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Original Article

Assessment of honey production in Cross River State, Nigeria

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ABSTRACT

Honey production plays significant roles in socio-economic and environmental development; supplying a significant portion of domestic food and generating income for sustainable livelihood. There is limited information on honey production in Cross River State, Nigeria. This study therefore examines the socio-economic characteristics of honey producers, five-year trends in honey production, and the cost of honey production in Cross River State, Nigeria. Systematic and purposive sampling techniques were used to sample respondents from the area. Beekeepers and hunters were interviewed using a semi-structured questionnaire. Ten Key Informant Interviews and 3 Focus Group Discussions were carried out to verify and enhance the information. Data were analyzed using descriptive (mean, percent and standard deviation) and inferential statistics (ANOVA). The findings revealed that most honey producers are male (96.7% beekeepers, 100% bee-hunters), married (84.7% beekeepers, 93.2% bee-hunters), and have a relatively high level of education (32.6% post-secondary education among beekeepers). The five-year trend shows an increase in honey production among beekeepers (from 192.1 kg to 234.5 kg) and a decline among bee-hunters (from 10.1 kg to 7.5 kg), with beekeepers consistently producing higher quantities of honey. The mean unit price indicates that honey production contributes to the income of individuals in the study area (28.2% of income), with an annual mean income from honey production of ₦113,536.8. Thus, training and empowerment programs should be implemented to support beekeepers, particularly women, while introducing sustainable beekeeping practices and modern technologies to improve efficiency, reduce costs, and increase income for beekeepers, to meet the growing demand for honey.

K E Y W O R D S : *Apiculture, Beehives, Beekeeping, Honey, Sustainable*

INTRODUCTION

Honey is the main product of 'Beekeeping', produced by a species of bees *called Apis mellifra). It* is an unfermented natural sweet substance that varies in taste and colour, depending on the plants upon which bees forage for nectar and pollen (National Honey Board Report, 2011; Azeez & Akankuku, 2012). About 1.2 million metric tonnes of honey are produced worldwide yearly for various value chain uses (Ugbe & Japheth, 2023).

Honey production is a low-investment and low-input business enterprise that directly generates economic gains for the participating members. It integrates well with agriculture, which forms the main economic activity of rural communities (Belete & Ayele, 2020). Practised by men, women, youth, and the aged; honey production has

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numerous advantages, including the source of income and a means of poverty reduction. enhances the quality of life of the people (Amechi *et al.*, 2013). Honey production harbours great potential for increasing income and supportive sustainable development, particularly the diverse players and chain of activities along the broader value chain (CODIT, 2009).

Strengthening value chain of the beekeeping can make the sector less vulnerable to climate change. This willensure its secondary benefits to other economic sectors in value addition like production, marketing and consumption by end users (FAO, 2021). Thus, there is a dearth of information and databases on honey production (activities involving converting inputs into outputs) in Cross River State. This study aims to examine and analyze the trends and patterns of honey production in Cross River State over the last five years (2017 to 2022), to assess the factors influencing honey production, and also evaluate its impact on the livelihoods of beekeepers, and the local economy. The study will make recommendations that may perhaps improve and sustain honey production in the area.

MATERIALS AND METHODS

Description of the Study Area

Data for this study was obtained from the tropical rainforest region of Cross River State, Nigeria (Macarthy *et al.* 2010). With an area of 21,265 square kilometers, the state is situated between latitudes 4°30'0"N and 7°0'0"N and longitudes 8°30'0"E and 9°30'0"E. It receives heavy rainfall in the wet season (April-November), with yearly precipitation ranging from 1800mm to 4000mm and temperatures between 10°C and 32°C. Cross-River is home to half of Nigeria's remaining tropical high forests (CRSFC, 2018), including Forest Reserves, Community forests, and Cross River National Park forests. The forests span approximately 8,968 square kilometers, and it is categorized into three ecological zones, namely: Tropical High Forest, swamp forest, and Savannah Forest, providing forest resources.

Sampling Method

Applying systematic and purposive sampling techniques, participants, i.e. honey value chain actors, were sampled from the three ecological zones in Cross River State namely: Northern, Central, and Southern Ecological zones. Within these ecological zones, 10 Local Government Areas (LGAs) were selected dependent on the existence of organized/unorganized honeybee farmers, bee hunters, sellers, and buyers. The Taro Yamane formula and Snowball teniques were applied to determine the sample size and identify respondents. Consequently, 301 respondents comprising 242 bee farmers and 59 honeybee hunters were identified and selected for the study.

Data Collection and Analysis

The research followed ethical guidelines by acquiring Free Prior Informed Consent (FPIC) from all communities involved in data collection to promote inclusivity and trust. Data was gathered by giving honeybee producers semi-structured questionnaires through the Electronic Kobo Toolbox Mobile application (version 3.0, 2022), increasing objectivity and efficiency. Ten (10) Key Informant Interviews (KII) and 3 Focus Group Discussions (FGD) were carried out to verify and enhance the information. Sample points were recorded, and locations were verified using the Global Position System (GPS). Expert consultation, revision, and GPS validation were used to ensure the instrument's validity and reliability.

Data collected were analyzed using descriptive (frequency distribution, percentage, mean, and standard deviation) and inferential statistics (One-way analysis of variance). Spearman's Rho correlation analysis was used to test for a significant relationship between the method of honey production and socioeconomic attributes of honey production.

RESULTS

Socio-economic Characteristics of Honey Producers and Marketers in Cross River State

The result (Table 1) on the socioeconomic characteristics of honey producers shows that out of the bee keepers, 3.3% were female, while 96.7% were male. For honey bee hunters, 100% were male. The surveyed beekeepers were primarily married (84.7%), 9.1% were divorced/separated, while the remaining 5% and 1.2% respectively were single and divorced. For bee hunters, 93.2% were married, 3.4% were single, 3.4% were divorced/separated, and non (0.0%) of the respondents was widowed.

The level of education of Honey bee keepers and Honey bee hunters showed that a greater proportion (45.5% and 66.1%) of honey bee keepers and honey bee hunters respectively had secondary education. Similarly, 32,6% and 23.7% of the honeybee keepers and honeybee hunters respectively had tertiary education. This means the greater proportion of both honeybee keepers and honeybee hunters had one form of education or the other with only 3.3% of the honeybee keepers having no formal education. Household sizes varied, with most of the honey beekeepers (88.4%) and honeybee hunters (98.3%) respectively having household sizes of 5-10 members. Only 4.1% and 1.7% of honeybee keepers and honeybee hunters respectively had the smallest households with less than 5 members. Most honey beekeepers (56.1%) and honey bee hunters (66.1%) had 5-10 years of experience, while the remaining 43.9% and 33.9% of the honey bee

keepers and honeybee hunters respectively are experienced beekeepers and honey bee hunters of 10 to more than 20 years. The occupation of honey hunters showed that the vast majority (94.9%) were involved in honey production /marketing, with the remaining (1.7%) respectively being farmers, employed, or students.

Table 1: Socio-economic Characteristics of Honey Producers (Keepers & Hunters) in Cross-River State, Nigeria

Variables		Honey Keepers		Honey Hunters	
		Freq.	%	Freq.	%
Gender	Female	8	3.3	0	0
	Male	234	96.7	59	100
	Total	242	100.0	59	100
Age category (yrs)	20 -29	9	3.7	0	0
	30 – 39	8	3.3	3	5.1
	40 – 49	98	40.5	25	42.4
	50 – 59	103	42.6	30	50.8
	60 & above	24	9.9	1	1.7
	Total	242	100	59	100
Marital status	Single	12	5	2	3.4
	Married	205	84.7	55	93.2
	Divorce/Separated	22	9.1	2	3.4
	Widowed	3	1.2	0	0
	Total	242	100	59	100
Level of education	No formal education	8	3.3	0	0
	Primary education	45	18.6	6	10.2
	Secondary education	110	45.5	39	66.1
	Tertiary education	79	32.6	14	23.7
	Total	242	100	59	100
Household size	<5	10	4.1	1	1.7
	05-10	214	88.4	58	98.3
	11-15	17	7	0	0
	>15	1	0.4	0	0
	Total	242	100	59	100
Experience in Honey Production/Marketing	< 5			0	0
	5-10	152	56.1	39	66.1
	11-15	61	35.4	17	28.8
	16 -20	12	4.4	0	0
	>20	11	4.1	0	0
	Total	236	100	59	100
Occupation	Employed (civil servants)	40	19.9	1	1.7
	Farmer & traders	51	25.4	1	1.7
	Honey producer/marketer	142	70.6	56	94.9
	Trader	2	1.0	0	0
	Unemployed	3	1.5	0	0
	Student	3	1.5	1	1.7
	Total	241	100.0	59	100

Relationship between Demography Attributes and Methods of Honey Production

The statistical analysis (Table 2) revealed insignificant relationships between various test variables and Methods of Honey Production (MHP). The correlation coefficient of -0.49 under gender indicated a weak negative relationship, but the *p*-value of 1.000 confirmed that this relationship was not statistically significant. Similarly, the correlation between age and MHP yielded a coefficient of 0.05, indicating a very weak positive relationship, the *p*-value of 0.539 indicated no significant correlation. Marital status also showed a weak negative relationship with MHP, with a coefficient of -0.06, but the p-value of 0.337 confirmed that this relationship was not significant. Furthermore, the analysis revealed no significant relationships between educational status, household size, and experience in honey production, with coefficients of -0.04, 0.07, and -0.05, respectively, and p-values of 0.596, 0.308, and 0.520, respectively.

Table 2: Relationship between Demographic Attributes and Methods of Honey Production (MHP)

Test Variables	R	*P*-value	Decision
Gender	-0.49	1.000	Not significant
Age Vs MHP	0.05	0.539	Not significant
Marital status vs MHP	-0.06	0.337	Not significant
Edu. Status Vs MHP	-0.04	0.596	Not significant
H. size Vs MHP	0.07	0.308	Not significant
Exp. in honey production (yrs.)	-0.05	0.520	Not significant

*Derived using Tetrachoric correlation; Fisher's exact p-value; Level of Significance = 0.05; Edu = Education; Exp = Experience

The findings (Table 3) showed that gender could affect preferences for honey production as there was a statistically significance and negative correlation (Spearman's Rho = -0.18, $p < 0.05$) between gender and preference for honey production. Age and preference for honey production showed a significant and negative correlation (Rho = -0.25, $p < 0.01$), indicating that older people might have different preferences than younger people. Higher education levels may be linked to fewer years of honey production and consumption, as there was a significant negative correlation (Rho = -0.37, $p < 0.01$) between the duration of honey production and education status. The amount of honey produced, and household size showed a significant positive correlation (Rho = 0.75, $p < 0.01$).

Table 3: Spearman's Rho Relationships between Demographic Factors and Quantity of Honey Produced and Consumed (per kg)

	Years of production of honey	Quantity of honey produced in a year	Preference	Unpleasant experience during/after honey production
Gender	-0.29**	-0.12	-0.18*	0.06
Age	0.52**	0.56**	0.25**	-0.25**
Marital status	0.22**	0.16*	0.11	-0.20**
Education status	-0.17*	-0.37**	-0.36**	0.29**
Household size	0.43**	0.75**	0.20**	-0.31**
Years of consuming honey	-	0.42**	0.14	-0.28**

Note: * = Correlation is significant at the 0.05 level; ** = Correlation is significant at the 0.01 level (2-tailed).

Trends in Honey Production in Cross River State between 2017 and 2021.

Figure 1 shows the mean quantity of honey (in kg) produced by bee hunters and beekeepers in the area across five years from 2017 to 2021. Throughout these years, there were clear differences in the mean quantity of honey produced by the two groups. In 2017, beekeepers produced a higher mean quantity of honey at 128.8 kg compared to bee-hunters, who produced 13.2 kg on average. However, over the following years, beekeepers and bee-hunters experienced a decrease in the mean quantity of honey produced. By 2021, beekeepers maintained a higher mean quantity of honey production, reduced to 178.9 kg, while bee-hunters saw a further decrease to 5.3 kg on average.

Figure 1 presents a result of the quantity of honey produced in Cross Rivers State, Nigeria, spanning five years from 2017 to 2021. This result showed distinct categories of honey producers: the honeybee Hunters which comprised 59 bee producers, and honeybee Keepers consisting of 242 bee producers. For each year, the table shows the unit price per kilogram and unit price per 75cl bottle, alongside the corresponding *p*-values, which indicate the statistical significance of the differences between the two groups.

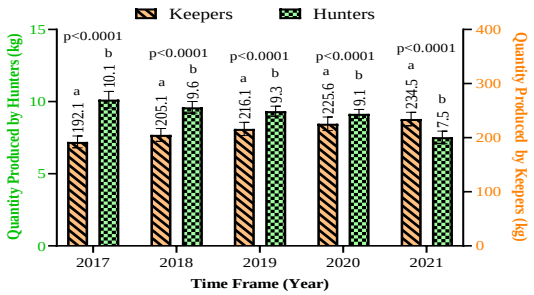


Figure 1: Mean Quantity of Honey (kg) Produced by Beekeepers and Bee-hunters in Cross-River State, Nigeria.

Figure 2 presents the mean number of beehives owned and colonized by beekeepers over five years (2017 to 2021). The findings showed number of hives beekeepers typically owned and the rate of hive colonization changed

during this period. In 2017, beekeepers owned an average of 18 beehives, of which 16 were colonized. This trend remained consistent in 2018, with the average number of owned and colonized hives remaining at 19 and 16, respectively. By 2019, there was a slight increase in both metrics, with beekeepers now owning an average of 24 hives, of which 21 were colonized.

By 2020 and 2021, the average number of hives owned and colonized continued to increase. Beekeepers averagely owned 27 hives in both years, out of which 21 hives were colonized in 2020 and 22 in 2021. The trend analysis of beekeeping activities over these five years revealed that in 2020 and 2021, the average number of hives beekeepers owned and colonized continued to rise. This upward trend indicates a sustained expansion of beekeeping activities over the years, reflecting increased interest, participation, and possibly market demand for bee products.

By 2019, there was a significant increase in hive ownership and colonization, with beekeepers owning an average of 24 hives, of which 21 were colonized. This increase was accompanied by a rise in production quantity to 164.5 units, marking the highest recorded value during the period. In the more recent years of 2020 and 2021, hive ownership remained consistent at an average of 27 hives, with a slight increase in colonized hives from 21 to 22. Correspondingly, the mean quantity of bee honey production also exhibited an upward trend, reaching 166.1 kg units in 2020 and 178.9 kg in 2021. Statistical analysis indicated significant differences in hive ownership, colonization, and production quantity across the years analyzed, as evidenced by p-values of 0.000 for hive ownership and production quantity, and 0.002 for hive colonization.

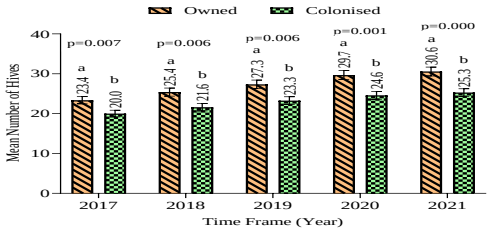


Figure 2: Mean Number of Hives owned and colonized by Beekeepers within 5-Years

Mean Annual Quantity of Honey Sales in Cross-River State, Nigeria

The distribution of the quantity of honey sold per year by beekeepers in Cross-River State is presented in Figure 3. The result showed the distribution of honey production among beekeepers specifying valuable insights into the scale of honey production activities. Most beekeepers, comprising 22.1%, sold less than 61 kg of honey annually. Also, 15.0% of beekeepers sold from 61 - 120 kg, while 25.7% sold honey between 121 to 180 kg. A significant portion, accounting for 31.0%, sold between 181-240 kg, indicating a substantial volume of honey production within this range. Smaller percentages are observed for higher quantity ranges, such as 241 to 300 kg (4.4%), 361 to 420 kg (0.9%), and 421 to 480 kg (0.9%).

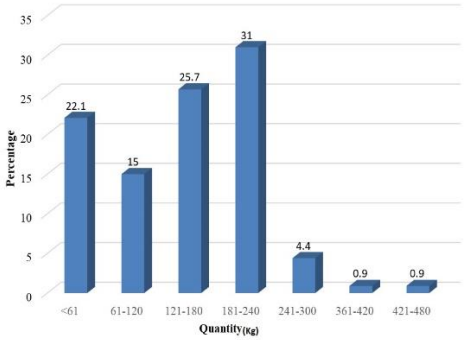


Figure 3: Annual Mean Quantity of Honey Sold by Beekeepers in the Study Area

Mean Unit Price of Honey Production in Cross-River State, Nigeria

The mean unit price (₦/Kg) of honey produced by the bee hunters and beekeepers in the area over five years, (2017 to 2021) is shown in Figure 4. Over this timeframe, both bee-hunters and beekeepers witnessed fluctuations in the mean unit price of honey. In 2017, bee hunters recorded a mean unit price of ₦2,057.6 per kg, while beekeepers reported a slightly higher mean unit price of ₦2,069.2 per kg. Over the subsequent years, both groups experienced varying trends in their mean unit prices. By 2021, bee-hunters observed a mean unit price of ₦2,661.0 per kg, whereas beekeepers had a slightly lower mean unit price of ₦2,651.2 per kg (Figure 4).

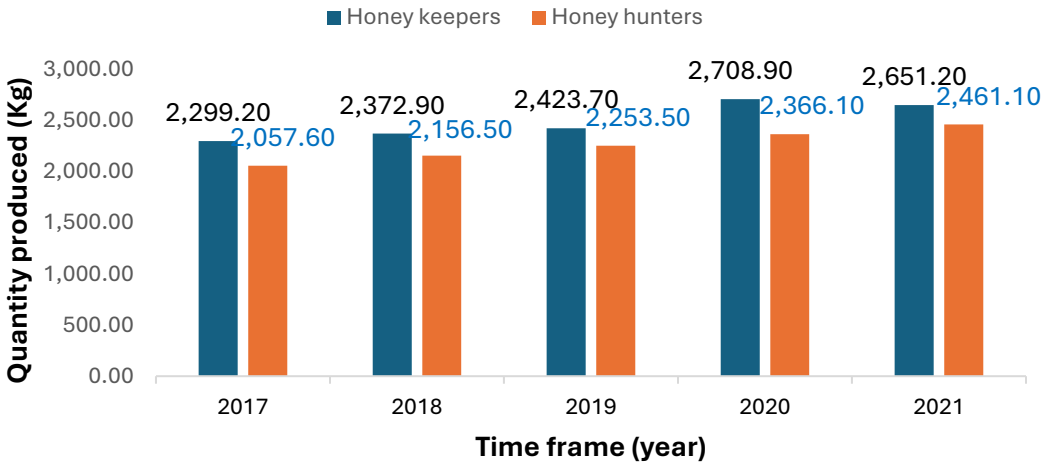


Figure 4: Mean Unit Price/Kg (₦) of Honey Produced by Beekeepers and Bee-hunters in the Area

DISCUSSION

Socio-economic Characteristics of Honey Producers in Cross River State

The honey producers in this study were predominantly male, with most of the beekeepers and hunters being men. Most were married. The education level of the respondents varied, with a significant portion of beekeepers holding postsecondary degrees. The household size of the respondents also varied, with most beekeepers having 5-10 members and a few having 11-15 members. Most of the beekeepers have 5-10 years of experience, followed by 11-15 years of experience. Honey hunters are predominantly involved in honey production and marketing. This result was consistent with Schouten's (2020) study, indicating that beekeepers in Africa typically had a household size ranging from 5-7 individuals. Ajao & Oladimeji (2015) reported that the average household size in Kwara state, Nigeria is 7. This implies that larger households with more members have a sufficient workforce to devote to honey beekeeping activities. Consistent with this finding, earlier research conducted by Lawal and Banjo (2010) and Inah *et al.* (2006) reported similar results

This result is in line with the report of Berhe *et al.* (2016), who found that beekeepers in Ethiopia were predominantly male. Schouten (2020) reported that beekeepers in Africa had a relatively high level of education. A similar result was reported by Yirga and Teferi (2010), Awraris *et al.* (2012), and Chala *et al.* (2012) from Northern and Southwestern Ethiopia who reported that gender (males and females) and age have a great role in beekeeping management.

Five Years Trend in Honey Production and Marketing in Cross River State

The five-year trend in honey production in Cross River State revealed a change between beekeepers and bee-hunters. The mean quantity of honey produced by both groups from 2017 to 2021 showed clear differences in their production levels. In 2017, beekeepers produced a higher mean quantity of honey (128.8 kg), compared to bee-hunters that averagely produced 13.2 kg per hive. This finding contradicts the report by Namwata *et al.* (2013), which indicated that the average honey production per hive in Balang'adu ward was between 12 to 20 kg during the peak season for top bar hives. Additionally, the URT (2001) reported that the national average honey production in Tanzania is below 7 kg for log hives and 15 kg for top bar hives.

However, from 2017 to 2021, bee keepers experienced an increase while bee hunters had a decrease in honey production. Beekeepers consistently maintained a higher mean quantity of honey production than bee-hunters throughout the five years. This result agrees with the finding by Lehébel-Péron *et al.* (2016) reported that the period between 1970 and 2000 was a golden age for heather honey producers in the Mont Lozere area, but after 2000 beekeepers experienced a decline in honey production caused by environmental changes. This situation could also be attributed to several factors, including harsh climatic conditions, anthropogenic activities, diseases, and predators like honey badgers and ants (Godfrey, 2015).

The honey production volume in Cross Rivers State, Nigeria, between Hunters and Keepers indicates the average honey yield and variability (13.2±0.3). According to Gratzer *et al.* (2021), beekeepers in Ethiopia experience a significantly high honey production compared to bee

hunters, which is consistent with this finding. Similarly, Thomas & Jim (2013) reported that beekeepers in Kenya experience a higher honey production than bee-hunters.

The unit prices of honey per kg in Nigerian Naira (₦) fluctuate based on various factors such as quality, quantity, and market demand (Ismaiel *et al*., 2014). This result agrees with the report by Onwumere *et al*. (2012) found that the price of honey was significantly higher for modern beekeepers than for traditional beekeepers in Abia, Nigeria, which is in line with this finding.

This finding shows significant trends and differences in honey production between hunters and keepers over five years. Also, statistical differences in the amount of honey produced, with Hunters consistently producing less honey than Keepers. The difference may be due to the different methods of honey production and hive management strategies used by each group. The differences in honey production amounts are consistent across the five years, indicating a persistent gap between Hunters and Keepers. In contrast, the unit prices per kg and 75cl (0.75kg) of honey show less consistent patterns of statistical variation between Hunters and Keepers. While significant differences were observed in the first year (2017), subsequent years revealed non-significant differences in unit prices. This indicates that, over time, pricing dynamics may become more consistent between Hunters and Keepers, potentially due to market forces and competition. The findings imply that, although Hunters and Keepers differ significantly in honey production amounts, their pricing strategies could converge over time. This could be attributed to various factors. For instance, bee Hunters and Keepers may adjust their prices in response to market demand and competition. Keepers may produce higher-quality honey, but Hunters may improve their quality over time, leading to more consistent pricing. Hunters and Keepers may share knowledge and best practices, leading to more uniform pricing strategies.

The upward trend in hive ownership and colonization among beekeepers from 2017 to 2021 indicates a sustained expansion of beekeeping activities, potentially driven by increased access to training and resources for beekeepers, improved awareness of the economic opportunities associated with beekeeping and growing demand for honey and other bee products in local and global markets. The findings are consistent with previous research, that beekeeping can be a viable livelihood option for smallholder farmers and rural communities (Mihret *et al.*, 2020; Prodanovic *et al.*, 2024). The upward trend in hive ownership and colonization indicates that beekeeping activities are becoming more established and sustainable in the area.

Mujuni *et al*. (2012) reported that beekeepers with smaller apiaries (2-16 hives) tend to prioritize colonization over ownership, indicating a focus on utilizing existing hives rather than expanding their operations. This is consistent with the finding that 40.8% of beekeepers in this range colonize hives, compared to 30.0% who own them.

The result of this finding also shows a significant drop in ownership percentages in the higher ranges of hive numbers (47-61 and 62-76), indicating a concentration of beekeeping activities among a smaller subset of beekeepers. The variation in hive ownership and colonization patterns across different ranges of hive numbers reflects diverse strategies and preferences within the beekeeping community. Beekeepers may adopt different approaches depending on market demand, resource availability, and personal experience (Mujuni *et al*., 2012).

The distribution of honey sold per year indicates most of the beekeepers sell less than 61 kg of honey annually. This implies that beekeepers are small-scale producers, with limited honey production capacity. The distribution of honey production among beekeepers is skewed towards smaller quantities. Fewer beekeepers are engaged in large-scale honey production in the area. Small-scale beekeepers often face challenges in accessing markets and competing with larger-scale producers (Gratzer *et al*., 2021). The report of Gratzer *et al.* supports this finding, showing the need for targeted support and resources for small-scale beekeepers to enhance their production and marketing capabilities. The honey industry is characterized by few large-scale producers and many small-scale producers in the area (Sarka, 2017). This is in line with the result of this study.

The adoption of modern bee hives indicates that beekeepers in Cross-River State are embracing new technologies and innovations to improve their beekeeping practices (Bojago, 2022). This could be driven by increased access to training and resources, growing demand for honey and other bee products, and the need for more efficient and productive beekeeping methods. However, the low adoption rate of traditional bee hives raises concerns about the loss of indigenous knowledge and cultural heritage. Traditional bee hives are an important part of the cultural identity of many communities, and their decline could have significant social and environmental implications. This result is in line with the report of Prodanovic *et al.* (2024).

The primary reasons for beekeepers' preferences for specific types of bee hives show that most beekeepers preferred a particular hive type due to its ease of inspection, harvesting, and better yields. This means the practical considerations related to efficiency and productivity were significant factors influencing hive

selection. This result aligns with the report of Wagner (2019) and Nader *et al.* (2023). There was a steady increase in hive ownership and colonization over the years, with a significant increase in hive colonization by 2019 ($p < 0.05$). Beekeepers in the study area are adopting more efficient and productive beekeeping practices, as reflected in their preference for hive types that offer better yields and ease of management. This agrees with the report of Schouten (2020). The increase in hive ownership and colonization indicates a growing interest in beekeeping activities.

Over five years from 2017 to 2021, beekeepers have shown steady increases in the average number of beehives they own and in honey production, despite fluctuations in production levels. The Spearman correlation test on the relationship between demographic attributes and methods of honey production (MHP) in the study area indicates that age, marital status, education status, household size, and experience in honey production (years) have non-significant correlations with MHP. However, gender had a significant negative correlation with MHP. This implies that gender may influence the choice of methods of honey production.

Economic Analysis of Honey Production in the Study Area

The study observed fluctuations in the mean unit price of honey produced by bee hunters and beekeepers over five years (2017-2021). The price per kg of honey varied, with both producers experiencing different trends. However, the price per 75cl of honey showed a consistent upward trend for beekeepers and bee hunters, indicating an increase in value over time. This indicates that the demand and value of honey in smaller quantities (75cl) are increasing, while the price per kg is subject to more fluctuations due to the high demand for honey in 75cl quantities. The upward trend in the mean unit price of honey may be due to increased demand for honey, improved production practices, or higher production costs. This result is confirmed by the report of Ward (2014).

Honey production contributes significantly to the income of individuals in the study area, accounting for 28.2% of the total income. However, other sources contribute to most of the income. This result revealed the importance of diverse economic activities in the area. This means honey production is a vital source of income for bee producers, but it is not the only source of income. Other economic activities such as farming, civil service, trading, and other sources also contribute substantially to the overall income landscape in the study area. This result is supported by the work of Al-Ghamdi *et al.*, (2017), who worked on analysis of the profitability of honey production using traditional and box hives. The diversity of income streams among bee producers is evident, with beekeepers earning higher incomes from honey production and civil service, while bee hunters earn higher incomes from farming and civil service.

CONCLUSION AND RECOMMENDATIONS

The study reveals a thriving honey production industry, dominated by male, married, and educated individuals, with a significant increase in production among beekeepers over five years. The sector contributes substantially to household income, with larger households consuming more honey. The upward trend in hive ownership and colonization indicates potential growth, driven by access to training, economic opportunities, and growing demand. To sustain this growth, training and empowerment programs should support beekeepers, especially women, and introduce sustainable practices and modern technologies to improve efficiency and income. This will meet the growing demand for honey, ensure ecological benefits, and contribute to the economic well-being of households in the study area.

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Authors' contributions

U.J.A managed literature searches, development of methods, data collection, interpretation of results, writing of the manuscript, and funding. T.T.N & A.P.U. supervised the development of methods, data analysis, and reviewed the manuscript. All authors read and approved the manuscript.

Ethics Committee Approval: N/A.

REFERENCES

Ajao, A. & Oladimeji, U. (2015). Structure, production and constraints of honey hunting and traditional beekeeping activities in patigi, Kwara state, Nigeria. *Egyptian Academic Journal of Biological Sciences.* A, Entomology. 8. 41-52. https://doi.org/10.21608/eajbsa.2015.12921

Al-Ghamdi, A. A., Adgaba, N., Herab, A. H., & Ansari, M. J. (2017). Comparative analysis of profitability of honey production using traditional and box hives. *Saudi Journal of Biological Sciences*, *24*(5), 1075-1080. https://doi.org/10.1016/j.sjbs.2017.01.007

Amechi, E., Onwubuya, E. M., Mbah, E., Ugbajah, M., & Nenna, M. (2013). Using honey production for enhancing household income among rural communities of Nsukka Local Government Area of Enugu State, Nigeria. Journal of Agricultural and Crop Research, 1(2), 17-23.

Awraris, G. S., Yemisrach, G., Dejen, A., Nuru, A., Gebeyehu, G. & Workneh, A. (2012) Honey production systems (Apis mellifera L.) in Kaffa, Sheka and BenchMaji zones of Ethiopia. Journal of Agricultural Extension and Rural Development 4:528-541.

Azeez, F. & Akankuku, A. (2012): Assessment of honey production as a means of sustainable livelihood in Ibadan Metropolis. *Continental journal of agricultural economics.* 46-51.

Belete, Y. M., & Ayele, Z. A. (2020). Bee-keeping for women empowerment: Case of new business model in honey value chain development project's beneficiaries in Amhara Regional State, Ethiopia. Livestock Research for Rural Development, 32(6).

Berhe, A., Abadi, A., Asale, A., & Yewhalaw, D. (2016). Community perception on beekeeping practices, management, and constraints in Termaber and Basona Werena districts, Central Ethiopia. *Advances in* Agriculture, 1-9.

Bojago, E.D. (2022). Adoption of Modern Hive Beekeeping Technology: Evidence from Ethiopia. https://doi.org/10.5772/intechopen.106890.

Chala, K., Taye, T., Kebede, D., & Tadele, T. (2012). Opportunities and challenges of honey production in Gomma district of Jimma zone, South-west Ethiopia. *Journal of Agricultural Extension and Rural Development*, 4(4), 85-91.

CRSFC -Cross River State Forestry Commission (2018): Annual Report. Pp. 2-4.

FAO (2021). Good beekeeping practices for sustainable apiculture FAO Animal Production and Health Guidelines No. 25. Rome. Published by: The Food and Agriculture Organization of the United Nations and Istituto Zooprofilattico Sperimentale del Lazio e della Toscana M. Aleandri and Apimondia and Chinese Academy of Agricultural Sciences Rome, 2021: Pp:267. https://doi.org/10.4060/cb5353en

Godfrey G (2015). Epidemiology of honey bee disease and pests in selected zones of Tigray region, northern Ethiopia, M.Sc. Thesis.

Gratzer, K., Wakjira, K., Fiedler, S. & Brodschneider, R. (2021): Challenges and perspectives for beekeeping in Ethiopia. A review. *Agron. Sustain. Dev.* **41**, 46 (2021). https://doi.org/10.1007/s13593-021-00702-2

Inah, E.I, Smith, O.F & Sowande, T (2006). Poverty reduction and assessment of traditional beekeeping in Kwande Local Government Area of Benue State, Nigeria, ASSET 6 (2): 15-25.

Institute of Community and Organizational Development (CODIT). (2009). Beekeeping/Honey Value Chain Financing Study Report, 41 pp.

Ismaiel, S. , Kahtani, S. , Adgaba, N. , Al-Ghamdi, A. & Zulail, A. (2014) Factors That Affect Consumption Patterns and Market Demands for Honey in the Kingdom of Saudi Arabia. *Food and Nutrition Sciences*, 5, 1725-1737. https://doi.org/10.4236/fns.2014.517186.

Lawal O.A. & Banjo A.D. (2010). Appraising the beekeeping knowledge and perception of pests' problem in beekeeping business at different ecological zones in South-Western Nigeria. *World Journal of Zoology* 5(2): 137-142.

Lehébel-Péron, A., Sidawy, P., Dounias, E., & Schatz, B. (2016). Attuning local and scientific knowledge in the context of global change: The case of heather honey production in southern France. *Journal of Rural Studies*, *44*, 132-142. https://doi.org/10.1016/j.jrurstud.2016.01.005

Mihret, W., Teferi, E. T., Wassie, S. B., & Ayele, Z. B. (2020). The impact of improved beehive on income of rural households: Evidence from Bugina District of Northern Ethiopia. *Ethiopian Journal of Economics*, 29(1), 131-153.

Mujuni, A., Natukunda, K., & Kugonza, D. (2012). Factors affecting the adoption of beekeeping and associated technologies in Bushenyi District, Western Uganda. Livestock Research for Rural Development, 24.

Nader, E. A., Kleftodimos, G., Kyrgiakos, L. S., Kleisiari, C., Gallai, N., Darwich, S., Berchoux, T., Vlontzos, G., & Belhouchette, H. (2023). Linking Beekeepers' and Farmers' Preferences towards Pollination Services in Greek Kiwi Systems. *Animals : An Open Access Journal From MDPI*, *13*(5). https://doi.org/10.3390/ani13050806

Namwata, B.L.M., Mdundo, K. & Malila, N. (2013). Potentaila and Challenges of Beekeeping Industry in Balang'dalalu Ward, Hanang' District in Manyara, Tanzan. *Kivukoni.* J. 1:75-93.

Onwumere, J., Onwukwe, F., & Alamba, C. S. (2012). Comparative analyses of modern and traditional bee keeping entrepreneurships in Abia State, *Nigeria. Journal of Economics and Sustainable Development*, 3(13), 1-9.

Prodanovic, R., Brkić, I., Soleša, K., Ljubojević Pelić, D., Pelić, M., Bursic, V., & Vapa-Tankosić, J. (2024). Beekeeping as a tool for sustainable rural development. *Journal of Agronomy Technology and Engineering Management (JATEM)*, 7, 1054-1066.

Schouten, N. C. (2020). Factors influencing beekeepers' income, productivity and welfare in developing countries: a scoping review. *Journal of Apicultural Research*. https://doi.org/10.1080/00218839.2020.1844464

Sperandio, G., Simonetto, A., Carnesecchi, E., Costa, C., Hatjina, F., Tosi, S., & Gilioli, G. (2019). Beekeeping and honey bee colony health: A review and conceptualization of beekeeping management practices implemented in Europe. *Science of The Total Environment*, *696*, 133795. https://doi.org/10.1016/j.scitotenv.2019.133795

Ugbe, J.A. & Japheth, H.D (2023): Sustainable Forest Ecosystems: The Role of Bees as a Key Player to

Conservation of Biodiversity; *Proceedings of Wildlife Society of Nigeria 2023: 222-235.*

United Republic of Tanzania (URT) (2001). National Forest Programme in Tanzania 2001-2010; Ministry of Natural Resources and Tourism; Forest and Beekeeping Division.

Wagner, K., Meilby, H., & Cross, P. (2019). Sticky business - Why do beekeepers keep bees and what makes them successful in Tanzania? *Journal of Rural Studies*, *66*, 52-66. https://doi.org/10.1016/j.jrurstud.2019.01.022

Yirga, G., & Teferi, M. (2010). Participatory technology and constraints assessment to improve the livelihood of beekeepers in Tigray region, northern Ethiopia. *Momona Ethiopian Journal of Science*, 2(1), 76-92.