Behavioural Insights into Dairy Farmers' Adoption of Feeding Innovations

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Abstract: The Philippine Carabao Center (PCC) has promoted various feeding innovations to enhance buffalo-based dairy enterprise and increase milk production, yet adoption rates have been suboptimal. This study explores the decision-making processes of dairy farmers regarding the adoption of these innovations, focusing on how attitudes and subjective norms influence their intentions to implement PCC-endorsed feed technologies, such as improved forage, concentrate feeding, legume supplementation, and forage ensiling. Data were collected through structured interviews with 60 dairy farmers. The analysis was conducted using the Statistical Package for Social Sciences (SPSS). Results showed that socioeconomic factors and farm characteristics minimally impact the intention to adopt innovations, with land ownership and herd size positively influencing concentrate feeding. Perceived usefulness and difficulty significantly shape farmers' intentions, indicating that constraints like land availability and high production costs hinder the adoption of legume supplementation and forage ensiling. While attitudes toward feeding innovations are generally positive, practical challenges limit their uptake. Social norms, shaped by extension staff and peer farmers, play a significant role in influencing farmers' intentions to adopt these innovations. This study emphasized the need to address practical barriers to enhance the uptake of feeding innovations and improve dairy buffalo production.

Keywords: Innovation adoption, farmer behavior, decision-making, sustainable practices, agricultural extension.

INTRODUCTION

One key factor influencing the sustainability of the Carabao Development Program (CDP) led by the Department of Agriculture - Philippine Carabao Center (DA-PCC) is the effective transfer of buffalo-based technologies to farmers, including feed improvement technology. This dissemination is achieved through various extension methods, such as training and demonstrations, aiming to enhance farmer income by improving nutrition and, ultimately, dairy buffalo milk production. Despite the availability of these technologies, adoption remains low, limiting the productivity of buffalo farms. For instance, Palacpac *et al*. [1] found that total mixed ration (TMR), silage production, and urea-treated rice straw (UTRS) technologies have low uptake among dairy buffalo farmers in Region IV, with only 6% adopting UTRS. The FAO [2] notes that many producers adhere to traditional feeding practices and often resist adopting new scientific recommendations. A significant issue in adoption research is the tendency to view smallholders as a homogeneous group, usually overlooking individual perspectives, as highlighted by Devendra and Chantalakhana [3]. This generalization can impede understanding why resource-poor farmers struggle to utilize new technologies effectively. Research also suggests that factors such as technology attributes, farm socio-economic characteristics, and decision-makers perceptions all influence adoption rates [4].

Traditional research on technology adoption often follows the diffusion of innovation framework, which assumes that innovations will eventually spread across all populations, a perspective criticized for its "pro-innovation bias" [5]. Newer studies emphasize the importance of the decision-making process, distinguishing between "intuitive" decision-makers, who rely on personal and peer experience, and "analytical" ones, who compare options and predict outcomes. Farmers also consider others' opinions, making technology adoption a social process [4]. According to FAO [2], farmers evaluate attributes like cost, simplicity, and compatibility with existing practices before adopting innovations, aligning with Rogers' framework [6]. Locally, Palacpac *et al*. [17] found that years of education, dairying experience, animal inventory, and access to technical assistance are significant predictors of adoption. Yet, these studies often overlook behavioral intentions, which play a crucial role in farm productivity.

This study employs the Theory of Reasoned Action (TRA) by Ajzen and Fishbein [8] to examine the behavioral intentions underlying the adoption of feeding

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innovations among dairy farmers in Batangas and Cavite. By analyzing the behavioral drivers and barriers to the adoption of DA-PCC-endorsed feeding innovations, this research seeks to develop intervention strategies specifically tailored to the needs of these farmers. Therefore, the present study aimed to characterize the decision-making processes of dairy farmers that lead to the adoption or non-adoption of feeding innovations, to assess how attitudes and subjective norms influence their behavioral intention to implement these innovations, and to identify cognitive drivers and barriers impacting their adoption. By investigating these behavioral factors, the study aims to support the development of targeted strategies to boost adoption rates and ultimately improve productivity in dairy buffalo farming within these regions.

METHOD

Theoretical Framework

The acceptance and utilization of technological innovations in the animal sector are critically beneficial for both producers and consumers. The adoption of innovations represents a complex behavior influenced by various factors. According to the Theory of Reasoned Action (TRA), behavior is primarily determined by two components: attitudes and subjective norms. Attitudes are influenced by an individual's beliefs and expectations regarding the behavior and its potential outcomes, while subjective norms reflect the perceived social pressures from important others regarding the behavior. Understanding farmers' attitudes and subjective norms toward the adoption of feeding innovations is essential for designing effective intervention strategies that aim to increase adoption rates. This study employs the well-established social-psychological framework of the TRA to investigate the behavioral intentions of dairy buffalo farmers concerning the adoption of feeding innovations. The TRA provides a comprehensive approach for examining behavior through several key stages: identifying the specific behavior(s) under investigation, focusing on the adoption of feeding innovations aimed at improving milk production, identifying salient beliefs regarding the expected outcomes of the behavior and the social referents whose opinions may influence the farmers' decisions; developing structured interviews or questionnaires to gather data related to each behavior, ensuring that both attitudinal and normative aspects are addressed; and analyzing the collected attitudinal and normative data to derive insights into the farmers' behavioral intentions. According to TRA, an individual's intention to adopt feeding innovations is shaped by their attitudes towards the behavior and the influence of subjective norms. Intention, in this context, refers to the individual's readiness to perform the behavior. The stronger the intention to adopt feeding innovations, the more likely the individual is to implement the behavior. Attitude is determined by outcome beliefs (the extent to which individuals believe that behavior will lead to specific outcomes) and outcome evaluations (the importance of these outcomes to the individual). In contrast, subjective norms arise from subjective beliefs (the perception of how others, especially salient referents, view the behavior) and the motivation to comply with these referents' views [9]. Identifying specific referent subjective norms and outcome attitudes that correlate with intention can help pinpoint influential factors acting as cognitive drivers or barriers to the adoption of feeding innovations [10].

Data Collection

The study was conducted in compliance with ethical standards for research involving human participants. Informed consent was obtained from the farmers after providing them with clear information about the nature, purpose, and potential implications of the research. It utilized an exploratory, mixed-method design divided into two qualitative and quantitative phases to gain a comprehensive understanding of dairy farmers' adoption of feeding innovations. In Phase 1, a qualitative approach was employed, consisting of semi-structured interviews with 20 dairy farmers to gather insights on their behavioral beliefs and social influences concerning feeding innovations. These innovations included improved forage, concentrate feeding, legume supplementation, and forage ensiling. Farmers responded to open-ended questions on the perceived advantages, disadvantages, and influential individuals or groups (social referents) regarding these practices. This phase aimed to identify salient beliefs and referents, which subsequently informed the structured survey for Phase 2. Following the approach suggested by Francis *et al*. [11], 75% of all salient beliefs identified in Phase 1 were integrated into the Phase 2 questionnaire to ensure comprehensive representation.

In Phase 2, 60 dairy farmers from Batangas and Cavite were selected from a population of 188, using the same criteria established in Phase 1. The study shifted to a quantitative approach, designing a cross-sectional survey to measure constructs from the

Theory of Reasoned Action (TRA). Outcome variables included behavior and behavioral intention, while explanatory variables comprised attitudes, subjective norms, behavioral beliefs, outcome evaluation, salient beliefs, and motivation to comply. Each construct was measured using a five-point bipolar ordinal scale as follows: Behavioural Beliefs ranged from "Strongly Disagree" (-2) to "Strongly Agree" (+2); Outcome Evaluation ranged from "Unimportant" (-2) to "Very Important" (+2); Salient Beliefs captured the importance of referents' opinions from "Unimportant" (-2) to "Very Important" (+2); and Motivation to Comply ranged from "Not Motivated at All" (-2) to "Very Motivated" (+2). Behavioural Intention was assessed by asking how strongly farmers intended to adopt feeding innovations over the next year, with responses ranging from "Very Weak" (-2) to "Very Strong" (+2). To ensure consistency, the researcher conducted all interviews in person. During these interviews, demographic data were collected from participants, including their age, gender, education level, years of experience in dairying, household income sources, and household size. Detailed information regarding farm characteristics was gathered, including farm size (ha), herd size, the number of milking cows, and the area allocated for forage production (ha).

Data Analysis

The study computed specific measures to assess farmers' attitudes and subjective norms regarding their intention to adopt feeding innovations. Attitude Towards Behaviour (AB) was calculated using the formula AB=∑(bi×ei). In this equation, (b_i) represents the behavioral beliefs, scored on a scale from -2 to +2, and (e_i) signifies the outcome evaluation, also scored from -2 to +2. By multiplying each belief by its corresponding evaluation and summing the results, an overall attitude score is derived, reflecting the farmers' attitudes toward adopting feeding innovations. Subjective Norms (SN**)** were measured through both direct and indirect methods. For direct measurement, farmers rated, on a five-point scale from "Very Likely" (+2) to "Very Unlikely" (-2), how likely influential individuals were to approve or disapprove of feeding innovations. Indirectly, two components were assessed: Subjective Belief (sbj), rated from "Strongly Discourage" (-2) to "Strongly Encourage" (+2), and Motivation to Comply (mj), rated from "Not Motivated at All" (-2) to "Very Motivated" (+2). The subjective norm for each referent was calculated by multiplying the subjective belief by the motivation to comply, resulting in an overall subjective norm score represented by the formula SN=∑(sbj×mj). Finally, a correlation analysis was conducted to determine whether attitude or subjective norm had a stronger influence on farmers' Behavioural Intention (BI). The construct with the higher correlation to BI was considered the more influential factor in the farmers' decision to adopt feeding innovations. This analysis was pivotal in identifying primary motivators and barriers to adoption, providing a foundation for targeted interventions to promote innovative feeding practices among dairy farmers. Given the non-parametric nature of the TRA data, Spearman rank-order correlation was employed to analyze associations between key constructs, such

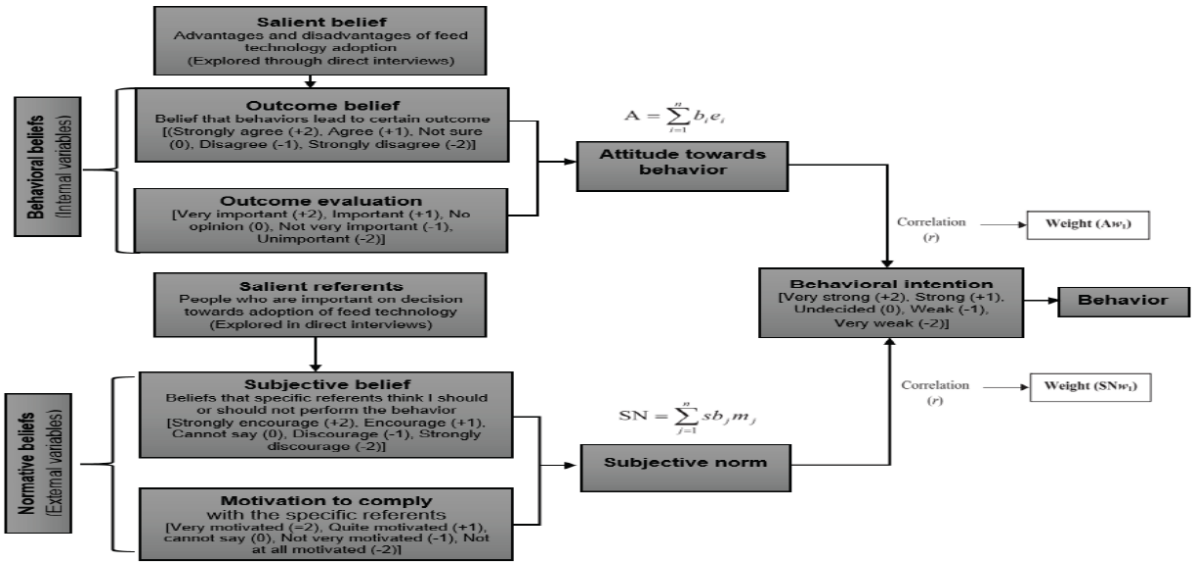

Figure 1: Summary of the scale used and analysis of the theory of reasoned action components adapted from Martinez-Garcia *et al*. [12].

as attitudes, subjective norms, and behavioral intentions. Scale reliability was assessed using Cronbach's alpha, ensuring the consistency of the measurements. All analyses were performed using Statistical Package for Social Sciences (SPSS) version 29. The analysis of the TRA components is summarized in Figure **1**.

RESULTS AND DISCUSSION

Socioeconomic and Farm Characteristics Associated with Farmers' Intention to Use Feeding Innovations

The correlation analysis between socioeconomic and farm characteristics with farmers' intentions to adopt feeding innovations is presented in Table **1**. Findings reveal no significant associations between socioeconomic factors and farmers' intention to adopt improved forage, concentrate feeding, legume supplementation, or forage ensiling. This result suggests that factors such as age, education, or income sources may not be primary drivers in decision-making about feeding innovations. Contrary to Martínez-García *et al*. [12], who identified socioeconomic factors like education and income sources as influential for technology adoption, this study found that more experienced dairy farmers tend to rely less on concentrate feeds, showing a negative correlation with concentrate feeding. This aligns with Rehman *et al*. [13], who observed that seasoned dairy farmers tend to rely on traditional practices, indicating that increased experience might reduce the likelihood of adopting new concentrate feeds.

In terms of farm characteristics, land ownership positively influences the likelihood of concentrate feeding, suggesting that those who own land have greater flexibility and control over their feed resources. In contrast, farmers using communal land may find it less economically viable to invest in concentrates due to the availability and lower cost of communal grazing. Similarly, herd size and the number of milking cows positively correlate with concentrate feeding, as larger herds have higher nutritional needs, necessitating supplemental feeding to maintain milk yield and health. The availability of forage areas further supports the adoption of feeding innovations, particularly improved forage and concentrates, as larger forage areas allow for a balanced approach between forage and concentrate feeding to optimize dairy productivity.

Intention, Attitude, and Subjective Norm

Table **2** shows correlations between farmers' intention to adopt feeding innovations and their

Table 1: Correlation of Socioeconomic and Farm Characteristics with Intention to Adopt Feeding Innovation

Variables	Correlation with intention			
	Feeding Improved Forage	Concentrate Feeding	Legume Supplementation	Forage Ensiling
Socio-economic				
Age	-0.057	-0.044	0.081	0.041
Gender	-0.048	-0.138	-0.136	-0.222
Level of Education	0.039	0.128	0.043	-0.021
Experience in Dairying	-0.106	-0.306[a]	-0.041	-0.098
Family Size	0.093	0.155	0.152	0.066
Paid Workers	0.130	0.202	-0.172	0.124
Income Source	0.084	0.029	-0.121	0.006
Farm Characteristics				
Landholding				
Owned	0.207	413[b]	0.194	0.089
Free/Communal	-0.053	-0.475[b]	-0.124	-0.109
Herd size	0.096	0.223	-0.056	0.023
Milking Cows	0.155	318[a]	-0.061	0.100
Forage Area	0.447[b]	477[b]	0.049	0.178

[a]Correlation is significant at the 0.05 level (2-tailed).
[b]Correlation is significant at the 0.01 level (2-tailed).

Table 2: Intention, Attitude, and Subjective Norm for Feeding Innovation

Variables	Feeding Improved Forage		Feeding Concentrates		Legume Supplementation		Forage ensiling	
	Mean	(r_s)*	Mean	(r_s)*	Mean	(r_s)*	Mean	(r_s)*
Strength of Intention	1.60		0.73		0.93		-0.88	
Stated Attitude	1.42	-0.224	1.72	0.092	0.83	-0.159	0.57	-0.190
Perceived Usefulness	1.63	0.660[b]	1.30	0.866[b]	0.97	0.734[b]	0.30	0.542[b]
Perceived Difficulty	1.73	0.575[b]	1.57	0.556[b]	1.12	0.706[b]	0.42	0.301[a]
Calculated attitude	15.82	0.377[b]	10.95	0.786[b]	13.77	-0.033	12.02	-0.471[b]
Stated subjective norm	1.33	0.458[b]	1.33	0.769[b]	0.93	0.465[b]	-0.57	0.468[b]

[a]Correlation is significant at the 0.05 level (2-tailed).
[b]Correlation is significant at the 0.01 level (2-tailed).

attitudes, perceived usefulness, difficulty, and subjective norms. Farmers displayed a strong intention toward improved forage feeding, moderate intentions for concentrates and legume supplementation, and a negative inclination toward forage ensiling. A notable positive correlation was observed between perceived usefulness and difficulty and the intention to adopt feeding innovations, indicating that farmers view feeding innovations as beneficial yet challenging due to issues such as land scarcity, high concentrate prices, and labor-intensive forage production practices.

Stated attitudes, including outcome beliefs and evaluations, are favorable toward improved forage and concentrate feeding, suggesting that farmers' intentions to adopt these practices are primarily influenced by perceived benefits such as higher milk yield and better animal health. Salient referents also positively impact farmers' intentions toward improved forage, concentrates, and legume supplementation, showing that peer and family approval plays a key role in adoption decisions. These findings align with Garforth *et al*. [4], who emphasized that favorable attitudes and supportive social norms can strongly influence farmers' behavior.

BELIEF AND ATTITUDE FOR EACH FEEDING INNOVATION

Table **3** presents the mean values for each outcome attitude and the corresponding outcome beliefs (bi) and evaluations (ei) regarding the adoption of feeding innovations on farms. Cronbach's α coefficients for outcome attitudes related to improved forage, concentrate feeding, legume supplementation, and forage ensiling were 0.803, 0.791, 0.740, and 0.717, respectively, establishing high reliability for the scales employed. Farmers' attitudes toward feeding improved forage and concentrates show positive associations with adoption intentions. Specifically, beliefs that improved forage provides "readily available quality feed," "ease of management," and "increases in milk yield" contribute positively to adoption intentions, while the perceived difficulty of propagation during summer presents a barrier. For concentrate feeding, the strong influence of beliefs such as "increased milk yield" and "improved body condition" supports adoption, reflecting that farmers value these benefits as contributors to productivity and economic viability.

Conversely, legume supplementation, though high in protein, is seen as labor-intensive, with farmers expressing concerns about "land requirements," "time-consuming harvesting," and "limited consumption by buffalo." These factors appear to hinder its adoption, particularly among farmers with constrained resources or competing labor needs. Forage ensiling, though perceived positively for "increased milk yield," faces challenges due to added labor and input costs, as well as practical concerns over forage supply. According to Batz *et al*. [14], the decision to adopt feeding innovations often aligns with utility, productivity, and profitability - a perspective consistent with our findings. Farmers prioritize practices that demonstrate clear advantages in ease, utility, and economic benefit, supporting the notion that perceived impact on farm productivity drives technology adoption in dairy farming. These insights suggest that interventions promoting feeding innovations should address practical challenges and emphasize the specific benefits farmers perceive as valuable.

Correlation of Intention with Outcome Belief, Evaluation, and Attitude for Each Feeding Innovations

Table **4** presents the correlations of intention with outcome beliefs, evaluations, and attitudes related to

Table 3: Mean Outcome Beliefs, Evaluations, and Attitudes for Feeding Innovation

Outcomes Feeding improved forage will …	Feeding Improved Forage		
	Outcome belief (b)	Outcome evaluation (e)	Outcome Attitude (b) * (e)
Increase Milk Yield	1.58	1.78	2.95
Provide readily available quality feeds	1.70	1.72	3.13
Easy to manage	1.62	1.60	2.82
Improve body condition	1.33	1.40	2.08
Reduce feed cost	0.52	1.30	0.57
Lead to higher milk quality	0.70	1.07	1.27
Hard to propagate during summer	1.70	1.68	3.00
Calculated attitude			15.82
Cronbach's coefficient of scale reliability			0.803
Outcomes Feeding Concentrates will …	**Feeding concentrate feeds**		
	Outcome belief (b)	Outcome evaluation (e)	Outcome Attitude (b) * (e)
Increase Milk Yield	1.68	1.85	3.22
Improved body condition of buffalo	1.58	1.57	2.68
Increase feed intake	1.05	1.62	1.67
Increase water intake	0.80	1.62	1.38
Provide high-quality nutrients/feeds	1.08	1.48	1.77
Calculated attitude			10.95
Cronbach's coefficient of scale reliability			0.791
Outcomes Feeding Legumes will …	**Legume Supplementation**		
	Outcome belief (b)	Outcome evaluation (e)	Outcome Attitude (b) * (e)
Increase milk yield	1.07	1.67	1.85
Seldom consumed by buffalo	1.22	1.67	2.05
Laborious	1.73	1.72	3.15
Challenging to propagate during the summer	1.08	1.63	1.77
Requires availability of land	1.37	1.40	2.12
Harvest is time-consuming	1.63	1.60	2.83
Calculated attitude			13.77
Cronbach's coefficient of scale reliability			0.740
Outcomes Forage ensiling will …	**Forage Ensiling**		
	Outcome belief (b)	Outcome evaluation (e)	Outcome Attitude (b) * (e)
Increase milk yield	1.67	1.87	3.17
Infeasible due to an insufficient supply of forage for silage	1.32	1.30	3.08
Add to the cost of labor and inputs	1.20	1.73	2.23
Lack practicality as buffalo can eat forage directly	0.88	1.65	1.62
Time - Consuming	0.55	1.90	1.02
Laborious	0.47	1.58	0.90
Calculated attitude			12.02
Cronbach's coefficient of scale reliability			0.717

Table 4: Correlation of Intention with Outcome Belief, Evaluation, and Attitude Toward using Feeding Innovations

Outcomes Feeding improved forage will …	Feeding Improved Forage		
	Belief (bi)	Evaluation (ei)	Attitude (bi x ei)
	rs	rs	rs
Increase Milk Yield	0.394[b]	0.408[b]	0.419[b]
Provide readily available quality feeds	0.247	0.238	0.256[a]
Easy to manage	0.249	0.184	0.219
Improve body condition	0.292[a]	0.229	0.286[a]
Reduce feed cost	0.203	-0.183	0.197
Lead to higher milk quality	0.162	0.185	0.085
Hard to propagate during summer	0.234	0.178	0.233
Calculated attitude			0.377[b]
Outcomes Feeding Concentrates will …	**Feeding concentrate feeds**		
	Belief (bi)	Evaluation (ei)	Attitude (bi x ei)
	rs	rs	rs
Increase Milk Yield	0.627[b]	0.493[b]	0.644[b]
Improved body condition of buffalo	0.640[b]	0.556[b]	0.624[b]
Increase feed intake	0.701[b]	0.165	0.712[b]
Increase water intake	0.631[b]	0.053	0.603[b]
Provide high-quality nutrients/feeds	0.482[b]	0.230	0.466[b]
Calculated attitude			0.786[b]
Outcomes Feeding legumes will …	**Legume supplementation**		
	Belief (bi)	Evaluation (ei)	Attitude (bi x ei)
	rs	rs	rs
Increase milk yield	0.267[a]	0.053	0.302[a]
Seldom consumed by buffalo	0.078	0.287[a]	0.193
Laborious	-0.008	0.048	0.015
Challenging to propagate during the summer	0.101	-0.006	0.072
Requires availability of land	070	0.123	0.104
Harvest is time-consuming	0.014	0.059	0.043
Calculated Attitude			-0.033
Outcomes Forage Ensiling will…	**Forage Ensiling**		
	Belief (bi)	Evaluation (ei)	Attitude (bi x ei)
	rs	rs	rs
Increase milk yield	-0.023	0.016	0.036
infeasible due to an insufficient supply of forage for silage	-0.234	0.034	-0.035
Add to the cost of labor and inputs	-0.367[b]	-0.057	-0.338[b]
Lack practicality as buffalo can eat forage directly	-0.373[b]	-0.138	-0.365[b]
Time - Consuming	-0.401[b]	0.018	-0.411[b]
Laborious	-0.443[b]	-0.238	-0.384[b]
Calculated Attitude			-0.471[b]

[a]Correlation is significant at the 0.05 level (2-tailed).
[b]Correlation is significant at the 0.01 level (2-tailed).

each feeding innovation. For improved forage, strong positive correlations are observed between beliefs such as "Increase Milk Yield" and "Improve Body Condition" with farmers' attitudes. This indicates that those who believe in these outcomes are likely to develop a favorable attitude towards feeding improved forage, subsequently enhancing their intention to adopt or continue this practice. Conversely, the belief that feeding improved forage is "Hard to propagate during summer" has a positive but non-significant correlation with attitude. This suggests that while farmers may acknowledge this challenge, their positive attitude towards improved forage may stem from the perceived benefits outweighing the difficulties. Similarly, the belief in "Reduce Feed Cost" shows a non-significant correlation with attitude, indicating a potential, albeit limited, influence on farmers' attitudes compared to beliefs about milk yield and body condition. In the context of feeding concentrates, positive correlations between beliefs and attitudes are compelling. Specifically, beliefs such as “increasing milk yield,” “improving body condition,” and “enhancing water intake” demonstrate strong associations with favorable attitudes toward feeding concentrates. These positive attitudes are instrumental in shaping farmers' intentions to adopt or sustain the use of concentrates, emphasizing the importance of reinforcing these beliefs to promote their continued use in dairy buffalo production. Regarding legume supplementation, the correlation analysis reveals that the belief that legume supplementation will "enhance milk yield" exhibits a weak positive correlation with intention. However, evaluations of this outcome do not significantly correlate with intention, suggesting that farmers' attitudes and evaluations do not strongly influence their intentions to adopt legume supplementation. In contrast, beliefs about the "seldom consumption of legumes by buffalo" indicate a weak positive correlation with intention, while evaluations show a significant but weak correlation. Practical challenges associated with legume supplementation, such as labor intensity and difficulty of propagation during summer, show very weak correlations with intention. This implies that despite recognizing these challenges, they do not substantially deter farmers from considering legume supplementation. For forage ensiling, beliefs such as "Increase Milk Yield" show no significant correlation with attitude, indicating that recognizing potential benefits does not translate into favorable attitudes. Conversely, beliefs questioning the feasibility of ensiling due to insufficient forage supply exhibit negative correlations with attitude, suggesting that perceived barriers significantly shape farmers' attitudes and intentions. Farmers' views on the impracticality, costs, and labor requirements of ensiling strongly correlate with a reluctance to adopt this practice.

Subjective Belief, Motivation to Comply, and Subjective Norm towards using Feeding Innovation

Table **5** presents the subjective beliefs, motivation to comply, and subjective norm in relation to intentions regarding the six salient referents for adopting feeding innovations. A statistically significant positive correlation between the direct subjective norm and the intention to adopt feeding innovations within the next 12 months is observed. This finding suggests that perceived social pressure, as captured by the directly stated subjective norm, plays a significant role in shaping farmers' intentions to adopt these innovations. A notable disparity exists in the motivation to comply with different referents, with PCC staff/personnel, self-initiative, and fellow farmers demonstrating higher levels of influence than other sources. This variance likely arises from the perceived credibility and relevance of these referents in farmers' decision-making processes. PCC staff and personnel are often seen as knowledgeable and authoritative, enhancing their influence. In addition, self-initiative reflects an internal drive and confidence, motivating adoption. Fellow farmers, through peer influence and shared experiences, also play a critical role, as their practical insights and success stories can be compelling motivators. Informal social networks - including relatives, friends, and farmer groups - are essential for disseminating technology and providing platforms for exchanging ideas and experiences. Chowdhury *et al*. [15] reported that social networks significantly influence the short-term adoption of new agricultural technologies, emphasizing the importance of leveraging these connections to enhance technology uptake. This finding aligns with the results of this study, which indicate that social pressure from various referents significantly impacts the intention to adopt concentrated feeding. Moreover, Garforth *et al*. [4] noted that understanding the varying levels of motivation among farmers to comply with different information sources can help identify effective channels for promoting adoption. This observation is reflected in the current findings, where all six referents show a significant correlation with farmers' intention to adopt concentrate feeding. While all six referents correlate significantly with farmers' intention to adopt concentrate feeding, this trend does not extend to improved forage and forage ensiling, suggesting that social influences

Table 5: Subjective Belief, Motivation to Comply, and Subjective Norm for using Feeding Innovation

Referent	Subjective belief (sbj)	Motivation to Comply (mj)	Subjective norm (sbj x mj)	Correlation (r) with intention			
				Feeding Improved Forage	Concentrate Feeding	Legume Supplementation	Forage Ensiling
	Mean	Mean	Mean				
Fellow dairy farmer	1.28	1.37	2.03	0.079	0.552[b]	0.289[a]	0.238
PCC staff	1.62	1.58	2.78	0.004	0.453[b]	0.045	0.138
Self-Initiative	1.37	1.40	2.22	0.017	0.468[b]	0.183	0.198
Self - Observation	1.33	1.30	2.05	-0.056	0.456[b]	0.084	0.146
Coop Manager	0.85	0.87	1.12	-0.032	0.384[b]	0.322[a]	0.228
Coop Chairman	1.12	1.13	1.57	-0.139	0.310[a]	0.328[a]	0.194
Calculated subjective norm			11.77	-0.029	0.550[b]	0.249	0.221
Cronbach's coefficient of scale reliability			0.938				

[a]Correlation is significant at the 0.05 level (2-tailed).
[b]Correlation is significant at the 0.01 level (2-tailed).

may be less critical for these innovations. The particular significance of the coop chairman and manager, alongside fellow farmers, in the context of legume supplementation indicates their roles as trusted advisors within the community. Their influence may stem from their expertise and position within the cooperative structure, making their endorsement particularly valuable. These insights hold practical implications for strategies aimed at promoting the adoption of feeding innovations. It is clear that leveraging peer influence and the endorsement of key community members, such as coop managers and chairmen, could enhance the adoption of concentrate feeding and legume supplementation. Strategies could include training programs aimed at these influential referents, equipping them with the knowledge and resources to advocate effectively within their networks. By fostering these relationships, extension programs can create a supportive framework that encourages farmers to embrace innovative feeding practices.

Cognitive Drivers and Barriers to the use of Feeding Innovations

Table **4** reveals three prominent cognitive drivers or promoters of feeding improved forage among farmers: the potential to "increase milk yield", the "provision of readily available quality feeds", and "improvements in body condition". Notably, no significant cognitive barriers to using improved forage were identified, indicating a generally positive attitude toward this innovation. Conversely, all five attitudes examined were identified as cognitive drivers or promoters of concentrate-feeding innovation among farmers. These include the anticipated benefits of "increased milk yield", "improved body condition of buffalo", "enhanced feed intake", "increased water intake", and the "provision of high-quality nutrients". This positive attitude towards concentrated feeding indicates its potential for widespread adoption. Regarding legume supplementation, the primary cognitive driver or promoter identified was the expected "increase in milk yield". This suggests that farmers perceive legume supplementation as a means to enhance productivity, specifically in terms of milk production. In contrast, forage ensiling presents notable cognitive barriers to adoption. These include concerns about additional costs for labor and inputs, doubts about practicality given that buffalo can consume forage directly, and the perception that it is time-consuming and labor-intensive. These cognitive barriers may contribute to resistance among farmers toward adopting silage production technology.

In other words, while feeding improved forage and concentrate feeding is viewed favorably by farmers with clear cognitive drivers promoting their adoption, legume supplementation is primarily seen as beneficial for increasing milk yield. Forage ensiling, however, faces significant cognitive barriers that may impede its widespread adoption. Understanding these cognitive drivers and barriers is crucial for developing targeted strategies to promote the adoption of specific feeding innovations among farmers. Garforth *et al*. [10] noted that if a compelling driver of behavior change can be effectively strengthened within a specific population, it is likely to increase the adoption rate of the behavior. Consequently, extension programs should consider strategies that encourage and reinforce these beliefs, particularly among farmers who have not yet adopted the technology.

CONCLUSION

While socioeconomic factors and farm characteristics have a limited impact on dairy farmers' intentions to adopt legume supplementation and forage ensiling, elements like land ownership, herd size, and forage area availability play a crucial role in adopting improved forage and concentrate feeding practices. Farmers generally regard improved forage and concentrate favorably, recognizing the potential benefits for milk yield and animal condition; however, labor and cost constraints significantly limit the adoption of legume supplementation and forage ensiling. Social norms, especially influence from PCC staff and peer farmers, affect the adoption of concentrate feeding and legume supplementation, underscoring the value of respected community figures in promoting feeding innovations. Cognitive drivers, such as the potential for enhanced milk yield, promote adoption, while perceived costs and labor intensity act as deterrents, particularly for forage ensiling. These insights suggest that effective adoption strategies should focus on increasing forage area availability, leveraging positive social influences, and addressing practical barriers through targeted training and support. Proactive engagement by technology providers through consistent monitoring and guidance could further enhance adoption rates, aligning research and extension efforts with the specific needs and challenges faced by dairy farmers.

AVAILABILITY OF DATA

The raw data are available upon request.

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