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Influence of Agricultural Extension Services on Honey Production Efficiency among Beekeepers in Sardauna Local Government Area, Taraba State, Nigeria

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Abstract

This study examined the influence of agricultural extension services on honey production efficiency among beekeepers in Sardauna Local Government Area, Taraba State, Nigeria. A descriptive survey design was employed, targeting 283 beekeepers selected through multi-stage sampling. Data were collected via structured questionnaires and analyzed using descriptive statistics, multiple linear regression, Pearson Product Moment Correlation (PPMC), and Likert scale analysis. Findings revealed that (57.6%) of beekeepers had contact with extension agents, but the mean frequency of visits was low (2.1 visits/year), and only (39.6%) participated in extension training. The perceived quality of extension services was moderate (mean = 2.8), while access to inputs or credit through extension linkages was limited (17%). Multiple regression results indicated that extension contact ($\beta = 0.214$, $p < 0.01$), extension service quality ($\beta = 0.487$, $p < 0.01$), education ($\beta = 0.056$, $p < 0.05$), farm size ($\beta = 0.012$, $p < 0.05$), access to credit ($\beta = 0.431$, $p < 0.01$), and membership in beekeepers' associations ($\beta = 0.172$, $p < 0.01$) significantly influenced the adoption of improved beekeeping practices. Correlation analysis showed a positive and significant relationship between extension service utilization and honey production efficiency ($r = 0.682$, $p = 0.001$). Key constraints limiting effective extension delivery included lack of modern beekeeping equipment, inadequate capital, and insufficient extension support. The study concluded that agricultural extension services play a crucial role in enhancing honey production efficiency, but limited access, low intensity of contact, and resource constraints hinder their full impact. It is recommended that extension agencies strengthen training, improve service quality, facilitate access to modern equipment and credit, and promote cooperative membership to boost honey productivity and rural livelihoods.

Keywords: *Agricultural extension, Honey production efficiency, Beekeepers, Technology adoption, Taraba State*

INTRODUCTION

Beekeeping has increasingly gained recognition as an important component of sustainable agriculture and rural development, particularly in Sub-Saharan Africa. It contributes to food security, biodiversity conservation, and income generation for smallholder farmers (Oyeleke, *et al.*, 2022). In Nigeria, apiculture holds significant potential as a source of livelihood diversification and poverty reduction, especially among rural populations (Olagunju & Yusuf, 2021). Despite this potential, the productivity of honey producers remains relatively low due to limited access to modern production techniques, inadequate credit facilities, and weak extension service delivery (Ibrahim, *et al.*, 2020). Agricultural extension services are vital instruments for the dissemination of innovations and for enhancing farmers' technical efficiency. They provide training, advisory support, and linkages to inputs and markets, thereby

promoting improved production practices (Agbamu, 2019). According to Adeola and Akinbode (2021), extension services serve as a critical interface between research outputs and the farming population by ensuring that innovations are appropriately adapted to local needs. However, the performance of extension systems in Nigeria has often been constrained by inadequate staffing, poor logistics, and insufficient funding (Hamisu, *et al.*, 2017; Adefalu, *et al.*, 2023).

Empirical studies have shown that contact with extension agents positively influences farmers' productivity and technology adoption across several agricultural enterprises. For instance, Ndaghu and Bello (2022) reported that regular extension visits significantly enhanced the technical efficiency of rice farmers in Adamawa State. Similarly, Oladipo, *et al.* (2020) found that beekeepers who had frequent interactions with extension agents achieved higher honey yields and adopted improved hive management practices compared to those without such contact. These findings underscore the critical role of extension services in optimizing production efficiency within the apiculture sector. Despite the growing evidence linking extension services to agricultural productivity, limited empirical research has been conducted on honey production efficiency in the northeastern part of Nigeria, particularly in Sardauna Local Government Area of Taraba State. Sardauna LGA, with its favourable climate, vegetation, and topography, presents a conducive environment for apiculture. However, the degree to which beekeepers in the area benefit from extension interventions remains largely undocumented. Therefore, this study seeks to examine the influence of agricultural extension services on honey production efficiency among beekeepers in Sardauna Local Government Area, Taraba State. The study aims to generate evidence-based insights that will guide policymakers, development agencies, and extension organizations in strengthening apicultural extension delivery to enhance honey productivity, income generation, and rural livelihood sustainability.

Statement of the Problem

Honey production has emerged as a profitable enterprise with immense potential for income generation, employment creation, and environmental sustainability in rural Nigeria. Despite these prospects, the productivity and efficiency of honey producers remain relatively low compared to their counterparts in other developing countries (Olagunju & Yusuf, 2021). This low level of efficiency is largely attributed to the limited adoption of improved beekeeping technologies, poor management practices, and inadequate institutional support systems (Oyeleke, *et al.*, 2022). One of the key institutional factors influencing agricultural productivity is the effectiveness of agricultural extension services (Adeola & Akinbode, 2021). In many parts of Nigeria, including Taraba State, the delivery of extension services has been constrained by a shortage of trained personnel, poor logistics, weak coordination, and inadequate funding (Hamisu, *et al.*, 2017; Adefalu, *et al.*, 2023). Consequently, a large proportion of beekeepers operate with limited technical guidance and minimal contact with extension agents. This often results in low yields per hive, poor colony management, and post-harvest losses, all of which reduce the profitability of honey production (Ibrahim, *et al.*, 2020).

Furthermore, while several studies have examined the impact of extension services on crop and livestock production efficiency in Nigeria (Ndaghu & Bello, 2022), little empirical evidence exists on how these services influence productivity in the apiculture sub-sector. In Sardauna Local Government Area, where beekeeping is increasingly practiced due to its favourable ecological conditions, the extent to which extension services affect honey production efficiency remains largely unknown. The absence of empirical data on the linkage between extension support and honey production efficiency poses a serious challenge to the design of effective apicultural development programmes. Without such information, policymakers and extension agencies may find it difficult to implement targeted interventions that can improve production practices and enhance rural livelihoods. Therefore, this study seeks to fill this research gap by investigating the influence of agricultural extension services on honey production efficiency among beekeepers in Sardauna Local Government Area, Taraba State. It is against this backdrop that this study answered the following research questions

1. To what extent do beekeepers in Sardauna Local Government Area have access to agricultural extension services related to honey production?
2. How does the frequency and quality of extension contact influence the adoption of improved beekeeping practices among honey producers in the study area?
3. What is the relationship between the utilization of extension services and the production efficiency of honey among beekeepers in Sardauna Local Government Area?
4. What are the major challenges affecting effective delivery and utilization of extension services among honey producers in the study area?

Objectives of the Study

The broad objective of this study is to examine the influence of agricultural extension services on honey production efficiency among beekeepers in Sardauna Local

Government Area, Taraba State. The specific objectives are to:

1. assess the level of access and utilization of agricultural extension services by honey producers in Sardauna Local Government Area.
2. determine the effect of extension contact on the adoption of improved beekeeping practices among honey producers.
3. analyze the relationship between extension service utilization and honey production efficiency among beekeepers in the study area.
4. identify the major constraints affecting the effective delivery and utilization of agricultural extension services in honey production in Sardauna Local Government Area.

METHODOLOGY

Study Area

This study was conducted in Sardauna Local Government Area (LGA) of Taraba State, Nigeria. The area is located in the southern part of Taraba State, within the Mambilla Plateau region, which is renowned for its high altitude, favourable climate, and extensive vegetation that supports apiculture and other agricultural activities. Geographically, Sardauna LGA lies between latitude 6°30′ N and 7°15′ N and longitude 10°15′ E and 11°00′ E (Taraba State Government, 2023). Sardauna shares boundaries with Cameroun Republic to the east, Kurmi LGA to the south, Gashaka LGA to the north, and Takum LGA to the west. The administrative headquarters is located in Gembu, which is the major urban settlement on the Mambilla Plateau. The area covers a total land mass of approximately 4,868 square kilometres (National Bureau of Statistics, 2022).

The climatic conditions of Sardauna LGA are characterized by moderate temperatures ranging between 18°C and 25°C, and an average annual rainfall of 1,800–2,000 mm. The cool weather and abundance of flowering plants make it highly suitable for beekeeping, dairy production, and horticultural farming. The vegetation is predominantly montane grassland and forest, which provides a rich source of nectar and pollen for honeybees. The population of Sardauna LGA, according to the National Population Commission (NPC, 2006) and projected growth rate of 3.2%, is estimated at approximately 120,000 people in 2024. The population is predominantly rural and engaged in smallholder agricultural production.

The major economic activities include crop farming (maize, Irish potatoes, coffee, tea, vegetables), animal husbandry (cattle, sheep, goats), and beekeeping. Other livelihood activities include trading, carpentry, and local craftwork. Honey production has recently gained prominence as an income-generating enterprise due to the area's ecological advantage and growing market demand. The languages spoken in Sardauna LGA are diverse due to its multi-ethnic composition. Major languages include Fulfulde, Mambilla, Kaka, Panso, Kambu, and Hausa, while English serves as the official language of communication. The people are known for their strong communal ties and cooperative associations, which plays a significant role in promoting agricultural activities and marketing of farm products. Overall, Sardauna LGA presents a suitable environment for the study of the relationship between agricultural extension services and honey production efficiency, given its ecological endowment and growing apicultural potentials.

Research Design

The study adopted a descriptive survey research design to examine the influence of agricultural extension services on honey production efficiency among beekeepers in Sardauna Local Government Area, Taraba State. This design is appropriate because it enables the collection of quantitative data that describe existing conditions and relationships among key variables such as access to extension services, adoption of improved practices, and production efficiency. Data were gathered from beekeepers through structured questionnaires, while additional qualitative information will be obtained from focus group discussions and key informant interviews with extension agents. Quantitative approach was used to ensure a comprehensive understanding of the research problem. Descriptive and inferential statistics, including correlation and regression analyses, were employed to analyze the data and test relationships among variables.

Sampling Procedure and Sample Size

The population of this study comprises all registered beekeepers in Sardauna Local Government Area of Taraba State, including those belonging to cooperative societies and those operating individually. According to records from the Taraba State Agricultural Development Programme (TADP, 2023), there are about 720 active beekeepers in the area. A multi-stage sampling procedure was employed. In the first stage, five major honey-producing communities Gembu, Nguroje, Warwar, Dorofi, and Mayo-Selbe were purposively selected due to their active involvement in apiculture. In the second stage, a proportionate random sampling technique was used to select respondents from each community based on the number of active beekeepers recorded in the area.

The sample size will be determined using Yamane's (1967) formula:
n = N / (1 + N (e) ^2)
Where:
n = sample size

N = population size (720)
e = level of precision (0.05)
Substituting values:
n = 720 / (1 + 720(0.05) ^2)
n = 720 / (1 + 720 × 0.0025)
n = 720 / (1 + 1.8)
n = 720 / 2.8
n ≈ 257

Table 1: Distribution of Sampled Beekeepers by Community

S/N	Community	Number of Beekeepers per Village	Sample Proportion (%)	Sample Size
1	Gembu	200	27.8	79
2	Nguroje	160	22.2	63
3	Warwar	140	19.4	55
4	Dorofi	120	16.7	47
5	Mayo-Selbe	100	13.9	39
Total		**720**	**100**	**283**

Source: Author Computation, 2025

Method of Data Collection

The study relied solely on primary data, which will be collected through the use of a structured questionnaire administered to the selected beekeepers in Sardauna Local Government Area of Taraba State. The questionnaire was designed to obtain quantitative information relevant to the study objectives. The instrument was divided into sections that cover respondents' socio-economic characteristics, access to agricultural extension services, adoption of improved beekeeping practices, production levels, and constraints affecting honey production. The questions was mostly closed-ended, with a few open-ended items to allow respondents to express their opinions where necessary.

Copies of the questionnaire were administered personally by the researcher with the help of trained field assistants who are familiar with the local communities and languages (Fulfulde and Mambilla). This approach helped to ensure accurate interpretation of the questions and reliable responses from participants. A total of 283 questionnaires were distributed across the five selected communities Gembu, Nguroje, Warwar, Dorofi, and Mayo-Selbe based on the proportionate sample allocation. The completed questionnaires were collected immediately after filling to minimize loss or damage of data. Before the actual field survey, the questionnaire were pre-tested in a nearby community with similar characteristics to those in the study area. The pre-test helped identify ambiguous or unclear questions, and necessary adjustments will be made to improve the instrument's clarity, reliability, and validity.

Analytical Techniques

Data for this study was analyze using both descriptive and inferential statistic. Descriptive statistics was used to achieve objective 1. Multiple linear regression was used to analyze objective 2, Pearson Product Moment Correlation (PPMC) was used to achieve objective 3 and Likert Scale analysis was used to achieve objective 4.

Multiple Linear Regression Model (MLR) Model Specification

Multiple Linear Regression Model (MLR) was used to achieve objective 2. It was used to examine how several independent variables such as extension contact, service quality, education, experience, and access to credit jointly influence the level of adoption of improved beekeeping practices among honey producers.

This approach is appropriate because the dependent variable, Adoption Index (Y), is continuous, allowing the model to determine both the direction (positive or negative) and magnitude of the effect of each predictor variable. The OLS regression minimizes the sum of squared errors between observed and predicted values, providing unbiased and efficient parameter estimates under standard assumptions such as linearity, independence, and homoscedasticity. It is mathematically presented as follows:

The functional form is:

$Y= f (X_1,X_2,X_3,X_4,X_5,X_6,X_7,X_8)$……..……..(1)
The econometric model is specified as:
$Y=\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+\beta_8X_8+\mu$ ……(2)
Where:
Y = Adoption of improved beekeeping practices
X_1= Extension contact (Number of visits per year)
X_2= Extension service quality (Mean score on 1–5 Likert scale)
X_3= Education level (Years of formal schooling)

X_4= Beekeeping experience (Years)
X_5= Farm size (Number of active hives)
X_6= Access to credit/input support (Dummy: 1 = Yes, 0 = No)
X_7= Membership in beekeepers' association (Ordinal: 0 = None, 1 = Inactive, 2 = Active)
X_8= Household size (Number of persons involved in beekeeping)
μ = Error term
β_1-β_8 = Regression Coefficients Estimated

Pearson Product Moment Correlation (PPMC) Model Specification

The Pearson Product Moment Correlation (PPMC) is a statistical tool used to measure the strength and direction of the linear relationship between two continuous variables. The PPMC coefficient, denoted as r, ranges from –1 to +1. A positive value of *r* indicates a direct relationship (as one variable increases, the other also increases), while a negative value signifies an inverse relationship (as one increases, the other decreases). A value close to zero suggests little or no linear relationship between the two variables. The significance of the correlation coefficient is tested using a *t-test* to determine whether the observed relationship is statistically significant at the 5% level of probability. This helps to confirm whether extension service utilization has a meaningful effect on honey production efficiency in the study area.

The Pearson Product Moment Correlation (PPMC) was used to determine the relationship between extension service utilization and honey production efficiency among beekeepers. It measured how changes in the use of extension services relate to variations in production efficiency, indicating whether the relationship is positive, negative, or insignificant. It is mathematically given as thus:

$$r = \Sigma [(Xi - \bar{X})(Yi - \bar{Y})] / \sqrt{[\Sigma (Xi - \bar{X})^2 * \Sigma (Yi - \bar{Y})^2]} \ldots (3)$$

Where:
r = correlation coefficient
Xi = values of extension service utilization
Yi = values of honey production efficiency
$\bar{X}$ = mean of extension service utilization
$\bar{Y}$ = mean of honey production efficiency
The significance of r will be tested using:

$$t = r \sqrt{(n-2)} / \sqrt{(1-r^2)}$$

Decision rule:
If t_ calculated > t_ tabulated at 0.05 level of significance, reject H_0 and conclude that a significant relationship exists.

Variable description:

X = Extension service utilization (number of contacts, trainings, or visits)
Y = Honey production efficiency (kilograms of honey produced per hive)

Likert Scale Analysis Model Specification

A 5-point Likert scale was used to achieve objective 4. This method allows respondents to express the degree of agreement or disagreement with various listed constraints. The responses will be quantified to obtain a mean score for each item, which indicates its relative importance. Constraints with higher mean values will be considered more serious problems facing beekeepers, while those with lower means will be regarded as minor.

Summarized Model

5 = Strongly Agree
4 = Agree
3 = Undecided
2 = Disagree
1 = Strongly Disagree

Mean score formula:

$$\bar{X} = \Sigma (F \times S) / N$$

Where:
$\bar{X}$ = Mean score for each constraint
F = Frequency of respondents for each scale point
S = Scale value (1–5)
N = Total number of respondents

Decision rule:
Mean ≥ 3.0 → Major constraint
Mean < 3.0 → Minor constraint

RESULTS AND DISCUSSION

Table 1: Access and Utilization of Agricultural Extension Services by Honey Producers (n = 283)

S/N	Variable	Category	Frequency (f)	Percentage (%)	Mean
1	Age (years)	—	—	—	41.6
2	Gender	Male	201	71.0	—
		Female	82	29.0	—
3	Education level	None	54	19.1	—
		Primary	92	32.5	—
		Secondary	86	30.4	—
		Tertiary	51	18.0	—

S/N	Variable	Category	Frequency (f)	Percentage (%)	Mean
4	Extension contact (Yes/No)	Yes	163	57.6	—
		No	120	42.4	—
5	Frequency of extension visits (visits/year)	—	—	—	2.1
6	Participation in extension training	Yes	112	39.6	—
		No	171	60.4	—
7	Membership of beekeepers' association	Member	94	33.2	—
		Non-member	189	66.8	—
8	Perceived extension quality (1–5 scale)	—	—	—	2.8
9	Access to inputs/credit via extension	Yes	48	17.0	—
		No	235	83.0	—
10	Average honey yield per beekeeper (litres/year)	—	—	—	51.4

Source: Field Survey, 2025

The findings in table 1 revealed that 57.6% of the respondents had contact with extension agents, though the mean frequency of visits was low (2.1 times per year). This indicates moderate access but limited intensity of extension interaction. Similar patterns have been reported *by Ogunbameru et al.* (2021), who found that infrequent visits and limited coverage reduced farmers' exposure to innovations in apiculture across Northern Nigeria. *Abdullahi et al.* (2022) further emphasized that poor mobility of extension workers and inadequate staffing weaken farmers' ability to receive timely advisory services. Participation in extension training was also low (39.6%), consistent with *Eze and Anyanwu* (2020), who reported that limited training participation among smallholder beekeepers hinders the adoption of improved hive management and honey harvesting techniques. Practical training and demonstration are critical for skill acquisition and behavioural change among rural farmers (*Adekola et al.*, 2023). Therefore, the low training coverage observed suggests a need to strengthen extension training delivery in Sardauna LGA.

The perceived quality of extension services recorded a mean of 2.8, showing only moderate satisfaction. This aligns with the findings of *Usman et al.* (2021), who reported that inadequate follow-up and the generic nature of advisory messages reduce farmers' trust in extension delivery. Similarly, *Tarekegn et al.* (2020) noted that the effectiveness of extension depends not only on contact frequency but also on message relevance and participatory delivery. Only 17% of respondents accessed inputs or credit through extension linkages, underscoring a major gap. *Adebayo et al.* (2022) found that lack of input and credit access constrains smallholder beekeepers' productivity, particularly in remote areas where modern hives and improved equipment are expensive. Strengthening partnerships between extension agencies, cooperatives, and microfinance institutions could enhance service integration.

Lastly, about one-third (33.2%) of beekeepers belonged to associations. According to *Uchechukwu et al.* (2022), membership in farmers' groups enhances access to collective training, bulk input procurement, and market opportunities. The weak group participation in this study area, therefore, implies missed opportunities for shared learning and scaling of improved practices. In summary, these findings show that although honey producers in Sardauna have moderate access to extension services, utilization remains low due to infrequent visits, limited training, and weak institutional support a pattern consistent with prior empirical studies across Nigeria and Sub-Saharan Africa (*Abdullahi et al.*, 2022; *Adekola et al.*, 2023).

Table 2: Multiple Linear Regression Results Showing the Effect of Extension Contact on Adoption of Improved Beekeeping Practices (n = 283)

Variable	Coefficient (β)	Std. Error	t-value	p-value
Constant	0.842**	0.291	2.89	0.004
X_1 Extension contact	0.214***	0.034	6.29	0.000
X_2 Extension service quality	0.487***	0.078	6.24	0.000

Variable	Coefficient (β)	Std. Error	t-value	p-value
X_3 Education	0.056**	0.018	3.11	0.002
X_4 Experience	0.009ns	0.006	1.50	0.135
X_5 Farm size	0.012**	0.004	3.00	0.003
X_6 Access to credit	0.431***	0.112	3.85	0.000
X_7 Membership in association	0.172***	0.049	3.51	0.001
X_8 Household size	-0.014ns	0.021	-0.67	0.503
R^2	0.59			
Adjusted R^2	0.57			
F Statistics	(8,274) = 31.0			

Source Field Survey, 2025 *** Significant at 1%, ** Significant at 5%, * Significant at 10%

The regression results presented in Table 2 show that six out of eight variables significantly influenced the adoption of improved beekeeping practices among beekeepers in the study area. Extension contact (β = 0.214) exhibited a strong positive and highly significant effect ($p < 0.01$), suggesting that increased interaction with extension agents enhances farmers' exposure to new technologies. This finding is consistent with *Ogunbameru et al.* (2021), who noted that frequent extension visits significantly improve technology uptake among smallholder farmers in Northern Nigeria. Similarly, *Tarekegn et al.* (2020) found that extension contact positively affects the adoption of modern hives and honey processing equipment in Ethiopia. Extension service quality (β = 0.487) was also highly significant ($p < 0.01$), implying that the quality and relevance of extension services are key determinants of technology adoption. According to *Adekola et al.* (2023), participatory and demand-driven extension approaches enhance the credibility of advisory services and encourage farmers to implement recommended practices.

Education level (β = 0.056) showed a positive and significant influence ($p < 0.05$), indicating that educated beekeepers are more receptive to innovations. This aligns with the findings of *Eze and Anyanwu* (2020), who observed that literacy levels significantly influence the adoption of improved beekeeping technologies in Southeastern Nigeria. Farm size (β = 0.012) and access to credit (β = 0.431) were also significant, underscoring the importance of resource endowment in technology adoption. *Adebayo et al.* (2022) reported similar results, emphasizing that financial capacity enables farmers to invest in modern tools and equipment. Membership in beekeeping associations (β = 0.172) was another significant factor ($p < 0.01$), demonstrating that collective participation enhances knowledge sharing and access to innovations. *Uchechukwu et al.* (2022) similarly found that group membership fosters adoption by facilitating peer learning and cooperative marketing. On the other hand, experience (β = 0.009ns) and household size (β = -0.014ns) were not significant, suggesting that long years of beekeeping or larger family sizes do not necessarily translate into higher adoption rates.

The model's R^2 value of 0.49 indicates that 49% of the variability in adoption of improved beekeeping practices is explained by the independent variables, confirming the strong explanatory power of extension-related and socio-economic factors. This outcome supports the assertion by *Abdullahi et al.* (2022) that effective extension contact and institutional support remain central to agricultural innovation and adoption among smallholders in Nigeria.

Table 3: Correlation between Extension Service Utilization and Honey Production Efficiency (n = 283)

Variables	r	p-value	Interpretation
Extension Service Utilization (X)	0.682	0.001	Positive and significant relationship
Honey Production Efficiency (Y)	—	—	—

Source: Field Survey, 2025

Table 3 reveals the Correlation between Extension Service Utilization and Honey Production Efficiency. The positive and statistically significant correlation (r = 0.682, p = 0.001) observed between extension service utilization and honey production efficiency in this study underscores the pivotal role of extension services in enhancing beekeeping practices. Extension services provide beekeepers with essential knowledge and skills, enabling them to adopt modern techniques and technologies that improve productivity. Similar findings have been reported in

southern Ethiopia, where beekeepers who adopted improved beehive technologies exhibited a 19.5% higher technical efficiency compared to non-adopters. Participation in extension demonstrations and access to extension services were significant determinants of this increased efficiency (Tadesse *et al.*, 2021). In Nigeria, research indicated that extension services positively influenced the technical efficiency of honey production, with factors such as education level, usage of modern technology, and extension contact significantly reducing technical inefficiency among beekeepers (Kuboja *et al.*, 2017).

In southwestern Ethiopia, 74.9% of respondents reported that poor extension services adversely affected beekeeping practices. The lack of specialized apiculture experts and inadequate extension support were identified as critical challenges hindering honey production efficiency (Tadesse *et al*., 2021). Similarly, in Saudi Arabia, beekeepers who participated in extension programs and training sessions showed higher adoption of recommended beekeeping practices, demonstrating the effectiveness of extension services in improving honey production (Almutlaq *et al*., 2025). These consistent findings emphasize the importance of strengthening extension services to enhance honey production efficiency. Enhancing the skills of extension agents, facilitating access to improved technologies, developing specialized support programs, and implementing monitoring systems are all critical strategies for improving productivity. In conclusion, the positive relationship between extension service utilization and honey production efficiency highlights the essential role of extension services in advancing beekeeping practices, ultimately contributing to increased productivity and sustainability in the sector.

Table 4: Constraints Affecting Agricultural Extension Services in Honey Production

Constraint	Mean Score	Classification	Rank
Lack of Modern Beekeeping Equipment	4.67	Major Constraint	1
Inadequate Capital	4.52	Major Constraint	2
Inadequate Extension Support	4.45	Major Constraint	3
Poor Access to Credit	4.32	Major Constraint	4
Climate Factors (e.g., drought, rainfall variability)	4.20	Major Constraint	5
Shortage of Forage Plants	4.15	Major Constraint	6
Lack of Incentives/Training	4.10	Major Constraint	7
Pest and Predator Attacks	4.05	Major Constraint	8
Poor Road Infrastructure	3.95	Major Constraint	9
Lack of Government Policy Support	3.85	Major Constraint	10
Cultural Beliefs and Practices	3.75	Major Constraint	11
Insecurity and Conflict	3.65	Major Constraint	12

Source: Field Survey, 2025 **Note:** Mean ≥ 3.0 → Major Constraint; Mean < 3.0 → Minor Constraint

The analysis in Table 4 indicates that all twelve identified constraints have mean scores above 3.0, classifying them as major constraints affecting the delivery and utilization of agricultural extension services in honey production in Sardauna Local Government Area. The highest-rated constraints were lack of modern beekeeping equipment (4.67), inadequate capital (4.52), and inadequate extension support (4.45), highlighting the critical barriers to effective beekeeping practices. These findings corroborate previous studies. Alabi and Anekwe (2023) reported similar challenges among beekeepers in Kaduna State, emphasizing that lack of modern equipment and inadequate extension services significantly limited productivity. Likewise, Onuwa *et al.* (2025) found that limited access to capital and weak extension support were primary obstacles in enhancing honey production efficiency. Other constraints, including poor access to credit (4.32), climate factors (4.20), and shortage of forage plants (4.15), further illustrate the environmental and economic challenges that restrict beekeepers' ability to adopt improved practices. Tadesse *et al*. (2021) similarly noted that climate variability and forage scarcity are major determinants of honey production efficiency.

Constraints such as lack of incentives/training (4.10), pest and predator attacks (4.05), and poor road infrastructure (3.95) also impede extension effectiveness, limiting technology adoption and market access, which is consistent with the findings of Alabi and Anekwe (2023). The slightly lower-rated but still significant constraints, including lack of government policy support (3.85), cultural beliefs and practices (3.75), and insecurity and conflict (3.65), demonstrate that socio-political and cultural factors also

shape extension service utilization. Overall, the study underscores the multifaceted nature of constraints in honey production and highlights the need for integrated interventions: provision of modern equipment, improved access to credit, strengthened extension services, environmental support, and policy measures. Addressing these constraints can enhance the effectiveness of agricultural extension services, ultimately improving honey production in Sardauna Local Government Area.

Conclusion

The study established that agricultural extension services significantly influence honey production efficiency among beekeepers in Sardauna Local Government Area, Taraba State. Beekeepers with regular extension contact, higher-quality advisory support, access to credit, and participation in cooperative associations demonstrated higher adoption of improved beekeeping practices, which translated into increased honey yields. However, low frequency of extension visits, limited training participation, inadequate access to modern beekeeping equipment, and weak institutional support constrained the full potential of extension services. These findings underscore the pivotal role of well-coordinated and resource-supported extension services in promoting technology adoption, improving productivity, and enhancing the livelihoods of rural beekeepers.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Increase the frequency of extension visits and provide demand-driven, participatory training programs to enhance beekeepers' knowledge and skills.
2. Establish linkages with financial institutions and suppliers to enable beekeepers to acquire modern hives, protective gear, and other essential inputs.
3. Encourage beekeepers to join or form associations to facilitate collective learning, bulk procurement of inputs, and access to markets.
4. Government and development agencies should formulate supportive policies, provide incentives, and ensure adequate staffing and logistical support for extension services in apiculture.

REFERENCES

1. Abdullahi, T. A., Yusuf, M., & Bello, I. (2022). Building human capacity for sustainable agricultural transformation: The role of extension training hubs in Nigeria. *Journal of Agricultural Extension, 27*(1), 67–83.
2. Adebayo, A. O., Musa, L. H., & Lawal, U. (2022). Agricultural input access and rural development among smallholder farmers in Northern Nigeria. *African Journal of Rural Development, 9*(2), 134–146.
3. Adefalu, L. L., Adebayo, O. O., & Adamu, A. U. (2023). Assessment of agricultural extension delivery and farmers' access to innovation in Northern Nigeria. *Journal of Agricultural Extension, 27*(2), 45–59.
4. Adekola, A., Bello, R., & Usman, H. (2023). Farmer participation and effectiveness of agricultural extension training in Nigeria. *International Journal of Agricultural Education and Extension, 11*(3), 55–66.
5. Adeola, R. G., & Akinbode, S. O. (2021). Repositioning agricultural extension services for sustainable rural transformation in Nigeria. *African Journal of Agricultural Research, 17*(6), 812–820.
6. Agbamu, J. U. (2019). *Essentials of agricultural extension: A comprehensive treatment of extension systems and methods*. Lagos: Spectrum Books Ltd.
7. Alabi, O. O., & Anekwe, C. E. (2023). Technical efficiency of honey and beeswax production in Kaduna State, Nigeria: Implications for climate and food security sustainability. *Journal of Agribusiness and Rural Development, 4*(70), 421–431.
8. Eze, C. C., & Anyanwu, C. J. (2020). Adoption of improved beekeeping practices in Southeast Nigeria: Implications for sustainable rural livelihoods. *Nigerian Journal of Agriculture and Development Studies, 20*(2), 45–58.
9. Feleke, H. G., et al. (2025). Climate on the edge: Impacts and adaptation in Ethiopia's agricultural systems. *Sustainability, 17*(11), 5119.
10. Hamisu, A. M., Bello, M. I., & Sulaiman, K. A. (2017). Challenges of effective agricultural extension delivery in Nigeria. *International Journal of Agricultural Development, 9*(1), 101–112.
11. Ibrahim, A. M., Yusuf, L. S., & Danjuma, H. A. (2020). Determinants of honey production among rural beekeepers in Kaduna State, Nigeria. *Nigerian Journal of Agricultural Economics, 10*(2), 134–142.
12. National Bureau of Statistics (NBS). (2022). *Annual Abstract of Statistics*. Abuja: National Bureau of Statistics.
13. National Population Commission (NPC). (2006). *Population and housing census of the Federal Republic of Nigeria: National and state population and housing tables*. Abuja: NPC.
14. Ndaghu, A. A., & Bello, A. (2022). Effect of extension contact on the technical efficiency of rice farmers in Adamawa State, Nigeria. *Journal of Agricultural Economics and Rural Development, 14*(1), 55–68.

15. Ogunbameru, B. O., Ibrahim, A., & Hassan, Y. (2021). Challenges of agricultural extension delivery in Northern Nigeria. *Journal of Agricultural Extension and Rural Sociology, 13*(1), 88–101.

16. Oladipo, F. S., Musa, I., & Tanko, A. A. (2020). Influence of extension contact on adoption of improved beekeeping technologies among beekeepers in North Central Nigeria. *Nigerian Journal of Rural Sociology, 20*(1), 78–89.

17. Olagunju, F. I., & Yusuf, T. K. (2021). Honey production as a livelihood diversification strategy among rural households in Southwestern Nigeria. *Journal of Sustainable Agriculture and Environment, 23*(3), 211–225.

18. Onuwa, G. C. (2025). *Empirical analysis of honey productivity among local beekeepers in Sanga, Kaduna State, Nigeria*. Agricultural Systems Research and Innovation Centre.

19. Oyeleke, O. S., Abdullahi, A. M., & Lawal, H. A. (2022). Apiculture development and livelihood sustainability among smallholder farmers in Nigeria. *International Journal of Agricultural Research, 18*(4), 44–53.

20. Tadesse, B., et al. (2021). Factors influencing organic honey production level and marketing: Evidence from southwest Ethiopia. *ResearchGate.*

21. Taraba State Government. (2023). *Taraba State official gazette and statistical yearbook*. Jalingo: Ministry of Budget and Economic Planning.

22. Tarekegn, K., Gebre, S., & Getaneh, D. (2020). Determinants of adoption of modern beekeeping technologies in Ethiopia. *Journal of Rural Studies, 79*, 69–77.

23. Uchechukwu, C. E., Nwafor, G. I., & Nwaobiala, C. U. (2022). Beekeeping cooperatives and livelihood improvement among rural farmers in Nigeria. *Journal of Cooperative and Development Studies, 5*(1), 23–37.

24. Usman, M., Bello, I., & Abdullahi, S. (2021). Quality of extension service delivery and farmers' satisfaction in Northwestern Nigeria. *Journal of Agricultural Extension and Service Research, 8*(2), 90–101.

25. Wakgari, M. (2021). Honeybee keeping constraints and future prospects. *Cogent Food & Agriculture, 7*(1), 187-192.