e-ISSN 3050-9602
p-ISSN 2795-4340

10.5281/zenodo.14983590 Vol. 08 Issue 02 February - 2025 Manuscript ID: #01801

Perceived Effects of Climate Change on Honey Production in southeast, Nigeria

J. C. Nwaiwu[1], A. O. Chukwu[2], H. A. Egwuonwu[3]

[123]*Department of Agricultural Economics, Extension and Rural Development, Faculty of Agriculture, Imo State University, Owerri, Nigeria.*

Abstract:

At a global level, the negative impact of climate change is being felt in bee farming. However, despite numerous studies conducted on climate change, empirical research incorporating bee production under increased climate change is still relatively scanty in the area. Therefore, this study assessed the effects of climate change on honey production in Imo State, Nigeria. From the specific objectives that guided the study, we ascertained bee farmers awareness of climate change; ascertained their sources of information on climate change; determined the perceived effects of climate change on bee production; and ascertained the observable changes in climate change among bee farmers. Multistage and purposive sampling procedures were used in the selection of fifty (50) bee farmers. A purposive sampling procedure was used to select only farmers who are involved in bee farming activities. Data collected were analyzed using descriptive statistical tools such as the flowchart and mean score of the Likert-type scale. All (100.00%) of the bee farmers were aware of climate change. Cooperative society (98.00%) and radio (90.00%) were among the major sources of awareness of climate change of the bee farmers. Farmers identified honey (96.00%) and beeswax (86.00%), among others, as the various products from bee farming. Findings further show that the bee farmers perceived that climate **change affected habitat environments (**$\bar{x}$ = 3.30; σ = 0.71**),** resulted in **extreme weather events (**$\bar{x}$ = 2.94; σ = 0.55**), and resulted in increased pest and disease** infestation ($\bar{x}$ = 3.16; σ = 0.74), among others. **Also, changes in bee workload and behavior (94.00%)**, increased competitive relationships in the colony (90.00%), and increased sunshine duration and rainy days in the colony (74.00%), among others, were among the observable changes of climate change as stated by the bee farmers. In conclusion, the study showed that the bee farmers require information and demonstrations to improve their climate change adaptation strategies and implement new ones to address the challenges they experience, which should be provided by the extension agents. Therefore, agricultural extension system should be strengthened by the government to provide bee farmers with up to date information and training in the area. The study also recommends that the bee farmers be encouraged to form a cooperative society so they could collectively pool productive resources together in obtaining inputs and financial resources in adapting effectively to climate change in the study area.

Keywords: Bees, Honey, Climate Change, Perceptions, Awareness, Likert Scale Type, Imo State & Nigeria.

How to cite: Nwaiwu, J. C., Chukwu, A. O., & Egwuonwu, H. A. (2025). Perceived Effects of Climate Change on Honey Production in southeast, Nigeria. *GPH-International Journal of Agriculture and Research*, 8(02), 01-10. https://doi.org/10.5281/zenodo.14983590

1.0 INTRODUCTION

The honeybee (*Apis mellifera;* Family: *Apidae*) is a beneficial social insect and among the most widely studied animals (Kiprono et al., 2024). According to Deksisa et al. (2024), their well-organized social features have remained the central attraction for several behavioral scientists. All types of bees belong to the series of insects known as *hymenopte*ra, meaning 'membrane pinion'. These series consists of some species consisting of wasps, ants, sawflies. Among the 25,000 or more narrated species of bees, the majority comprise honeybees, mostly laying eggs in tunnels, which they dig (Bareke et al., 2024). Bees are flitting insects and share close relationships with wasps and ants and are responsible for pollination and the production of honey and beeswax. Bees are found in all continents except Antarctica and in every habitat containing insect-bearing flowering plants on the planet (Kouchner et al., 2019). Beekeeping across the globe provides several invaluable benefits to farming societies. It supports agricultural production by pollinating crops thereby increasing pollinator-dependent crop yields (Ferenczi et al., 2023). Bees pollination services are worth USD 215 billion per annum globally (Food and Agricultural Organization (FAO), 2024). Beekeeping is a source of livelihood to millions by easing their credit constraints when coping with shocks. Income from beekeeping could also support investment in agricultural inputs, pay school fees of family members and smoothen consumption (Abro et al., 2022). More so, beekeeping can contribute to maintaining biodiversity (Krishnan et al., 2020). Furthermore, beekeeping could promote forest conservation, as forests are key sources of forage for bees (Biyena & Degu, 2024).

The medicinal and nutritional properties of beekeeping products contribute to farmers' nutrition and food security (Vincze et al., 2024). However, beekeepers have increasingly reported changes in honey yields and colony health, which they attribute to shifting climatic patterns. Climate change is a global phenomenon. It refers to a shift in average weather conditions including measures like temperature, humidity, rainfall, cloudiness and wind patterns and changes in the severity of these conditions. The perceived effects of climate change on honey production in Imo State manifest through variations in temperature, rainfall patterns, and flowering seasons, which directly impact nectar availability and bee foraging behavior (Nwaihu et al., 2015; Uchechukwu et al., 2022). Prolonged droughts, excessive rainfall, and rising temperatures can disrupt the life cycle of honeybee colonies, leading to reduced honey production and increased hive losses (Margaoan et al., 2024). Additionally, climate-related factors contribute to the spread of pests and diseases that threaten bee populations (Bayissa et al., 2024). Beekeepers in Imo State have reported fluctuations in honey production, raising concerns that climate-related factors such as unpredictable weather, excessive heat, prolonged droughts, and irregular flowering cycles may be negatively impacting honeybee colonies and nectar availability (Ihenacho et al., 2024). Additionally, despite the growing concerns, limited empirical research has been conducted to assess the specific effects of climate change on honey production in Imo State. There is also a gap in understanding how beekeepers perceive and adapt to these climate-related challenges. Without a clear understanding of the perceived and actual effects of

climate change on honey production, it is difficult to develop effective adaptation strategies and policies to mitigate these impacts. Hence, understanding how climate change affects honey production from the perspective of local beekeepers is essential for developing effective adaptation strategies. It was against these backdrops that the study ascertained bee farmers awareness of climate change; ascertained their sources of information on climate change; determined the perceived effects of climate change on bee production; and ascertained the observable changes in climate change among bee farmers in the study area.

2.0 MATERIALS AND METHODS

The study was carried-out in the South Eastern zone of Nigeria with Imo State poposively selected due to proximity and large numbers of honey bee hunters and producers in the area. The State lies between latitudes 5^{o} 45´N and 6^{0} 35´N of the equator and longitude 6^{0} 35´E and 7^{0} 28´ E of the Greenwich Meridian (Nigerian Meteorological Agency (NiMET), 2020). The State is bordered by Abia State on the East and Northeast, Rivers State on the South, Anambra State to the North and Rivers State to the South. Imo State is divided into three (3) agricultural zones of Owerri, Orlu and Okigwe and 27 Local Government Areas. With a total land area of 5,530km^2, the State has an estimated population of about 4.8 million people and an annual growth rate of 3.35 percent (Nigeria Populations Commission (NPC), 2006). The population of Imo State varies from 230 persons per kilometer square in Oguta/Egbema areas to about 1400 persons per kilometer square in Mbaise, Mbano, Orlu and Mbaitoli areas (National Boundary Commission (NBC) of Nigeria, 2020). Registered bee farmers and honey hunters in Imo State constituted the population for the study. In this study, honey hunters are described as those who scout for bee colonies in the wild for harvesting honey. They usually employ the traditional methods. Beekeepers are those who rear honeybees in their farms and employ mostly modern methods. The reason for the categorization of bee farmers into the two groups was to obtain detailed data since members of the two groups often apply different management methods and are likely to be affected by climate change differently. The population for the study was stratified into two - registered bee farmers and honey hunters. Multistage sampling procedure was used to select the sample for the study. The three (3) agricultural zones (Owerri, Orlu and Okigwe) of the State were purposively selected. Purposive sampling procedure was used to select area with high intensity of bee farming. The second stage involved the purposive selection of two local government areas (LGAs) in each of the zones, giving rise to six (6) Local Government Areas (LGAs). In the fourth stage, three communities were randomly selected from each of the (6) six LGAs, giving eighteen (18) communities. The eighteen (18) communities includes Ihitte-Ogada, Naze,Emii,Eziama, Ntu, Obike, Emekuku, Elelem, Akabo, Amaimo, Amakohia, Eziama-Ikeduru, Eguoma, Egwe, Mgbelle, Umukaegbu, Okoro-okwara and Umuchioma. In the fifth stage, one (1) honey hunter was randomly selected from each of the selected communities to a give a total of eighteen (18) honey hunters. For the registered bee farmers, thirty-two persons (32) were randomly selected from the sampling frame provided by the extension units of the Imo State Agricultural Development Programme (ADP). Finally, the total sample size was fifty (50) respondents for the study. In the fifth stage, one (1) honey hunter was randomly selected from each of the selected communities to a give a total of

eighteen (18) honey hunters. For the registered bee farmers, thirty-two persons (32) were randomly selected from the sampling frame provided by the extension units of the Imo State Agricultural Development Programme (ADP). Finally, the total sample size was fifty (50) respondents for the study. The study employed descriptive statistical tools in analyzing the data for the study. Precisely, descriptive statistical tools such as the frequency distribution, flow-chat, percentages and mean ($\bar{x}$) were used to realize objectives.

Also, a 4-point Likert type scale rating was used to obtain the perceived effects of climate change on bee production and then divided by the number of scales to obtain the discriminating index, for example, (4+3+2+1)/4 = 2.50 cut-off point. It was stated as follows;

SA = Strongly agreed (4)
A = Agreed (3)
D = Disagreed (2)
SD = Strongly Disagreed (1)

Decision Rule;

0.1-1.99= Minor effect;
2.0-2.49= Moderate effect;
2.50 and above = High effect;

Results and Discussion

1.0 Bee Farmers Awareness to Climate Change

The result of the bee farmers distribution based on awareness to climate change is presented in Table 1.

Table 1: Distribution of the Bee Farmers by Awareness to Climate Change

Item	Frequency	Percentage (%)
Aware	50	100.00
Total	**50**	**100.0**

Source: Field Survey Data, 2024

It indicates that all (100%) the bee farmers are aware of climate change in the area. This is an indication that the bee farmers may have over time been adapting to climate change to reduce its negative impact in their bee farming. The study of Vercelli et al. (2021) asserted that raising awareness of climate change among bee farmers is essential for promoting adaptive management, enhancing environmental stewardship, and building resilience, improving production, profit, income and standard of living.

2. Various Sources of Awareness on Climate Change among Bee Farmers

The outcome of various sources of awareness on climate change among bee farmers is displayed in Table 2.

Table 2: Distribution of the Various Sources of Awareness on Climate Change among Bee Farmers

S/No	Items	Frequency	Percentage (%)
1	Cooperative society	49	98.00
2	Social and religion gathering	45	90.00
3	Telephone (SMS)	41	82.00
4	Radio	36	72.00
5	Fellow/neighbouring farmer	33	66.00
6	Extension agents	14	28.00
7	Newspaper/Magazines	11	22.00
8	Television	8	16.00
9	Internet (social media)	5	10.00

Multiple responses were recorded;** ***Source: Field Survey Data, 2024

It shows that majority (98.00%) of the bee farmers identified Cooperative societyas one of their various sources of awareness on climate change. Result also reveals that social and religion gathering (90.00%), telephone (SMS) (82.00%), radio (72.00%), fellow/neighboring farmers (66.00%), extension agents (28.00%) and newspaper/magazines (22.00%) were identified by the bee farmers as their various sources of awareness on climate change. In addition, television (16.00%) and internet (social media) (10.00%) were stated by the bee farmers as among their various sources on information on bee farming in the area. The high use of radio as one of the main sources of information on climate change is obvious and expected because of its **accessibility, cost-effectiveness and portability** and **community building amongst others.**

Radio continues to play a vital role as a source of information in agricultural information dissemination and community engagement, providing accessible and versatile communication channels that serve the diverse needs and interests of farmers. The study of Yusuf et al. (2021) asserted that radio continues to be one of the most effective and reasonably priced communication instruments of the twenty-first century, even in the face of the development of social media and the advent of the digital era. The low use of television and internet (social media) as source of information could be attributed to low income and limited access in infrastructures such as power supply and network coverage to take care of the facilities in the area. Therefore, the finding becomes clear that the bee farmers have various sources of information on climate change to enhance their production, profit, sales, income and standard of living in adapting to climate change in the area.

3. Observable Changes of Climate in Bee Farming

The finding of observable changes of climate change in bee farming is displayed in Figure 1.

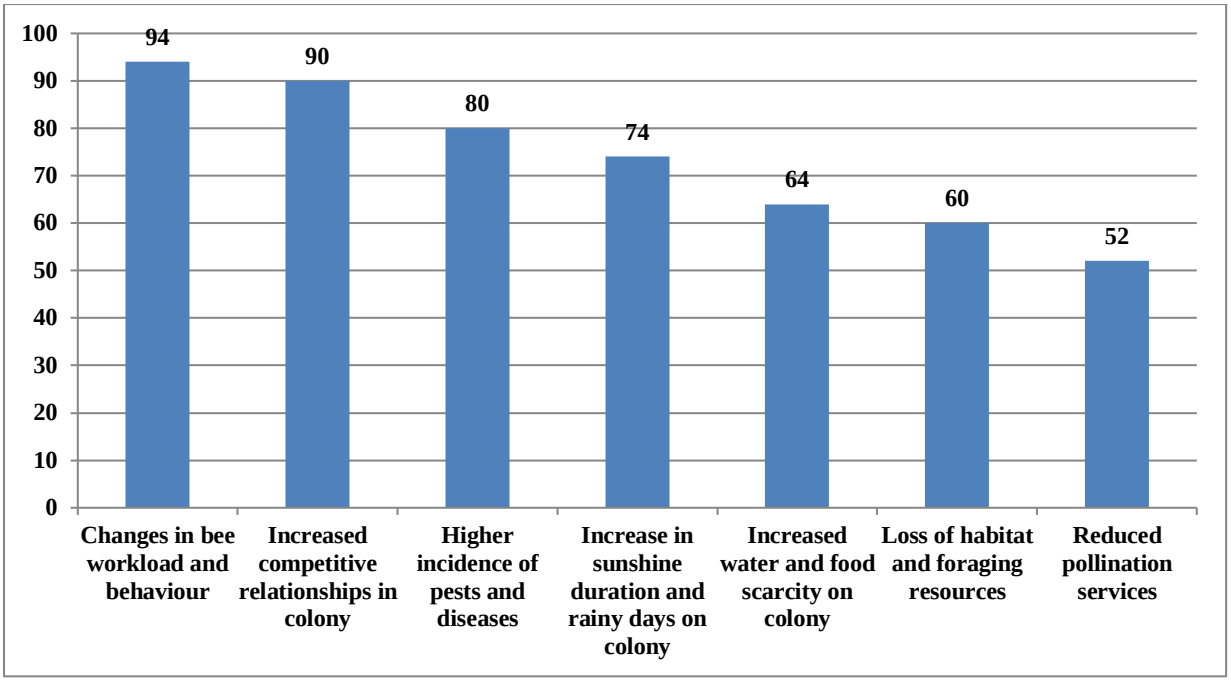

Figure 1: Observable Changes of Climate in Bee Farming

It shows that greater proportion (94.00%) of the bee farmers identified **changes in bee workload and behavior of** bees as one of the various observable changes of climate change in bee farming. The study is in line with the findings of Khalifa et al. (2021) which asserted that bees, as crucial pollinators and social insects, exhibit changes in workload and behavior due increased climate change effect. Findings also revealed that increased competitive relationships in colony (90.00%), **higher incidence of pests and diseases (80.00%),**increase in sunshine duration and rainy days on colony (74.00%), **increased water and food scarcity** on colony (64.00%), **loss of habitat and foraging resources (60.00%) and reduced pollination services (52.00%)**were identified by the bee farmers as among the various observable changes of climate change in bee farming. Climate change is among other major causes of colony collapse and **reduced pollination services (**Flores et al., 2019**)**.The finding is in consonant with the result of Barahona et al. (2024) who found that climate change is associated with increased sunshine duration and rainy days and **higher incidence of pests and diseases**which influences bee behaviour leading to increased competitive relationships in colony for **water and food. Ultimately, it is clear that the bee farmers are** observing significant changes of climate in their bee farming in the area.

4. Perceived Effects of Climate Change on Bee Farming

The result of the perceived effects of climate change on bee farming in the study area is shown in Table 4. The standard deviation value indicates high variances in bee farmers response regarding their perceived effects of climate change on bee farming. Additionally, the bee farmers perceived that climate change resulted to shifts in flowering season ($\bar{x}$ = 2.96; σ = 0.59); changes in habitat environment ($\bar{x}$ = 3.30; σ = 0.71); resulted to extreme weather events ($\bar{x}$ = 2.94; σ = 0.55); increased in pests and diseases infestation ($\bar{x}$ = 3.16; σ = 0.74) and altered phenology ($\bar{x}$ = 3.06; σ = 0.60).The result is in agreement with the study of Syed and Afshan, (2017); Landaverde et al. (2023) who asserted that climate change has severely

impacted global bee populations by depleting their habitats, behaviour, physiology and food sources. Similarly, bee farmers perceived that the incidence of climate change has reduced water availability ($\bar{x}$= 3.38; σ = 0.68); disruption of pollination services ($\bar{x}$= 2.44; σ = 0.40); destroying habitats and food sources ($\bar{x}$= 3.54; σ = 0.78); reduced honey yield, sales and income ($\bar{x}$= 3.00; σ = 0.60) and result to colony absconding ($\bar{x}$= 1.98; σ = 0.58). The finding is in line with the study of Van Espen et al. (2023); Yidiz and Özilgen (2019) who opined that rising temperatures increases the stress experienced by honey bee hives which further heightens the bees' susceptibility to pathogens. However, from the aggregate mean ($\bar{x}$ = 3.15; σ = 0.66) which is above the discriminatory score ($\bar{x}\geq$2.50), it shows that the bee farmers perceived rightly their knowledge about effects of climate change on bee farming and it was therefore accepted.

5. Conclusions and Recommendations

At a global level, the negative impact of climate change is being felt in bee farming. However, despite numerous studies conducted on climate change, empirical research incorporating bee production under increased climate change is still relatively scanty in the area. Therefore, this study assessed the effects of climate change on honey production in Imo State, Nigeria. From the specific objectives that guided the study, we ascertained bee farmers awareness of climate change; ascertained their sources of information on climate change; determined the perceived effects of climate change on bee production; and ascertained the observable changes in climate change among bee farmers. Multistage and purposive sampling procedures were used in the selection of fifty (50) bee farmers. A purposive sampling procedure was used to select only farmers who are involved in bee farming activities. Data collected were analyzed using descriptive statistical tools such as the flowchart and mean score of the Likert-type scale. All (100.00%) of the bee farmers were aware of climate change. Cooperative society (98.00%) and radio (90.00%) were among the major sources of awareness of climate change of the bee farmers. Farmers identified honey (96.00%) and beeswax (86.00%), among others, as the various products from bee farming. Findings further show that the bee farmers perceived that climate **change affected habitat environments (**$\bar{x}$ = 3.30; σ = 0.71**),** resulted in **extreme weather events (**$\bar{x}$ = 2.94; σ = 0.55**), and resulted in increased pest and disease** infestation ($\bar{x}$ = 3.16; σ = 0.74), among others. **Also, changes in bee workload and behavior (94.00%),** increased competitive relationships in the colony (90.00%), and increased sunshine duration and rainy days in the colony (74.00%), among others, were among the observable changes of climate change as stated by the bee farmers. In conclusion, the study on the perceived effects of climate change on honey production in Imo State, Nigeria, reveals significant challenges faced by beekeepers due to shifting climatic conditions. Changes in temperature, unpredictable rainfall patterns, and alterations in flowering seasons have negatively impacted honeybee behavior, nectar availability, and overall honey yield. Additionally, extreme weather events such as droughts and heavy rains have disrupted hive stability and increased colony losses. These challenges highlight the vulnerability of honey production to climate variability and underscore the need for adaptive strategies to sustain beekeeping in the region. Therefore, agricultural extension system should be strengthened by the government to provide bee farmers with up to date information and

training in the area. The study also recommends that the bee farmers be encouraged to form a cooperative society so they could collectively pool productive resources together in obtaining inputs and financial resources in adapting effectively to climate change in the study area. Beekeepers should adopt climate-resilient beekeeping techniques, such as hive shading, supplementary feeding, and strategic hive relocation, to mitigate the adverse effects of temperature fluctuations and extreme weather. stablishing and integrating weather monitoring tools will help beekeepers anticipate climatic changes and make informed decisions to protect their colonies. Finally, beekeepers should adopt climate-resilient beekeeping techniques, such as hive shading, supplementary feeding, and strategic hive relocation, to mitigate the adverse effects of temperature fluctuations and extreme weather.

Table 4: Perceived Effects of Climate Change on Bee Farming

n =50

S/No	Items	SA	A	D	SD	Mean ($\bar{x}$)	SD (σ)	Decision
1	Shifts in flowering season	14 (28.00)	23 (46.00)	11 (22.00)	1 (2.00)	2.96	0.59	High effect
2	Changes in habitat environment	23 (46.00)	21 (42.00)	4 (8.00)	2 (4.00)	3.30	0.71	High effect
3	Result to extreme weather events	20 (40.00)	10 (20.00)	17 (34.00)	3 (6.00)	2.94	0.55	High effect
4	Increased pests and diseases infestation	15 (30.00)	30 (60.00)	3 (6.00)	2 (4.00)	3.16	0.74	High effect
5	Altered phenology	19 (38.00)	18 (36.00)	10 (20.00)	3 (6.00)	3.06	0.60	High effect
6	Reduced water availability	25 (50.00)	20 (40.00)	4 (8.00)	1 (2.00)	3.38	0.68	High effect
7	Disruption of pollination services	7 (14.00)	10 (20.00)	31 (62.00)	2 (4.00)	2.44	0.40	Moderate effect
8	Destroying habitats and food sources	31 (62.00)	16 (32.00)	2 (4.00)	1 (2.00)	3.54	0.78	High effect
9	Reduced honey yield, sales and income	14 (28.00)	25 (50.00)	8 (16.00)	3 (6.00)	3.00	0.60	High effect
10	Result to colony absconding	10 (20.00)	30 (60.00)	9 (18.00)	1 (2.00)	2.98	0.58	High effect
	Aggregate Mean Score					**3.07**	**0.62**	**High effect**

Key; SA: Strongly Agreed; A: Agreed; SD: Strongly Disagreed; D: Disagreed; SD (σ); Standard Deviation; Discriminatory index: Cut off point $\bar{x} \geq 2.50$ Accepted; Decision Rule; 0.1-1.99= Minor effect; 2.0-2.49= Moderate effect; 2.50 and above = High effect; *Figures in parenthesis are percentage; Field Survey Data, 2024

References

Barahona, N. A., Vergara, P. M., Alaniz, A. J., Carvajal, M. A., Castro, S. A., Quiroz, M., Hidalgo-Corrotea, C. M., & Fierro, A. (2024). Understanding how environmental degradation, microclimate, and management shape honey production across different spatial scales. *Environmental science and pollution research international*, 10.1007/s11356-024-31913-1. Advance online publication. https://doi.org/10.1007/s11356-024-31913-1

Bareke, T., Roba, K., & Addi, A. (2024). Diversity of bee floral resources and honey Production calendar in Ethiopia's southwest Shoa zone. *Advances in Agriculture*, *2024*(1). https://doi.org/10.1155/2024/5428576

Bayissa, M., Lauwers, L., Mitiku, F., De Graaf, D. C., & Verbeke, W. (2024). System mapping of the production and value chain to explore beekeeping potential in southwest Ethiopia. *Insects*, *15*(2), 106. https://doi.org/10.3390/insects15020106

Biyena, L., & Degu, T. (2024). Assessment of function of Beekeepers Farmers Research Group in selected Oromia zones. *World Journal of Agricultural Science and Technology*, *2*(4), 130–142. https://doi.org/10.11648/j.wjast.20240204.13

Deksisa, K., Gemechu, A., & Tolera, T. (2024). Does cluster beekeeping improve the efficiency of honey production in participant households in southwestern Ethiopia? *Heliyon*, *10*(19), e38651. https://doi.org/10.1016/j.heliyon.2024.e38651

Dupleix, A., Jullien, D., Moity-Maizi, P., & Schatz, B. (2020). Practices and knowledge of beekeepers and beehive suppliers regarding the wood material in the South of France. *Journal of Rural Studies*, *77*, 11–20. https://doi.org/10.1016/j.jrurstud.2020.04.005

Ferenczi, A. F., Szűcs, I., & Gáthy, A. B. (2023). Economic Sustainability assessment of a beekeeping farm in Hungary. *Agriculture*, *13*(6), 1262. https://doi.org/10.3390/agriculture13061262

Flores, J. M., Gil-Lebrero, S., Gámiz, V., Sánchez-Rodríguez, M. I., Ortiz, M. A., & Quiles, F. J. (2019). Effect of the climate change on honey bee colonies in a temperate Mediterranean zone assessed through remote hive weight monitoring system in conjunction with exhaustive colonies assessment. *Science of the Total Environment*, *653*, 1111–1119. https://doi.org/10.1016/j.scitotenv.2018.11.004

Food and Agricultural Organization (FAO) (2024). Beekeeping and sustainable Livelihoods. The urban Producer's resource book, Rome, 67pp. Retrieved 30th November, 2024.

Ihenacho, A., Onwumere, C., Obodo, C., Ahaotu, E., & Uche, C. (2024). Profitability of Honey Production in Ngor Okpala Local Government Area of Imo State, Nigeria. *Direct Research Journal of Agriculture and Food Science*, *12*(1), 138–146. https://doi.org/10.26765/DRJAFS33428912

Khalifa, S.A.M., Elshafiey, E.H., Shetaia, A.A., El-Wahed, A.A.A., Algethami, A.F., Musharraf, S.G., Al Ajimi, M.F., Zhao, C., Masry, S.H.D., & Abdel-Daim, M.M. (2021). Overview of bee pollination and its economic value for crop production. *Insects*, 12, 688.

Kiprono, N., Gitau, R., & Chelang'a, N. (2024). Assessing the economic returns of modern and traditional beehives. *Journal of Agribusiness and Rural Development*, *72*(2), 144–152. https://doi.org/10.17306/j.jard.2024.01794

Kouchner, C., Ferrus, C., Blanchard, S., Decourtye, A., Basso, B., Conte, Y. L., & Tchamitchian, M. (2019). Bee farming system sustainability: An assessment framework in metropolitan France. *Agricultural Systems*, *176*, 102653. https://doi.org/10.1016/j.agsy.2019.102653

Krysik, J. I., & Fian, J. (2007). Research for effective social work practice. McGraw Hill 387pp.

Landaverde, R., Rodriguez, M.T., & Parrella, J.A. (2023). Honey Production and Climate Change: Beekeepers' Perceptions, Farm Adaptation Strategies, and Information Needs. *Insects*. 14(6):493. https://doi.org/10.3390/insects14060493

Margaoan, R., Papa, G., Nicolescu, A., Cornea-Cipcigan, M., Kösoğlu, M., Topal, E., & Negri, I. (2024). Environmental pollution effect on honey bees and their derived products: a comprehensive analysis. *Environmental Science and Pollution Research*. https://doi.org/10.1007/s11356-024-33754-4

National Population Commission (NPC) (2006). Nigeria Population Commission, *Nigeria Federal Government Initiative of individual head count by gender. Spread, State by State*, In :MOFINEWS; 6(3):Nigeria; Retrieved 28th March, 2021 from https://www.nationalpopulation.gov.ng/

National Root Crops Research Institute, Umudike Meteorological Station, (NRCRIMS) (2020). Rainfall pattern across South east Nigeria, Retrieved 28th March, 2021 from NRCRIMS archive

Nigerian Meteorological Agency (NiMET) (2020). Drought, Rainfall and Flood Monitoring in South-East Bulletin 2020. Retrieved 28th March, 2021, fromwww.nimet.gov.ng

Nwaihu, E. C., Egbuche, C. T., Onuoha, G. N., Ibe, A. E., Umeojiakor, A. O., & Chukwu, A. O. (2015). Bee-Keeping for wealth creation among rural community dwellers in Imo state, South-Eastern, Nigeria. *Agriculture Forestry and Fisheries*, *4*(3), 73. https://doi.org/10.11648/j.aff.s.2015040301.23

Syed, A., & Afshan, J. (2017).The Effects Of Climate Change On Apiculture Industry, *European Journal of Business, Economics and Accountancy*, 5(1), 91-100

Uchechukwu, N.U., Amadi, P. E., & Egesi, Z. O. (2022). Determinants of Adoption of Improved Beekeeping Technology among Small-Scale Farmers in Imo State, Nigeria, *Journal of Community and Communication Research*, 7(2), 4-12

Van-espen, M., Williams, J. H., Alvés, F., Hung, Y., De Graaf, D. C., & Verbeke, W. (2023). Beekeeping in Europe facing climate change: A mixed methods study on perceived impacts and the need to adapt according to stakeholders and beekeepers. *Science of the Total Environment*, *888*, 164255. https://doi.org/10.1016/j.scitotenv.2023.164255

Vercelli, M., Novelli, S., Ferrazzi, P., Lentini, G., & Ferracini, C. (2021). A qualitative analysis of beekeepers' perceptions and farm management adaptations to the impact of climate change on honey bees. *Insects*, *12*(3), 228. https://doi.org/10.3390/insects12030228

Vincze, C., Leelőssy, Á., Zajácz, E., & Mészáros, R. (2024). A review of short-term weather impacts on honey production. *International Journal of Biometeorology*. https://doi.org/10.1007/s00484-024-02824-0

Yidiz, C., & Özilgen, M. (2019). Thermodynamic assessment of the impact of the climate change on the honeybees. *International Journal of Global Warming*, *17*(2), 185. https://doi.org/10.1504/ijgw.2019.097864

Yusuf, S., Adio, E., Zwalmam, S., & Suberu, S. (2021). Challenges in Accessing Agricultural Information Sources and Services by Farmers in Edu Local Government Area of Kwara State, Library Philosophy and Practice (e-journal). 6192. https://digitalcommons.unl.edu/libphilprac/6192