Journal of Research in Forestry, Wildlife & Environment Vol. 13(3) September, 2021
E-mail: jrfwe2019@gmail.com***;*** jfewr@yahoo.com
http://www.ajol.info/index.php/jrfwe
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ISBN: 2141 – 1778
Oluwaseyi et al., 2021

EFFECT OF FLORA DIVERSITY ON HONEY PRODUCTION IN SELECTED LOCAL GOVERNMENT AREAS IN KWARA STATE

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ABSTRACT

The study on the effect of honeybee flora diversity on honey production was carried out in six selected local government areas of Kwara State between May 2018 and April 2019. The survey of the plants in the study area was done twice a week in all the locations during the study period. The plants identified and their relative abundance were determined. A total of 38 honeybee flora species categorized into 13 families with Fabaceae 11 (28.9%) being the highly visited followed by the families: Anacardiaceae 6 (15.8%) and Moraceae (15.8%). The flowering periods of the plants differed seasonally, with more flowering in the rainy season. The extensive cultivation and propagation, and conservation of these important honeybees plant species in the study area were suggested to improve honey production in Kwara State.

Keywords: Honeybee plants, Plant families, *Apis mellifera adansoni*, Kwara State

Correct Citation of this Publication

Oluwaseyi F. O., Mukaila A. M. and Mustapha M. A. (2021). Effect of flora diversity on honey production in selected local government areas in Kwara State. *Journal of Research in Forestry, Wildlife & Environment* **Vol.** 13(3): 29 - 36

INTRODUCTION

Tropical forests worldwide are under the threat of destruction, due mainly to human activities geared towards short-term economic gains. This accelerating irreversible loss of biodiversity can lead to extinction. In Africa, most of the communities living near the tropical forests consider the forests as their natural heritage, and a source of livelihood. This has resulted in hostility between organizations and the local people, except in cases where the communities have been involved in the process. In view of the clash of interest there is an increasing need to draw a template for such communities can derive a living from these biodiversity-rich ecosystems without adversely affecting their integrity (Raina *et al.*, 2010). This trend, coupled with extensive education and involvement of these custodians, has proven to be the best way of achieving the delicate balance between conservation and sustainable exploitation (Raina *et al*., 2009).

According to Lagrange (1991), honey is the most important products of beekeeping; it serves as food, as a food ingredient, as an ingredient in medicine-like products and in many fermented honey products. Honey is one of the non-wood products of tropical forests, which have significant livelihood value, leading to the consideration of non-wood products as a strategy for the sustainable use and conservation of forests (Kusters *et al*., 2006; Shackleton *et al*., 2008). Sustainable beekeeping can only be achieved through understanding and conservation of the most resourceful plants for the bees in terms of nectar, pollen and resin**.**

African honeybees (*Apis mellifera adansonii*) is the predominant honey bees species in Africa

and is well adapted to the African ecological conditions and gathers its own food throughout the year (Adjare, 1990; Abdullahi *et al*., 2011). Plants are essential to the African honeybees' life. The production of honey depends on an abundant supply of nectar and pollen producing plants within easy flight range of the bee colony (Waykar *et al*., 2014). Honey production and other honeybee products depend on availability of floral resources (bee forage); which is a very sacrosanct field for honey beekeepers (Amsalu *et al*., 2003). Most of the methods of obtaining information about plants used in an area are based on direct field observations of foraging honeybees. (Amsalu *et al*., 2003). Studies in various ecological zones in Nigeria have revealed a great availability of nectariferous and polleniferous plants of honeybees in the country. In the Sudan Savanna zone of north eastern Nigeria, Abdullahi *et al*. (2011) and Dukku (2013), identified a total of 103 and 61 plant species respectively, foraged by the Africa honeybees. Dukku (2013) revealed the members of family Fabaceae to be predominant. In guinea savanna, Zaria, Mbah and Amao (2009) identified 28 flowering plant species visited by African honeybees with the family Leguminosae being the largest followed by Asteraceae. In the South-western Nigeria, Ayansola and Davies (2012) reported 49 plant species belonging to different families. Nnamani and Uguru (2012) identified 56 honey plants belonging to 32 families, in South-South region of Nigeria. According to Hepburn and Radloff (1998), the plants visited by honeybees can be identified through direct observation of foraging bees (Ayansola and Davies, 2012); palynological analysis of honey (Adekanmbi and Ogundipe, 2009); analysis of pollen loads removed from returning foragers (Köppler *et al*., 2007); and analysis of pollen stores in nests or hives (Ramanujam and Kalpana, 1992). Experienced beekeepers are also an important, albeit secondary source of information on local floral resources (Teklay, 2011).

Today's overexploitation of tree resources has many consequences that are documented elsewhere, but has also led to decreased populations of honeybees. Loss of honeybee colonies not only deprives local people of sources of food and income, but there will be consequences from lack of pollination leading to reduced biodiversity. Beekeeping and honey production have an effect on plant vegetation, which entailed agriculture and forestry sector. However, due to degradation, fragmentation and habitat losses, combining with the recent increase in honey demand, it becomes necessary to estimate the contribution of forest resources in honey production in order to develop beekeeping and conserve forest resources in Nigeria. There is paucity of information on effect of honeybee flora diversity on honey production in Kwara State, Nigeria. Therefore, this serves as the rationale for this study. The objectives of this study are to identify the bee floral resources in Kwara State, with a view to determine the abundance of the plants which could be exploited by beekeepers.

MATERIALS AND METHODS

Study Areas

The study was conducted in six selected local government areas in Kwara State. These selected local governments were Asa Local Government, Ekiti Local Government, Ilorin East Local Government, Ilorin West Local Government, Ilorin South Local Government and Moro Local Government in Kwara State, Nigeria. Kwara state is located between latitudes 80º 05' and 100 05' north and longitudes 20 50' and 60 05' east. The climate of Kwara State is characterized by both wet and dry seasons. The rainy season begins towards the end of April and last until October while the dry season begins in November and ends in April. The temperature of the state ranges from 33ºC to 35 ºC from November to January while from February to April; the value ranges between 34 ºC to 37 ºC. The total annual rainfall in the area ranges from 990.3mm to 1318mm. The relative humidity at Ilorin city ranges from 75% to 88% from May to October, while in the dry season it ranges from 35% to 80% (Ajibade and Ojelola, 2004). The topography is mainly plain lands to slight gentle rolling. The annual rainfall ranges between 1000mm and 1500mm. Average temperature ranges between 30 and 350C (KWADP, 1996).

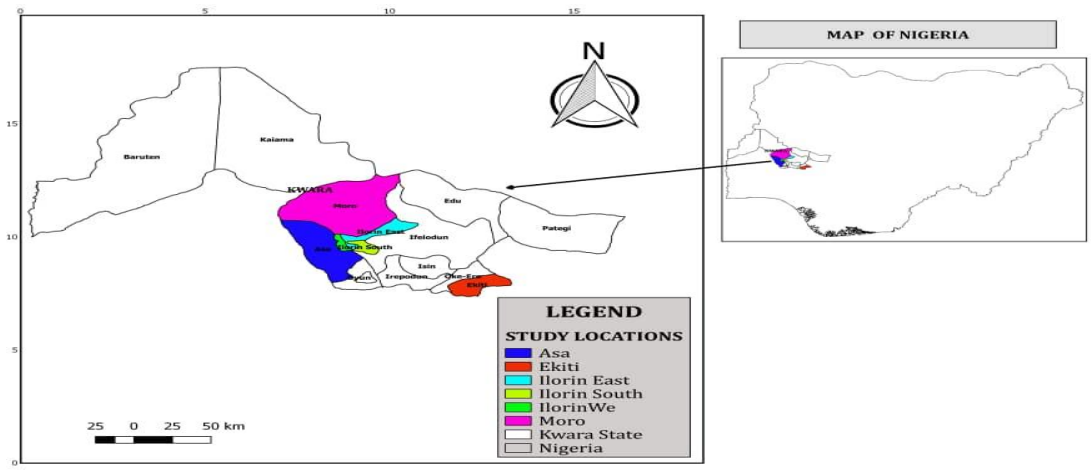

Figure 1: Map of Kwara State showing the study areas

Data Collection and Analysis

The point count quadrant method was employed to determine the physio-sociological characteristics of the woody vegetation. A length of 400m was transverse. Point quadrants were dropped at every 15m along the transects. Dominancy of vegetation in each study areas were determined by the vegetation analysis (Zobel *et al*. 1987) where frequency, relative frequency, density, relative density, dominance and relative dominance were calculated to get important value index (IVI), i.e.

IVI = RF + RD + RDo …… [1]

Where:
IVI = Important Value Index
RF = Relative Frequency
RD = Relative Density
RDo = Relative dominance

The physiological composition of woody species was analysed using the Shanon Wiener Index and represented in a table showing the species name, local name, number of species found at the study areas.
Mathematically, Shannon Wiener Index is represented as:

$$H = \sum \frac{ni}{n} l_n \frac{ni}{no} \quad \text{..... [2]}$$

Where:
H= value of SW Diversity index
n = total number ith species

The Importance value Index (IVI), for tree species in potential sites of CP was calculated by using formulae (Cottom and Cartis, 1956):

RD = NIS/TNIS x 100 ……..….. [3]

RD = TBCI/ TBCS x 100 … [4]

RF = NOS/ TNOS x 100 …….. [5]

IVI = RD + RDo + RF ……..…. [6]

Where:
RD = Relative density
NIS = Number of individuals of a species
TNIS = Total number of individuals of all species
RD = Relative dominance
TBCI = Total basal cover of individual species
TBCS = Total basal cover of all species
RF = Relative frequency
NOS = Number of occurrences of a species
TNOS = Total numbers of occurrence of all species
IVI = Important Value Index
RD = Relative Density
RDo = Relative dominance
RF = Relative Frequency

RESULTS

Woody Species Occurrence, Abundance and Important Value Index (IVI)

Table 1 shows the individual trees species composition with their scientific names, abundance, relative frequency, relative density, relative dominance and IVI. In the sample units

of tree species studied, *Mangifera indica* is the most frequent (6.67), most dominant (2.67), with the highest density (13.59) and the most important species with IVI of 22.93. Figure 2 shows that distribution of the tree species according to their respective families. The family Fabaceae have the most tree species.

Woody Species Diversity

Trees present in the vegetation sample are presented in Table 2. Proportion Pi was obtained for individual trees and while H measure (PilnPi). Thus, Shanon H' is given-∑ as (-2.08333) = (2.08333) for Shannon index of the trees species.

Table 1: Tree Species and their corresponding Important Value Index (IVI)

S/No.	Scientific name	Abundance	R.F	R.D	R.Do	IVI
1	*Accacia spp*	1.35	1.67	1.45	0.67	3.79
2	*Acacia nilotica*	2.12	5.00	1.94	2.00	8.94
3	*Anacardium occidentale*	1.00	3.33	0.48	1.33	5.14
4	*Annona senegalensis*	3.50	3.33	1.94	1.33	6.60
5	*Azadirachta indica*	10.50	3.33	4.37	1.33	9.03
6	*Balanites aegyptiaca*	2.67	1.67	1.45	0.67	3.79
7	*Bambusa vulgaris*	3.20	3.33	0.48	1.33	5.14
8	*Carica papaya*	8.90	1.67	2.43	0.67	4.77
9	*Chromolaena odorata*	6.60	3.33	0.48	1.33	5.14
10	*Eleais guineensis*	12.50	5.00	7.28	2.00	14.28
11	*Entada gigas*	1.40	1.67	1.45	0.67	3.79
12	*Eucalyptus globulus*	1.00	1.67	0.48	0.67	2.82
13	*Ficus benjamina*	2.50	1.67	0.97	0.67	3.31
14	*Ficus capensis*	6.50	1.67	0.48	0.67	2.82
15	*Ficus sur*	2.00	1.67	1.45	0.67	3.79
16	*Irvingia gabonesis*	1.00	1.67	0.48	0.67	2.82
17	*Khaya ivorensis*	2.71	1.67	1.94	0.67	4.28
18	*Khaya senegalensis*	10.67	5.00	5.82	2.00	12.82
19	*Mangifera indica*	22.50	6.67	13.59	2.67	22.93
20	*Manihot esculenta*	2.56	1.67	6.80	0.67	9.14
21	*Musa spp*.	8.00	1.67	5.34	0.67	7.68
22	*Nauclea latifolia*	4.50	3.33	3.40	1.33	8.06
23	*Parkia biglobosa*	6.50	5.00	4.37	2.00	11.37
24	*Parinari spp*	2.71	1.67	3.88	0.67	6.22
25	*Piliostigma thonningii*	4.00	1.67	3.88	0.67	6.22
26	*Poga oleosa*	1.00	1.67	0.97	0.67	3.31
27	*Prosopris Africana*	5.50	1.67	0.48	0.67	2.82
28	*Pterocarpus erinaceus*	2.00	1.67	0.48	0.67	2.82
29	*Rauvolfia vormitoria*	1.00	1.67	0.48	0.67	2.82
30	*Solemonostamon monostachyus*	1.00	1.67	1.45	0.67	3.79
31	*Talinum triangulare*	1.00	3.33	0.97	1.33	5.63
32	*Terminalia laxiflora*	1.50	1.67	2.43	0.67	4.77
33	*Terminalia spp*	3.67	1.67	2.91	0.67	5.25
34	*Tridax procubens*	5.00	3.33	1.45	1.33	6.11
35	*Vitellaria paradoxa*	4.50	3.33	4.37	1.33	9.03
36	*Vitex doniana*	3.33	5.00	6.31	2.00	13.31
37	*Vitis vinifera*	6.50	1.67	0.48	0.67	2.82
38	*Zanthoxylum anthoxyloides*	1.00	1.67	0.48	0.67	2.82
	Total	171.89	100.0	100.0	100.0	300.0

Note: R.F = Relative Frequency; R.D = Relative Density; Relative Dominance, IVI = Important Value Index;

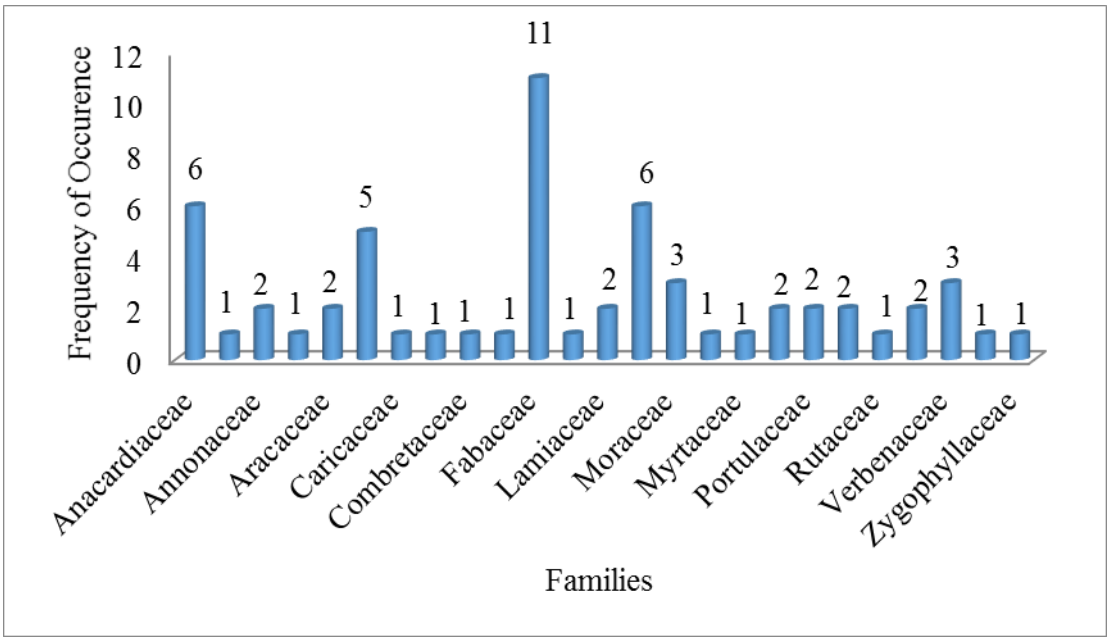

Figure 2: Tree Species Distribution by Family

Table 2: Shannon Weiner Diversity Index for Trees Species

No.	Tree Species	Pi	LnPi	H
1	*Accacia spp*	0.0147	-4.217	-0.0622
2	*Acacia nilotica*	0.0041	-5.5048	-0.0224
3	*Anacardium occidentale*	0.0015	-6.4857	-0.0099
4	*Annona senegalensis*	0.0269	-3.614	-0.0974
5	*Azadirachta indica*	0.0005	-7.5843	-0.0039
6	*Balanites aegyptiaca*	0.0219	-3.8231	-0.0836
7	*Bambusa vulgaris*	0.0005	-7.5843	-0.0039
8	*Carica papaya*	0.1012	-2.291	-0.2318
9	*Chromolaena odorata*	0.2237	-1.4975	-0.335
10	*Eleais guineensis*	0.0036	-5.6384	-0.0201
11	*Entada gigas*	0.0036	-5.6384	-0.0201
12	*Eucalyptus globulus*	0.0031	-5.7925	-0.0177
13	*Ficus benjamina*	0.0112	-4.4932	-0.0503
14	*Ficus capensis*	0.0056	-5.1864	-0.029
15	*Ficus sur*	0.2689	-1.3133	-0.3532
16	*Irvingia gabonesis*	0.0122	-4.4062	-0.0538
17	*Khaya ivorensis*	0.0046	-5.387	-0.0246
18	*Khaya senegalensis*	0.0025	-5.9748	-0.0152
19	*Mangifera indica*	0.0005	-7.5843	-0.0039
20	*Manihot esculenta*	0.0163	-4.1185	-0.067
21	*Musa spp.*	0.0036	-5.6384	-0.0201
22	*Nauclea latifolia*	0.0015	-6.4857	-0.0099
23	*Parkia biglobosa*	0.0005	-7.5843	-0.0039
24	*Parinari spp*	0.0005	-7.5843	-0.0039
25	*Piliostigma thonningii*	0.002	-6.198	-0.0126
26	*Poga oleosa*	0.0336	-3.3946	-0.1139
27	*Prosopris Africana*	0.0005	-7.5843	-0.0039
28	*Pterocarpus erinaceus*	0.0081	-4.8117	-0.0391

Table 2: Shannon Weiner Diversity Index for Trees Species (Cont'd)

No.	Tree Species	Pi	LnPi	H
29	*Rauvolfia vormitoria*	0.0015	-6.4857	-0.0099
30	*Solemonostamon monostachyus*	0.0015	-6.4857	-0.0099
31	*Talinum triangulare*	0.0066	-5.0193	-0.0332
32	*Terminalia laxiflora*	0.0046	-5.387	-0.0246
33	*Terminalia spp*	0.0849	-2.4663	-0.2094
34	*Tridax procubens*	0.0005	-7.5843	-0.0039
35	*Vitellaria paradoxa*	0.002	-6.198	-0.0126
36	*Vitex doniana*	0.0071	-4.9452	-0.0352
37	*Vitis vinifera*	0.0015	-6.4857	-0.0099
38	*Zanthoxylum anthoxyloides*	0.0041	-5.5048	-0.0224
	Total	0.8917	-203.978	-2.08333

Thus, Shannon Index-(-H), Therefore (H'): - for (-2.08333) trees which is 2.08333

Difference in the Vegetation Structure and Quality of Honey from the Study Areas

Table 3 presents the differences in the vegetation and the quality of honey produced in the study areas. Statistically, there is significant difference between the vegetation found around the apiaries at Asa local government area (f = 3.19, p = 0.00), Ilorin East local government area (f = 1.51, p = 0.00), Ilorin West local government area (f = 0.98, p = 0.01), Moro local government area (f = 1.30, p = 0.04) and quality of honey produced in the study areas. There were no significant differences between the vegetation found around the apiaries at Ekiti local government area (f = 0.69, p = 0.11) and Ilorin South local government area (f = 2.31, p = 0.07).

Table 3: Difference in the Vegetation Structure and Quality of Honey from the Study Areas

Variables	F	*Sig
Asa LGA	3.19	0.00**
Ekiti LGA	0.69	0.11
Ilorin East LGA	1.51	0.00**
Ilorin West LGA	0.98	0.01**
Ilorin South LGA	2.31	0.07
Moro LGA	1.30	0.04*

**P<0.05 and **P<0.01*

DISCUSSION

Beekeeping is more dependable on ecological suitability of an area than any other livestock production and, honeybee population and their productivities in general are mainly influenced by the nature of honeybee flora (Adgaba, 2002). Vegetation characteristics of the study areas are considered an important indicator for the potentialities of the area for beekeeping Survey conducted showed that, the potential of cultivated and natural honey flora makes it very favourable for beekeeping. Thirty-eight (38) flora species grouped into thirteen (13) families were identified in six selected local government areas in Kwara State, Nigeria. Honeybee flora species such as *Aspilia africana, Ageratum conyzoides, Mangifera indica, Tectona grandis, Tridax procumbens, Vernonia amygdalina, Zea mays, Carica papaya, Manihot esculenta, Luffa cylindrical, Musa sapientum, Sida acuta, Urena lobata, Citrus sinensis, Chromolaena odorata, Talinum triangulare, Cucurbita maxima, Chamaecristis mimosoides, Cleome viscose, Crotalaria retusa, Physalis angulata, Psidium guajava, Ricinus communis, Sarcocephallus latifolius, Solanum torvum, Triumfetta cordifolia, Ludwigia decurrens, Senna occidentalis, Watheria indica* and *Combretm sp,*

were also reported in the Sudan Savannah, guinea savannah and tropical rainforest of southwest and south-south of the vegetative zones of Nigeria (Omoloye and Akinsola, 2006; Mbah and Amao, 2009; Ebenezer and Olugbenga, 2010; Abdullahi *et al*., 2011; Abel and Banjo, 2012; Nnamani and Uguru, 2012; Dukku, 2013). This study therefore confirms that these plants previously reported are visited by honeybees. The family Fabaceae had the highest number of species across the study areas. This observation is tandem with the findings of Dukku (2013) in Northeast of Nigeria, who reported that the Fabaceae as the most abundant honeybee flora specie. However, this is not in conformity with the findings of Akunne *et al*., (2016) which reported that the family Asteraceae had the highest number of honeybee flora species in Awka, Nigeria. Also, this observation is in contrast to the findings of Mbah and Amao (2009) in Northwest; Nnamdi and Uguru (2011) in South-south, who reported that Leguminosae and Euphorbiaceae as the most abundant, respectively.

CONCLUSION

The blooming of some honeybees plant species overlaps the wet and dry seasons, thus providing forage throughout the year. Thus, the attitude of farmers and herdsmen who deliberately clear and set on fire bushes in the sampled locations during the dry season and at the beginning of planting season should be highly discouraged. This practice though meant to drive small animals out of hiding for the hunters and stimulate growth of fresh leaves for cattle rearers, it also burns out shrubs and herbs (especially those near drying up water sources) that serve as natural sources of food for honey bees. This is one of the reasons why bees in affected areas swarm out in search of shelter where they have guaranteed food and water. Such bush fires may also destroy beehives on tree branches and undermine the next build-up period in the honeybee calendar

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