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Challenges and benefits of extension service delivery for dairy cooperatives in Kaduna State, Nigeria

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ABSTRACT: This research aimed to evaluate the challenges and benefits of extension service delivery for dairy cooperatives in Kaduna State. Using a multi-stage sampling approach, 250 cooperative members were selected. Primary data were collected through a survey and analysed with descriptive and inferential statistics to meet the research objectives. Logistic regression was used to analyse the determinants of extension service delivery to the farmers. The study's findings reveal that most of those surveyed are middle-aged, with 62% between the ages of 31 and 50 years and a mean age of 38. Males dominate the cooperatives (72%), and 72% are married, highlighting a well-established group of farmers with an average farming experience of 11 years and a farm size of 1.8 hectares. Logit regression analysis revealed that household size, years of farming experience and farm size were significant at the 5% level, while contact with extension agents was significant at the 1% level, whereas, age and gender were significant at the 10% level. The primary challenges identified include inadequate frequency of extension visits (75.2%), poor access to services in remote areas (66.0%), and insufficient follow-up after training sessions (50.8%). Despite these challenges, significant benefits of effective extension service delivery such as improved dairy productivity (78%), increased knowledge of modern farming techniques (72.8%), enhanced access to market information (66.8%), better livestock health and management practices (61.6%), and access to innovative farming technologies (54.8%) are reported. Based on these conclusions, suggestions were made that extension agencies should develop a structured schedule that ensures frequent, predictable visits and create mobile extension units that will ensure sustained support. Additionally, implementing a post-training support system and providing hands-on workshops will reinforce training and improve dairy productivity, particularly in remote areas.

Keywords: Agriculture, cooperatives, dairy, extension services, productivity.

INTRODUCTION

One of the main forces in Nigeria is the agricultural sector of the country's economy, providing livelihoods for a sizeable segment of the populace. The quality of agricultural extension services is a critical issue in Nigeria, where agriculture plays a leading position in the economy, contributing significantly to the gross domestic product (GDP), export earnings, and employment (Tonuchi and Onyebuchi, 2019). Agriculture remains the backbone of the rural economy, with over 70% of Nigeria's population residing in rural areas and relying on agriculture for their livelihoods (Adebayo *et al.*, 2021a; Olawoye, 2018). Agricultural extension services involve the application ofscientific research and knowledge to farming practices through farmer education, aimed at improving productivity and sustainability (Oluwatayo and Akinola, 2021; Abdulahi *et al.,* 2023).

These services are designed to provide technical guidance to farmers on best farming practices, introduce new farming technologies, and supply inputs to cooperatives to enhance production (Ogunniyi and Oladejo, 2019). Access to extension services enables cooperatives to acquire essential information about available services and technologies, thereby reducing the uncertainty farmers face when adopting new methods (Adetunji and Adepoju, 2020). These services contribute to higher agricultural productivity by offering farmers insights into production challenges and the necessary solutions (Ogunleye and Adeola, 2021). Well-informed farmers are better equipped to decide how to proceed with their production methods, leading to more effective management of agricultural challenges (Oluwatayo and Akinola, 2021). As a result, farmers gain access to crucial resources and services such as credit, insurance, improved market linkages, and advanced farming techniques like artificial insemination and ration formulation (Adebayo *et al*., 2021b). Therefore, extension services play a crucial part in enhancing agricultural productivity, bolstering food security, and promoting agriculture's contribution to economic growth (Ibrahim and Musa, 2018; Ameh *et al.,* 2023).

Dairy cooperatives, in particular, play a crucial part in helping small-scale dairy farmers pool resources, access markets, and increase productivity. However, one of the most vital mechanisms supporting these cooperatives is agricultural extension services—programs designed to provide farmers with technical knowledge, training, and market information. Despite their importance, extension services in Nigeria encounter many difficulties that hinder their effectiveness, particularly for dairy cooperatives, which require specialized support. The main issues include insufficient resources and subpar infrastructure, and insufficient training for extension officers, all of which result in inconsistent service delivery to rural areas. Dairy cooperatives, largely composed of small-scale farmers in Nigeria's rural regions, often struggle with limited access to these services, which impedes their ability to adopt modern farming practices and improve milk production. Limited government investment and an overstretched agricultural extension system mean that many dairy farmers remain disconnected from valuable resources that may greatly enhance their standard of living (Ibrahim and Musa, 2018; Iliyasu *et al.,* 2023). Furthermore, these limitations are compounded by logistical issues such as poor road networks, which restrict the movement of extension officers and make it difficult for dairy cooperatives to receive timely support. Nigeria's rural infrastructure is often underdeveloped, and in remote areas where there is a lot of dairy farming, the lack of transportation services severely hampers the reach of extension programs (Ibrahim and Musa, 2018).

Beyond logistical and infrastructural issues, institutional and governance challenges further hinder effective extension service delivery. Several agricultural programs have been introduced by the Nigerian government aimed at improving the effectiveness of extension services, but the implementation of these policies has been inconsistent. The National Agricultural Extension and Research Liaison Services (NAERLS), which is tasked with coordinating extension programs, often faces institutional bottlenecks such as inadequate funding, mismanagement, and a lack of clear policy direction. These issues result in a fragmented approach to service delivery, with overlapping responsibilities between federal, state, and local agencies (Adebayo *et al*., 2021b; Odoh *et al.,* 2023).

Moreover, poor coordination between governmental agencies and non-governmental organizations (NGOs) further complicates service delivery, leading to gaps in coverage, especially for dairy cooperatives in more marginalized regions. Dairy farming in Nigeria has unique challenges, such as the requirement for specialized knowledge in animal health care, feed management, and milk processing. Unfortunately, most extension officers lack specific training in dairy production, which diminishes their ability to provide relevant guidance to cooperatives (Adebayo *et al*., 2021b). As a result, many cooperatives are unable to fully utilize the services provided, even when these services are available. This mismatch between the services offered and the actual needs of dairy farmers creates inefficiencies in the extension system, further weakening its impact on dairy production (Lai-Solarin *et al.,* 2023).

Technological limitations also represent a significant barrier to the successful delivery of extension services to dairy cooperatives in Nigeria. In numerous developing nations, such as Nigeria, the use of information and communication technologies (ICTs) is commonly acknowledged as a means of bridging the disparity between extension officers and rural farmers. However, the penetration of these technologies remains low, particularly in rural areas where dairy farming is most prevalent. The limited availability of mobile phones, internet services, and digital literacy hampers the ability of dairy cooperatives to access important agricultural information through ICT platforms (Oluwatayo and Akinola, 2021). Moreover, Nigeria's ICT infrastructure is concentrated in urban areas, leaving rural dairy farmers disconnected from innovative digital extension programs. If properly utilized, ICTs could offer a scalable solution to the challenges of delivering extension services across Nigeria's vast and often inaccessible rural landscape. As an illustration, mobile applications could enable farmers to receive up-to-date information on livestock management, market prices, and disease outbreaks, reducing their reliance on face-to-face interactions with extension agents. However, without concerted efforts to expand ICT access and digital literacy among rural farmers, these technological innovations remain out of reach for most dairy cooperatives (Odoh *et al.,* 2024).

Despite the numerous challenges faced by Nigeria's extension services, there are definite advantages when these services are successfully delivered to dairy cooperatives. Among the most important advantages is the improvement in dairy farming practices, which leads to increased productivity and profitability. Extension services provide training in areas such as animal husbandry, disease control, and feed management, all of which are critical to enhancing milk yields and ensuring the health of livestock (Olawoye, 2018). Additionally, extension programs help farmers to embrace more sustainable practices, which contribute to long-term environmental conservation and resource management. The support provided by extension services also empowers farmers by building their leadership and decision-making capacities within cooperatives (Sennuga *et al.,* 2024a). Through targeted training and capacity-building programs, farmers are able to strengthen the governance structures of their cooperatives, making them more resilient and sustainable. Furthermore, extension services play an important part in linking dairy cooperatives to larger markets, providing farmers with information on market trends, buyer preferences, and pricing strategies. This improved market access helps dairy cooperatives to bargain for lower costs for their goods, thereby increasing their incomes and contributing to the overall development of rural communities. However, to fully realize these benefits, there is a need for increased investment in Nigeria's extension infrastructure, additionally reforms in policy implementation to ensure that extension services are more responsive to the specific needs of dairy cooperatives. This study aims to evaluate the challenges and benefits of extension service delivery for dairy cooperatives in Kaduna State. To accomplish this, the following objectives are put forward:

1. Describe the socio-economic characteristics of the dairy cooperative members in the study area.
2. Determine the socio-economic determinants of extension service delivery in dairy cooperatives in the study area.
3. Examine the perceptions of dairy cooperative members concerning the extension services delivery in the study area.
4. Identify the primary challenges of extension services delivery for dairy cooperatives in the study area.
5. Evaluate the benefits of effective extension service delivery for dairy cooperatives in the study area.

LITERATURE REVIEW

Theoretical framework

Rogers' diffusion of innovations theory

The Diffusion of Innovations Theory, developed by Rogers in 1962, offers a thorough framework for comprehending the dissemination and assimilation of novel concepts, innovations, and practices in social systems. The theory is particularly relevant in agricultural contexts, where innovations such as enhanced livestock and modern farming methods management practices, or advanced marketing strategies are disseminated to farmers through extension services. This theory can be directly applied to the study of extension service delivery for dairy cooperatives in Nigeria to explore how new agricultural innovations are introduced to and adopted by cooperative members, as well as to identify the barriers to adoption that may arise. The core concept of Rogers' theory revolves around the diffusion process, which explains how ideas gradually proliferate within a society. This process involves several stages: awareness, interest, evaluation, trial, and adoption (Rogers, 2003). For dairy cooperatives in Nigeria, extension services play a critical role in facilitating this process by creating awareness of new farming techniques, providing knowledge to evaluate these innovations, and assisting farmers in the practical application of these methods. For instance, extension agents might introduce new feeding regimens, veterinary care techniques, or milk production technologies to cooperative members, aiming to improve their productivity and efficiency. Another important concept from Rogers' theory is the role of social systems in shaping the diffusion of innovations. In the context of dairy cooperatives, social systems refer to the relationships, norms, and organizational structures within the cooperatives and the wider farming community. Social dynamics, such as peer influence, cooperative governance, and trust in extension agents, can either facilitate or obstruct the adoption of new practices. For instance, if key members of a cooperative (such as influential farmers or leaders) are early adopters of an innovation, their success can encourage others in the group to follow suit. Conversely, if early attempts at adoption are unsuccessful or poorly managed, this may deter other members from trying out the innovation (Sennuga *et al.,* 2024b).

According to the theory, people in a social system can be divided into five groups: innovators, early adopters, early majority, late majority, and laggards, depending on how open they are to accept advances. These classifications help understand how different members of dairy cooperatives in Nigeria respond to new farming practices introduced through extension services. The adoption of innovation within these clusters is influenced by factors such as participants' communication habits, sources of information, personality traits, and socio-economic factors, including age, gender, educational level, and income (Oluwatayo and Akinola, 2021).

Conceptual framework

The conceptual framework for this research is shown in Figure 1, which also examines the connection between the independent variables and the dependent variable (the

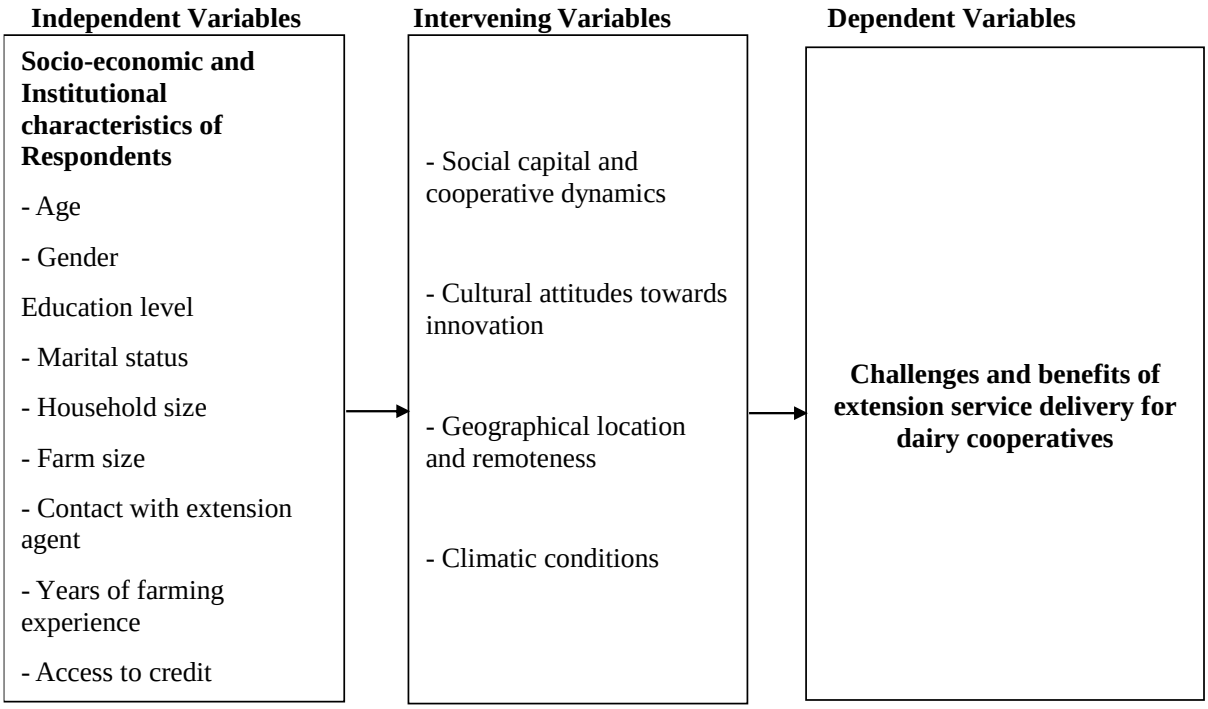

Figure 1. Conceptual framework of the study.

advantages and difficulties of providing extension services), which is mediated by the intervening variables. The study's independent variables, which include institutional and socioeconomic traits, have a direct impact on how extension services are provided and received. The study's dependent variable is the advantages and disadvantages dairy cooperatives face when providing extension services. These challenges and benefits reflect the effectiveness of extension services in improving the productivity, sustainability, and market access of dairy cooperatives in Nigeria. The intervening variables mediate the relationship between the independent variables and the dependent variable, either amplifying the challenges or enhancing the benefits of extension service delivery. These elements are not directly controlled by extension services, but they influence how effectively the services are implemented and received. The key intervening variables are: social capital and cooperative dynamics, cultural attitudes towards innovation, geographical location and remoteness, and climatic conditions.

MATERIALS AND METHODS

Study area

This investigation was carried out in Kaduna State, located in the north-western region of Nigeria. Kaduna is one of the 36 states in the country and has a major impact on Nigeria's agricultural sector due to its favourable climatic conditions. As per the 2006 National Population Census, the state had an estimated population of 6,066,562 people (National Population Commission, 2006). The state is divided into 23 Local Government Areas (LGAs), each contributing to its diverse socio-economic landscape. Kaduna State shares boundaries with several other states: Katsina and Kano to the north, Plateau to the northeast, Nasarawa and Abuja to the south, and Niger and Zamfara to the west.

Geographically, Kaduna State is located between latitude 9°N and 12°N and longitude 6°E and 9°E. It covers an expansive land area of approximately 48,473.2 square kilometres, making it one of the largest states in the country (National Population Commission, 2006). The state enjoys a tropical climate with a mean annual rainfall of 1,524 mm, which is distributed over 7 to 9 months of the year. The temperature ranges from 14.6 to 36°C throughout the year, creating optimal conditions for agriculture. The fertile soils, consisting of a mix of fine sand and clay, support the cultivation of a wide variety of crops, including maize, millet, rice, sorghum, groundnuts, cowpeas, yams, cassava, and ginger. These favourable agroecological conditions have positioned Kaduna as a key agricultural hub in Nigeria.

About 80% of the state's population is engaged in small-scale, subsistence farming, producing both food and cash crops (Olawoye, 2018). Agriculture is primarily rain-fed, but during the dry season, many farmers engage in

irrigation farming along rivers and dams to maintain crop production year-round. The Northern part of the state is classified as the Northern Guinea Savanna, while the Southern region falls under the Southern Guinea Savanna, both of which provide suitable environments for continuous cropping and livestock farming (Olawoye, 2018; Olaitan *et al.,* 2024a). Given its vast agricultural potential and population engagement in farming, Kaduna State is a critical area for understanding the dynamics of agricultural extension services, particularly in dairy farming.

Population of the study and research design

The study's population was made up of members of dairy cooperatives in Kaduna State, Nigeria. The target population includes dairy farmers who are organized within formal or informal dairy cooperatives, as these cooperatives play a critical role in pooling resources, enhancing knowledge transfer, and providing access to markets for small-scale farmers.

The research design adopted for this study is a descriptive survey design, which is well-suited to capturing the challenges and benefits of extension service delivery in dairy cooperatives. This design allows for the collection of both quantitative and qualitative data. A mixed-methods approach was employed to combine the strengths of both quantitative and qualitative research. Quantitative data were gathered through structured questionnaires administered to a sample of dairy cooperative members. This data allowed for statistical analysis to identify patterns and relationships between key variables. In addition, qualitative data were collected through in-depth interviews and focus group discussions with members of dairy cooperatives and extension officers. That provides rich insights into the experiences, challenges, and success stories of extension service delivery, offering a more nuanced understanding of the study's objectives.

Sample size and sampling techniques

For this study, a multi-stage sampling technique was employed to select a total of 250 respondents from dairy cooperatives across various Local Government Areas (LGAs) in Kaduna State, Nigeria. Kaduna State is divided into four agricultural zones: Birnin-Gwari, Maigana, Lere, and Samaru-Kataf. These zones represent different agricultural dynamics and cooperative structures, making them ideal for capturing a wide range of experiences with extension service delivery.

In the first stage, two LGAs were randomly selected from each agricultural zone, resulting in a total of eight LGAs. The selected LGAs were Igabi and Birnin-Gwari from the Birnin-Gwari zone, Kudan and Makarfi from the Maigana zone, Lere and Kubau from the Lere zone, and Zango-Kataf and Jaba from the Samaru-Kataf zone. This random selection ensured that the study captured data from different parts of the state, reflecting the diversity in farming practices and cooperative structures.

In the second stage, two villages were randomly selected from each of the eight chosen LGAs, leading to a total of 16 villages. This further narrowed down the areas of study while ensuring that the sample remained representative of the broader population within each LGA.

In the third stage, a list of dairy cooperative members was obtained from the Kaduna State Agricultural Development Project (KADP). Using this list, 10% of the dairy cooperative households from each of the 16 selected villages were randomly chosen, resulting in a sample size of 250 respondents. This approach ensures that the sampling design is self-weighting and avoids bias, providing a representative sample of dairy cooperative members from across the state. The selection of respondents was balanced to include a mix of cooperative members to gather a comprehensive view of the challenges and benefits of extension service delivery in the study area.

Data collection

A structured questionnaire intended to collect a wide range of data relating to the study in Kaduna State of Nigeria served as the main data collection tool in this investigation, Nigeria. The questionnaire was administered to a sample of dairy cooperative members. Each survey session took approximately 1 hour to complete, ensuring that respondents had ample time to provide detailed responses. The key themes explored in the questionnaire included the socio-economic characteristics of cooperative members, the socio-economic determinants of extension service delivery in dairy cooperatives, the benefits and challenges of these services, and the perspectives and satisfaction levels of cooperative members concerning the extension services delivery to dairy farmers. To ensure the questionnaire's validity and reliability, it was subjected to pre-testing in a pilot study. The pilot study was conducted with a small sample of dairy cooperative members who were not part of the main study. This pilot phase allowed for the identification of any ambiguities or issues with the questionnaire design. Based on feedback from the pilot, necessary adjustments were made to enhance the clarity, relevance, and effectiveness of the questions. This process helped ensure that the final questionnaire was well-suited for capturing accurate data related to the specific challenges and benefits experienced by dairy cooperatives in their interaction with extension services. Additionally, to further enhance data accuracy, twenty trained enumerators were employed to administer the questionnaire, ensuring that respondents fully understood the questions and provided thoughtful responses.

Data analysis

The data gathered for this study were analysed using a mix of descriptive and inferential statistical techniques. Descriptive statistics, such as percentages, frequency counts, and means, were employed to address objectives (1), (4), and (5) of the study. For objective (2), the logit regression model was applied to identify significant relationships. Objective (3) was analysed using a 4-point Likert scale to evaluate participant responses. The analysis was carried out using the Statistical Package for the Social Sciences (SPSS), version 24, which offered a robust platform for both descriptive and inferential analyses, including the use of the logit regression model to derive deeper insights from the data.

Model specification

Logit regression model

A logistic regression model was utilized to identify the socio-economic determinants of extension service delivery in dairy cooperatives within the study area. This model allows the study to determine the socio-economic and institutional factors that either promote or hinder active participation in extension services among cooperative members. The implicit form of the Logit model is expressed as:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10})$$

The explicit form of the Logit model is given as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + e$$

Where: Y = Determinants of participation in extension service delivery, X_1 = Age (in years), X_2 = Years of experience in dairy farming (in years), X_3 = Gender (male=1, female=0), X_4 = Household size (in numbers), X_5 = Marital status (married=1, otherwise=0), X_6 = Educational attainment (in years), X_7 = Farm size (in hectare), X_8 = Access to credit (access=1, otherwise=0), X_9 = Access to extension services (access=1, otherwise=0), β_0 = Constant (intercept), e = Error term.

This model enabled the study to examine how various socio-economic characteristics (e.g., age, education, and farm size) and institutional factors (e.g., access to credit and extension services) influence extension service delivery in dairy cooperatives. By using this approach, the study provided insights into which factors were most significant in either enhancing or limiting participation, offering a deeper understanding of the key drivers of engagement with extension services among dairy cooperatives in Kaduna State.

RESULTS AND DISCUSSION

Socio-economic and institutional characteristics of respondents

The results in Table 1 reveal a significant gender disparity among the cooperative members, with 72% of the respondents being male and 28% female. This is consistent with earlier research indicating that men dominate agricultural activities in many parts of Nigeria, particularly in sectors like dairy farming (Adeoti, 2019). The underrepresentation of women may be attributed to socio-cultural norms that often limit women's participation in agriculture, especially in rural areas (Adebayo *et al*., 2021b). Despite the growing recognition of women's contributions to agriculture, their involvement in dairy cooperatives remains constrained. Women's participation is crucial for enhancing household livelihoods, yet their lower representation may suggest structural barriers, such as access to resources and decision-making roles within cooperatives (Olaitan *et al*., 2024b). This gender imbalance reflects broader trends of male dominance in agricultural cooperatives across sub-Saharan Africa.

The findings in Table 1 indicate that the majority of the cooperative members are married, accounting for 72% of the respondents, followed by 16% who are single, 8% widowed, and 4% divorced or separated. This high proportion of married individuals reflects the typical demographic of smallholder farmers in rural Nigeria, where family labour is often central to agricultural activities (Olawoye, 2018). Married farmers tend to have larger households, providing them with more labour for dairy farming, which could explain their higher involvement in cooperatives. The lower participation of widowed and divorced individuals may be linked to reduced access to household labour and resources, which are crucial for active participation in agricultural cooperatives (Adebayo and Adeola, 2020).

The results in Table 1 show that a majority of the respondents, 52%, have household sizes ranging from 6 to 10 members, followed by 28% with more than 10 members, and 20% with 1 to 5 members. The results also indicate that the mean household size among the respondents is 8 members. This reflects the typical large household sizes found in rural Nigerian communities, where extended families and multiple generations often live together (Akinbile, 2019). Large households provide additional labour for farming activities, including dairy production, which is labour-intensive and benefits from family participation (Ayoade and Adeola, 2018). Household size is critical in smallholder farming systems, as larger families are more likely to contribute labour, reducing the need for hired help and enhancing productivity (Akinbile, 2019). Thus, the predominance of larger households among cooperative members suggests a reliance on family labour for dairy farming operations.

Table 1. Socio-economic and institutional characteristics of respondents (n = 250).

Variable	Freq (n =250)	Percent
Gender		
Female	70	28.0
Male	180	72.0
Marital status		
Single	40	16.0
Married	180	72.0
Divorced/separated	10	4.0
Widowed	20	8.0
Household size (Mean = 8 members)		
1 – 5	50	20.0
6 – 10	130	52.0
> 10	70	28.0
Educational level		
No formal education	40	16.0
Primary school	80	32.0
Secondary school	90	36.0
Post-secondary education	40	16.0
Age (Mean = 38 yrs)		
Less than or equal to 30 (≤ 30)	60	24.0
31 -40	85	34.0
41 -50	70	28.0
Greater than 50 (> 50)	35	14.0
Years of farming Experience (Mean = 11 yrs)		
1 – 5	30	12.0
6 – 10	70	28.0
11 – 15	90	36.0
> 15	60	24.0
Farm Size (Mean = 1.8 ha)		
< 1	80	32.0
1 – 2	110	44.0
3 – 4	40	16.0
> 4	20	8.0
Access to Extension Services		
Yes	170	68.0
No	80	32.0
Access to Credit		
Yes	90	36.0
No	180	64.0

Source: Field data, 2024.

The educational level of the respondents in Table 1 reveals that 36% have attained secondary education, followed by 32% with primary education, and 16% each with no formal education and tertiary education. This distribution highlights that the majority of dairy cooperative members have a basic level of education, which is common among

rural farmers in Nigeria (Ibrahim and Musa, 2018). The relatively high proportion of respondents with secondary education may positively influence their ability to adopt new agricultural practices and interact effectively with extension services (Onu, 2018). Conversely, the 16% with no formal education may face limitations in accessing and utilizing agricultural information, which could affect their participation in cooperative activities (Ibrahim and Musa, 2018).

The age distribution of the cooperative members shows that the majority are within the 31 to 50 years range, with 34% aged 31 to 40 years and 28% aged 41 to 50 years, resulting in a mean age of 38 years. This indicates that the cooperative is largely composed of middle-aged individuals who are likely in their most productive years (Olawoye, 2018). The representation of younger members aged less than or equal to 30 years is 24%, suggesting a moderate level of youth involvement in dairy farming. Only 14% of respondents are above 50 years old, reflecting a lower proportion of older individuals in the cooperative. This age structure is typical of rural farming communities in Nigeria, where farming is often taken up as a primary occupation by individuals in their middle years (Olayemi, 2018). The concentration of members in the middle-age bracket may enhance the productivity and sustainability of the cooperative's activities.

The data shows that the majority of respondents have substantial farming experience, with 36% having 11 to 15 years of experience and 28% having 6 to 10 years, resulting in a mean farming experience of 11 years. This indicates that most members of the cooperative (88%) have more than 5 years of farming experience and are seasoned farmers, which can contribute to their ability to effectively manage dairy production (Oluwatayo and Akinola, 2021). A smaller proportion, 24%, reported having more than 15 years of farming experience, while 12% had 1 to 5 years of experience. The prevalence of experienced farmers suggests that the cooperative members are well-versed in agricultural practices, which is a key factor in ensuring the success of extension service delivery (Ogunleye and Adeola, 2021). This high level of experience may also contribute to the adoption of innovative dairy farming techniques introduced through extension services.

The findings indicate that 44% of the respondents operate on farms between 1 to 2 hectares, followed by 32% with farms less than 1 hectare, resulting in a mean farm size of 1.8 hectares. This suggests that most cooperative members are smallholder farmers, a common characteristic in Nigeria's agricultural sector (Aedoti, 2019). Only 16% of respondents reported having 3 to 4 hectares, while 8% had farms larger than 4 hectares. The predominance of smaller farm sizes highlights the subsistence nature of dairy farming in the region, where limited land size may constrain production scale (Adeoti, 2019). The small average farm size reflects broader challenges in land access, which is typical of rural farming households in Nigeria and affects the potential for dairy production expansion.

According to the findings, 32% of cooperative members lack access to extension services, whereas 68% of them do. The majority of farmers seem to profit from agricultural extension services, which are necessary for knowledge transfer and the adoption of contemporary dairy farming practices, based on the comparatively high access rate (Adetayo et al., 2020). Access to extension services plays a crucial role in improving farm productivity by providing farmers with the necessary technical support, information on livestock management, and innovations in dairy farming (Adetayo *et al*., 2020). However, the 32% of respondents without access underscores existing challenges in the reach of extension services, particularly in remote or underserved areas. This disparity reflects broader issues of extension service coverage in rural Nigeria, which can limit the full potential of cooperatives (Ibrahim and Musa, 2018).

The results show that a substantial 64% of the respondents do not have access to credit, compared to just 36% of the respondents who have. Smallholder farmers in Nigeria sometimes struggle to obtain credit due to financial institutions' strict requirements, which are challenging for them to meet in rural areas (Oluwatayo and Akinola, 2021).

The availability of credit is crucial for dairy cooperative members, as it enables them to invest in livestock, improve infrastructure, and adopt modern farming technologies (Ayoade and Adeola, 2018). The high percentage of farmers without access to credit suggests a major financial constraint, limiting their ability to scale their dairy operations and maximize productivity. This constraint aligns with broader issues in Nigeria's agricultural sector, where the lack of financial inclusion hinders the growth potential of small-scale farmers (Adeoti, 2019).

Socio-economic determinants of extension service delivery for dairy cooperatives

The model statistics in Table 2 provide important insights into the performance and fit of the logistic regression model analysing the socio-economic determinants of extension service delivery for dairy cooperatives. Based on 250 observations, the model's Likelihood Ratio Chi-Square (LR Chi²) of 38.45 indicates the goodness-of-fit of the model. The Pseudo R^2 of 0.234 means the model explains 23.4% of the variability, reflecting moderate explanatory power. Additionally, the model's overall p-value of 0.001 confirms its high statistical significance, demonstrating that the independent variables collectively influence the dependent variable. The log-likelihood value of -122.54 further supports the model's effectiveness in predicting the observed data, highlighting its suitability for identifying key factors in extension service delivery. Six (6)

Table 2. Logit regression table showing the socio-economic determinants of extension service delivery for dairy cooperatives.

Variable	Coefficient	Standard error	Z- value	P-value
Constant	-1.250	0.520	-2.40	0.016
Age	0.045*	0.025	1.80	0.072
Gender	-0.150*	0.090	-1.67	0.097
Marital Status	0.140	0.070	2.00	0.102
Household Size	0.102**	0.045	2.27	0.023
Educational Level	0.078	0.052	1.50	0.134
Farming Experience	0.067**	0.030	2.23	0.026
Farm Size	0.130**	0.065	2.00	0.045
Access to Credit	0.220	0.080	2.75	0.081
Extension Contact	0.300***	0.090	3.33	0.001
Number of Observation	250.00			
LR Chi^2 (9)	38.45			
Pseudo R^2	0.234			
P-Value	0.001			
Log likelihood	-122.54			

Note: ***, ** and * indicate significance at 1%, 5% and 10% probability level respectively (Source: Field Study, 2024).

of the nine (9) characteristics that were tested—age, gender, household size, agricultural experience, farm size, and access to extension—had statistically significant coefficients. These elements have been found to be significant predictors of the socioeconomic factors that influence the provision of extension services in dairy cooperatives.

With a coefficient (β) of 0.045 and a p-value of 0.072, the logit regression results show that age is a significant factor in extension service delivery in dairy cooperatives. This means that the relationship is significant at the 10% level. This positive coefficient indicates that the probability of using extension services rises with cooperative members' ages. This is consistent with other research showing that older farmers are more likely to participate in agricultural initiatives because of their stability, expertise, and extended farming careers (Onemolease and Alabi, 2018). Older cooperative members are typically more established in their farming activities, making them more inclined to seek and utilize external support, such as extension services, to improve productivity (Adeola and Egbetokun, 2020).

Gender is a major factor of extension service delivery in dairy cooperatives, according to the logit regression results, which show a coefficient (β) of -0.150 and a p-value of 0.097, indicating significance at the 10% level. The negative coefficient indicates that women are less likely to engage in extension services compared to men. This is consistent with findings in prior studies, which highlight that gender disparities often limit women's access to agricultural resources, including extension services, due to socio-cultural norms, household responsibilities, and limited decision-making power (Onu, 2018). Men tend to dominate agricultural programs, leaving women with fewer opportunities to benefit from extension services (Ibrahim and Musa, 2018). The significant gender gap reflects broader patterns of inequality in rural Nigeria, where structural barriers disproportionately affect women's participation in agricultural extension programs.

With a coefficient (β) of 0.102 and a p-value of 0.023, the logit regression results indicate that household size is a major factor of extension service delivery in dairy cooperatives, and it is significant at the 5% level. Larger households appear to be more likely to use extension services, according to the positive coefficient. This is consistent with earlier research that shows households with more members typically have more labour available, which increases their participation in agricultural activities and programs (Adebayo *et al*., 2021b). Larger families often rely on multiple income streams and seek agricultural support to enhance productivity, making extension services more critical (Ibrahim and Musa, 2018).

The logit regression analysis indicates that years of farming experience significantly influence extension service delivery in dairy cooperatives, with a coefficient (β) of 0.067 and a p-value of 0.026, making it significant at the 5% level. The positive coefficient suggests that farmers with more years of experience are more likely to engage in extension services. This finding is consistent with existing literature, which shows that experienced farmers are generally more proactive in seeking information and support to improve their productivity (Ogunleye and Adeola, 2021). Experienced farmers tend to have a better understanding of the importance of extension services and are more likely to engage with such programs (Adebayo *et al*., 2021b). Their long-term involvement in farming

activities often drives their interest in adopting new technologies and practices that extension services provide, further enhancing their productivity.

With a coefficient (β) of 0.130 and a p-value of 0.045, the logit regression results show that farm size strongly influences the delivery of extension services in dairy cooperatives. This finding is significant at the 5% level. The positive correlation indicates that farmers are more likely to use extension services if their farms are larger. This result is consistent with other research demonstrating that farmers who own more land participate in agricultural programs more actively because they frequently have more resources and are more driven to spend money on services that increase production. Larger farms are often viewed as having a higher potential for commercial success, which makes extension service providers more likely to target them (Adetunji and Adepoju, 2020).

The logit regression results show that access to extension services is a highly significant determinant in the model, with a coefficient (β) of 0.300 and a p-value of 0.001, indicating significance at the 1% level. This highlights the crucial role of extension services in improving dairy cooperative members' access to valuable agricultural knowledge and resources. The positive coefficient demonstrates that respondents who have access to extension services are far more likely to benefit from enhanced farming techniques and productivity (Adetunji and Adepoju, 2020). Extension services are vital in providing technical support, modern practices, and market information, all of which directly impact the performance of smallholder farmers (Oluwatayo and Akinola, 2021).

The logit regression analysis shows that marital status is not a significant determinant of access to extension services, with a coefficient (β) of 0.140 and a p-value of 0.102. Despite this, the positive coefficient suggests that married cooperative members may have a higher likelihood of participating in extension services compared to their single, widowed, or divorced counterparts. This trend is consistent with findings that married individuals often have larger household sizes and better social networks, which can facilitate engagement with agricultural programs. Married farmers are also more likely to manage family farms, making them more motivated to seek out resources that enhance productivity (Adebayo *et al*., 2021).

The logit regression results indicate that educational level is not a statistically significant determinant of extension service delivery in dairy cooperatives, with a coefficient (β) of 0.078 and a p-value of 0.134. Despite this, the positive coefficient suggests that higher educational attainment may still improve the likelihood of participating in extension services, as education is often linked to greater awareness and adoption of agricultural innovations (Akinola and Ogunbameru, 2020). While not statistically significant in this model, previous studies have shown that educated farmers are typically more receptive to new farming technologies and are better able to understand and apply the recommendations provided by extension agents (Ogunniyi and Oladejo, 2019).

With a coefficient (β) of 0.220 and a p-value of 0.081, the logit regression analysis demonstrates that loan availability is not a statistically significant factor influencing the provision of extension services in dairy cooperatives. The positive coefficient indicates that farmers who have access to financing are more likely to use extension services, even though it is not statistically significant. This result is consistent with earlier studies that show how access to finance encourages farmers to make improvements to their operations, implement new technology, and seek out extension services for technical assistance (Adebayo *et al*., 2021).

Challenges of extension service delivery for dairy cooperatives

The results presented in Table 3 paint a comprehensive picture of the difficulties faced by dairy cooperatives in accessing and benefiting from extension services. The most significant challenge reported by the respondents is the inadequate frequency of extension visits, with 75.2% of cooperative members identifying this as a key issue. The lack of regular visits can lead to a disconnect between farmers and extension services, reducing the effectiveness of the advice and training provided. According to earlier research, sporadic visits by extension agents frequently lead to a lack of trust and a decrease in the implementation of advised practices (Oluwatayo and Akinola, 2021).

Poor access to extension services in remote areas was reported by 66.0% of respondents, making it the second most significant challenge. Remote locations often suffer from poor road networks, lack of transportation, and limited communication infrastructure, all of which hinder the ability of extension agents to reach farmers regularly (Onemolease and Alabi, 2018). The difficulty in accessing these services exacerbates the challenges faced by dairy farmers, particularly those in isolated regions where extension services are most needed. This aligns with findings from Ibrahim and Musa (2018), who noted that farmers in remote areas are often left underserved, leading to disparities in agricultural productivity.

Another significant challenge is the lack of tailored training specific to dairy farming, identified by 60.8% of respondents. This indicates that the training provided by extension services may not always meet the specific needs of dairy farmers. Generalized training programs that do not address the unique challenges of dairy farming, such as livestock management, milk production, and disease control, are less effective in improving productivity (Akinola and Ogunbameru, 2020). This challenge high-

Table 3. Challenges of extension service delivery for dairy cooperatives.

Constraints/Challenges	Frequency	Percentage
Inadequate frequency of extension visits	188	75.2%
Poor access to extension services in remote areas	165	66.0%
Lack of tailored training specific to dairy farming	152	60.8%
Insufficient follow-up after initial training sessions	127	50.8%
Limited availability of knowledgeable extension agents	113	45.2%
Inadequate communication between farmers and extension agents	95	38.0%

Multiple Response Allowed* (Source: Field Study, 2024).

lights a gap in the current extension service delivery model, where one-size-fits-all approaches may fail to address the nuanced needs of different farming sectors. Insufficient follow-up after initial training sessions was noted by 50.8% of respondents, reflecting concerns about the continuity and effectiveness of the training provided. Without adequate follow-up, there is a risk that the initial training may not translate into sustained changes in farming practices, thereby limiting the long-term impact of extension services (Adetunji and Adepoju, 2020).

The limited availability of knowledgeable extension agents was reported by 45.2% of respondents, indicating a significant concern about the quality of the support provided. The lack of adequately trained and knowledgeable agents can lead to misinformation, ineffective advice, and ultimately, a lack of confidence in the extension services offered. This issue is particularly acute in specialized areas like dairy farming, where a deep understanding of specific practices and challenges is necessary to provide relevant and practical support (Ogunleye and Adeola, 2021). Finally, inadequate communication between farmers and extension agents was identified by 38.0% of respondents as a significant challenge. Communication barriers can arise from various factors, including language differences, lack of access to communication tools, and the absence of regular contact. When communication is ineffective, it diminishes the value of the extension services, as farmers may not fully grasp or correctly implement the recommendations provided (Oluwatayo and Akinola, 2021).

Benefits of effective extension service delivery for dairy cooperatives

Table 4 highlights the benefits of effective extension service delivery as perceived by dairy cooperative members, with responses reflecting the diverse impacts of these services on dairy farming. The results suggest that while certain benefits are widely recognized, others are perceived with varying levels of significance, as indicated by the high and low percentages. The highest percentage, 78%, was reported for improved dairy productivity, indicating that the most significant impact of effective extension services is on the productivity of dairy operations. This suggests that extension services are crucial in enhancing the efficiency and output of dairy farming, likely through the dissemination of best practices, improved herd management, and better utilization of resources (Adetunji and Adepoju, 2020).

Following closely, 72.8% of respondents cited increased knowledge of modern dairy farming techniques as a significant benefit. This high percentage suggests that extension services play a critical educational role, equipping farmers with the knowledge necessary to adopt advanced farming techniques. The dissemination of modern practices through training and workshops helps farmers improve their operations, which in turn contributes to higher productivity and efficiency (Akinola and Ogunbameru, 2020). The emphasis on knowledge transfer is consistent with studies that highlight education as a key driver of innovation and improvement in agricultural practices (Ogunniyi and Oladejo, 2019).

Enhanced access to market information was identified by 66.8% of respondents as another major benefit, suggesting that effective extension services not only improve farming practices but also provide valuable insights into market trends and opportunities. Access to market information is critical for farmers to make informed decisions about when and where to sell their products, which can significantly impact their income and profitability (Ibrahim and Musa, 2018). The relatively high percentage indicates that extension services are successful in bridging the gap between production and market access, enabling farmers to maximize their returns.

Better livestock health and management practices were reported by 61.6% of respondents, highlighting the importance of extension services in promoting animal welfare. Effective extension services often include veterinary support, guidance on nutrition, and disease management, all of which contribute to healthier livestock and, consequently, higher productivity (Adetunji and Adepoju, 2020).

Access to new and innovative farming technologies was noted by 54.8% of respondents. This indicates that not all farmers are equally exposed to or able to adopt new

Table 4. Benefits of extension service delivery for dairy cooperatives.

Benefits	Frequency	Percentage
Improved dairy productivity	195	78.0%
Increased knowledge of modern dairy farming techniques	182	72.8%
Enhanced access to market information	167	66.8%
Better livestock health and management practices	154	61.6%
Access to new and innovative farming technologies	137	54.8%
Increased income and profitability	100	40.0%

Multiple Response Allowed* (Source: Field Study, 2024).

technologies, possibly due to financial constraints or limited access to resources (Oluwatayo and Akinola, 2021). This suggests that while extension services are introducing innovations, the reach and adoption of these technologies may vary among cooperative members.

Increased income and profitability were reported by 40% of respondents, the lowest among the listed benefits. Although this percentage indicates that a substantial number of farmers perceive financial gains from effective extension services, it also suggests that the link between extension services and income might not be as direct or immediate as other benefits. Income improvements often result from a combination of factors, including market conditions, access to credit, and the ability to implement new practices effectively (Adebayo *et al*., 2021).

Conclusion and Recommendations

This article provides a comprehensive analysis of the socio-economic characteristics of dairy cooperative members, the determinants of extension service delivery, the challenges faced by these cooperatives in accessing and benefiting from extension services, and the perceived benefits of effective extension service delivery.

The socio-economic characteristics of the respondents reveal that the majority are middle-aged, with 62% of respondents falling within the 31 to 50 years age range and a mean age of 38 years. This age distribution suggests that the cooperative members are predominantly in their productive years, which is critical for the adoption and implementation of extension services. The gender distribution shows a significant male dominance, with 72% of the respondents being male, which reflects broader trends in agricultural participation in Nigeria. Most respondents are married (72%), with an average household size of 8 members. Educational levels among the respondents are varied, with 68% having at least a primary or secondary education, which is essential for understanding and applying the information provided by extension services. Farming experience is notably high, with 88% of respondents having more than 5 years of experience, and the mean farm size is 1.8 hectares, indicating the prevalence of smallholder farming within the cooperative.

In examining the socio-economic determinants of extension service delivery, the logit regression analysis identified several significant and non-significant factors. Age ($\beta = 0.045$, $p = 0.072$) and gender ($\beta = -0.150$, $p = 0.097$) were significant at the 10% level, suggesting that older farmers and male farmers are more likely to access extension services. Household size ($\beta = 0.102$, $p = 0.023$) and years of farming experience ($\beta = 0.067$, $p = 0.026$) were significant at the 5% level, indicating that larger households and more experienced farmers are more engaged with extension services. Farm size ($\beta = 0.130$, $p = 0.045$) was also significant at the 5% level, reflecting the tendency of larger farms to benefit more from extension services. In contrast, extension contact ($\beta = 0.300$, $p = 0.001$) was significant at the 1% level.

The challenges faced by dairy cooperatives in accessing and benefiting from extension services are significant and multifaceted. The most commonly reported challenge was the inadequate frequency of extension visits (75.2%), followed by poor access to extension services in remote areas (66.0%). Other notable challenges included the lack of tailored training specific to dairy farming (60.8%), insufficient follow-up after initial training sessions (50.8%), limited availability of knowledgeable extension agents (45.2%), and inadequate communication between farmers and extension agents (38.0%). These challenges highlight critical barriers that need to be addressed to enhance the effectiveness and reach of extension services, particularly in rural and underserved areas.

Despite these challenges, the benefits of effective extension service delivery, as perceived by dairy cooperative members, were substantial. Improved dairy productivity was the most significant benefit, reported by 78% of respondents, underscoring the direct impact of extension services on farm output. Increased knowledge of modern dairy farming techniques (72.8%) and enhanced access to market information (66.8%) were also highly valued, reflecting the educational and market-oriented benefits of extension services. Other important benefits included better livestock health and management practices (61.6%), access to new and innovative farming

technologies (54.8%), and increased income and profitability (40.0%). These findings demonstrate that when effectively delivered, extension services can significantly enhance the productivity, knowledge base, and economic outcomes of dairy cooperatives. While there are clear areas of success, particularly in productivity and knowledge acquisition, significant barriers remain that need to be addressed to ensure that all cooperative members can fully benefit from extension services. Addressing these challenges is crucial for improving the sustainability and profitability of dairy farming in Nigeria. Based on the findings of this study, the following recommendations have been put forward:

1. Extension agencies should develop a structured schedule that ensures frequent and predictable visits, particularly in remote areas. This could be achieved through better resource allocation, recruitment of more extension agents, and leveraging technology to maintain consistent communication between farmers and extension agents even between physical visits.
2. While educational level was not a significant determinant in the logit regression analysis, its importance should not be underestimated. Programs aimed at improving the educational level of farmers, such as adult education and literacy programs, should be supported. Additionally, extension materials should be designed to be easily understood by farmers with varying levels of education, using visual aids and local languages.
3. Credit facilities tailored to the needs of dairy farmers should be developed, possibly in collaboration with microfinance institutions and cooperative societies. These facilities should offer favourable terms, such as low-interest rates and flexible repayment schedules, to enable farmers to invest in their dairy operations.
4. Continuous professional development programs should be introduced to keep extension agents updated on the latest dairy farming practices and technologies. Additionally, specialization among extension agents could be promoted, where some agents focus specifically on dairy farming, ensuring that farmers receive expert advice.
5. Investments should be made in improving rural infrastructure, such as roads and communication networks, to facilitate easier access to extension services. Additionally, mobile-based extension services or digital platforms can be introduced to reach farmers in remote areas, ensuring they receive timely information and support.

CONFLICT OF INTEREST

The author declares that they have no conflicts of interest.

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