd expansion.

PCC should strengthen partnerships with cooperatives and local government units (LGUs) and develop them into community-based learning hubs to expand the reach of its extension and capacity-building initiatives. In collaboration with LGUs and cooperatives, PCC may conduct periodic community-level orientation and learning activities, particularly for new or less-informed farmers. Progressive farmer-leaders and cooperative members should be mobilized as local resource persons to sustain knowledge sharing.

Program orientations may be integrated with routine service delivery activities (such as artificial insemination and vaccination) to maximize farmer attendance and improve their participation and awareness. Field technicians and extension personnel should be trained to explain the benefits of lesser-known services and recommended practices simply, even in brief routine interactions, to gradually improve farmer understanding. Simple feedback or knowledge assessments during field visits may be used to monitor changes in farmers' awareness and refine outreach strategies accordingly.

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