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Economic Valuation of Medicinal Plants Used for Traditional Treatment of Diabetes in Benue State, Nigeria

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Abstract: *The study was conducted to provide information on the plants species (PS) used for the treatment of diabetes and their economic values due to paucity of information on the (PS) that could be used by decision and policy makers in planning for such (PS). Multistage, random and purposive sampling techniques were adopted to sample 360 respondents consisting of 240 users/key informants and 120 Traditional Medical Practitioners (TMPs) in the study area. The study made use of the primary data. Semi structure questionnaire, oral interview and personal observations were used to collect data from the respondents. Descriptive statistics, the payment card system used to elicit Willingness To Pay (WTP) values of the (PS) and the Sorensen Similarity Index (SSI) were used to analyzed the study data. Fifty five medicinal (PS) belonging to 32 different families were identified as plants used for diabetes treatment (DT) in the study area with the Euphorbiaceae (9.09%) being the most occurring family. The top 5 (PS) used for (DT) based on frequency of mention were Ocimum basilicum (38), Moringa oleifera (34), Phyllantus amarus (33), Vernonia amygdalina (29), Pennesetum typhoids (28), and Zingibar officinale (25) while the top 5 prioritized (PS) in terms of mean economic value of species per month were Kigelia africana (₦158.33), Trema orientalis (₦157.14), Erythrina senegalensis (₦155.56), Daniellia oliveri (₦150.00 and Detarium microcarpum. The total estimated economic value of the (PS) was (₦69, 090) while the mean economic value per month was (₦88.80). The (PS) in Ukum and Gwer East Local Government Area (LGAs) were more similar with (SI = 97.5%). The economic values of the medicinal plants indicate the value the society place on such (PS) and can not be said to be absolute values. This study therefore call for government, non-governmental organizations and private individuals to ensure sustainability of these plants species by embarking on both in-situ and ex-situ conservation of the plants.*

Keywords: *economic, valuation, medicinal plants, traditional, diabetes.*

1. INTRODUCTION

Diabetes is a disease that is characterized by excessive production and excretion of urine (Okoye, 2006). Accordingly, the World Health Organization (WHO, 1999) recognizes three main forms of Diabetess Mellitus; Type 1, Type 2, and gestational diabetes (occurring during pregnancy) which have similar signs, symptoms and consequences, but different causes and population distribution.

Diabetes can cause many complications. Acute glucose level abnormalities can occur if insulin level is not well controlled. Nathan *et al* (2004), remark that serious long term complications include cardiovascular disease (double risk), chronic renal failure (the main cause of dialysis in developed world adults and retinal damage (which can lead to blindness). Others are nerve damage (of several kinds) and micro vascular damage, which may cause erectile dysfunction (impotence) and poor healing. Poor healing of wounds, particularly of the feet, can lead to gangrene which can require amputation.

Rahmatullah *et al.,* (2012) reports that round 200 million people of the world are currently suffering from diabetes and the figure is projected to rise to 300 million within 2025 by the World Health Organization. The greatest prevalence is, however, expected to occur in Asia and Africa, where most patients will likely be found by 2030. The disease is caused by the inability of pancreas to produce

insulin or inability of the body metabolic system to properly use the insulin produced. The causes of this disease are not known; however, it is suspected that occurrences of the disease may result from increased number of elderly people, change in food habits, obesity, and adoption of a sedentary lifestyle. Because the human body cannot properly metabolize sugar when during diabetes, the first symptom of the disease is an increase in blood glucose or hyperglycemia.

The total economic value (TEV) of a forest system refers to the sum of (compatible) values i.e. direct and indirect use (and their associated option values), plus non-use values. Different forest land use options will be characterized by a different combination of direct, indirect and non-use values and thus a different total economic value. According to Bishop (1999), only part of this value is reflected in market prices, however, a risk that forest planners and land users will ignore or under-state certain important forest benefits.

Only some of the forest benefits are traded in markets and have a directly observable price. In general, direct use values are the most often reflected in market prices. Indirect use values may be reflected in the prices of certain goods and services which, depend heavily on the underlying environmental benefits, while non-use values are rarely reflected in market prices or decision-making. However, the absence of a market price does not mean that a thing has no economic value.

Contingent valuation method (CV) is used to elicit expressions of value from respondents for specified increases or decreases in quantity of a non-market good. Mitchell and Carson (1989), remark that most CV studies use data from interviews or postal survey and valuations produced by the CVM are contingent because value estimates are derived from a hypothetical situation that is presented by the researcher to the respondents. A hypothetical market situation investigated with the aid of CVM as a means of quantifying public preferences and willingness to pay (WTP) towards the conservation and use of forest resources is in line with the works of (Arrow *et al*, 1993; Cameron, 1988; Bishop, 1999 and Mitchell and Carson 1989). The underlying assumption in CVM is that people are able to translate a wide range of environmental criteria into a single monetary amount representing the total value of a particular resource. It is assumed that the more people value forest resources, the more they would pay for it.

Plants are known to be used in the treatment of ailments in the study area as reported by Igoli *et al.*, (2005). However, there is inadequate information on the plants used for the treatment of diabetes in the study area. In addition, there is limited information on the economic values on the plants species. Also information on the distribution of the plants species in the study area is limited.

This research was therefore conducted to provide information on the prioritized plants species for diabetes treatment in the study area that could be used for improvement and multiplication of the species. The study also aimed at providing information on the people's willingness to Pay (WTP) for the plants species and the economic values of the plant species that could be used by foresters and decision makers to enhance the values and marketability of the plants species. In addition, information on the distribution of plants species provided could to be used to identify areas of scarcity, make policy and provide for conservation of the plants species.

2. THE STUDY AREA

Benue State lies between Latitudes $6^{o}25'$N and $8^{0}8'$N and Longitudes $7^{o}47'$E and 10^{o}E. It is surrounded by five States, namely Nasarawa to the North, Taraba to the North East, Cross River to the South, Anambra to the South West and Kogi to the West. There is also a short international boundary between the State and the Republic of Cameroun along Nigeria's South East border.

Ostein (2012) reported that Benue State has an estimated population of about 4,291,244 million people in 2006 by the Nigerian Population Census (NPC, 2006). It also has a total land area of 30,910 km^2 and population density of 90 people per km^2. The Tiv, Idoma and Igede languages are spoken predominantly. With its capital at Makurdi, Benue is a rich agricultural region; some of the crops grown there are: potatoes, cassava, soya bean, guinea corn, flax, yams and beniseed.

The State has three ecological zones, which include the derived savanna, the guinea savanna and low land rainforest (keay, 1949; Geomantic International Inc. and Unilag Consults, 1998).

The State has 23 Local Government Areas (LGAs) namely; Agatu, Apa, Ado, Buruku, Gboko, Guma, Gwer East, Gwer West, Katsina-Ala, Konshisha, Kwande and Logo. Others include, Makurdi, Obi, Ogbadibo, Ohimini, Oju, Okpokwu, Otukpo, Tarka, Ukum, Ushongo and Vandeikya. The map of Benue State showing selected LGAs studied is shown in Figure 1.

Source: *Benue State Ministry of Lands and Survey, 2014.*

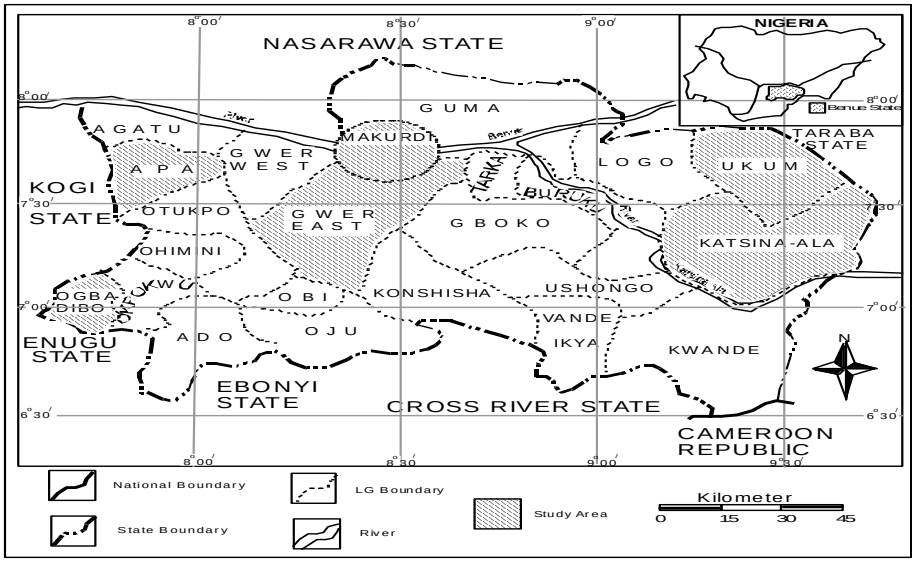

Figure1. *Map of Study Areas*

3. SAMPLING PROCEDURE AND SAMPLE SIZE

The population of the study consisted of the users / key informants of Medicinal Plant Species for Diabetes Treatment (MPSDT) and the Traditional Medical Practitioners (TMPs) in the study area. Multistage, purposive and random sampling techniques were adopted for the study. Two Local Government Areas (LGAs) were randomly selected in each of the three Senatorial Districts (SDs) and two Council Wards (CWs) in each of the LGAs. Two communities were then randomly selected in each of the CWs and one village selected in each of the communities. Ten users/key informants of MPSDT were purposively selected in each of the villages while 5 Traditional Medical Practitioners (TMPs) were randomly selected in each of the communities. The total sample size for the study was 360 respondents consisting of 240 users/key informants MPSDT and 120 TMPs.

Table1. *Summary of Sampling Procedure and Sample Size*

Parameter	**No Selected**
SDs	3
LGAs	6
CWs	12
Communities	24
Villages	24

i. Total users/Key informant: (10 x 24 = 240)

ii.Total TMPs per State: (5 x 24 =120)

4. INSTRUMENT FOR DATA COLLECTION

The study made use of the primary data. The primary data were collected with the aid of semi-structured questionnaires administered on the respondents.

5. DATA COLLECTION

Using standard ethno-botanic methods of Martin (1995) and Betti (2004), two main techniques participatory ethno-botany and artifact / interviews method were used to obtain data from respondents for a period of four months.

Following these methods, two set of semi-structured questionnaires designed to cover all the objectives of the study were administered to the TMPs and users / key informants of MPSDT in study area.

Research Assistants obtained from the local people and trained on the subject matter were used for data collection as proposed by Mbuya *et al.*, (1994) and Martin (1995). The plants species were

identified with the aid of assistance of a Taxonomist and Agishi (2004). Data on economic values of medicinal plants were obtained through the Payment Card System (CPS) of Contingent Valuation Method (CVM).

6. DEFINITION OF VARIABLES USED IN ANALYSIS

i. Estimated value of species: This is expressed as the sum of all the monetary values of each medicinal plant species in naira (₦) reported by respondents in the various locations.

ii. Mean economic value of species: This is expressed as the estimated monetary value of each medicinal plant species in naira (₦) divided by the total frequency of mention of the plant species.

iii. % of total species value: This is the monetary value of each medicinal plant species divided by the total of all the species monetary value in naira (₦) multiply by 100.

6.1. Data Analysis

Descriptive statistics such as the mean, frequency, percentage distribution, tabular presentations and charts were used to present results of identified medicinal plants species used for traditional treatment of diabetes while prioritization of the MPSDT was based on the frequency of mention and the economic values of the plants species as reported by the respondents.

Economic valuation method as used by Adekunle (2005) was adopted to elicit Willingness To Pay (WTP) values for MPSDT in each selected LGA and entire study area by application of the formulae:

$$WTP = \frac{\sum fx}{n}$$

Where:

WTP= mean willingness to pay value

Σ= Summation sign

f = frequencies of mention of plant species

x = Species value in Naira (N) and

n = Number of respondents

6.2. Sorensen Similarity Index

Assessment of similarity of medicinal plant species for diabetes treatment was achieved by use of Sorensen Similarity Index (SSI). Sorensen Similarity Index was used to determine the index of similarity of the plant species for diabetes treatment between any two locations in the study area. Sorensen Similarity Index (SSI) as expressed by Spellerberg (1991) is given as:

$$SSI = \frac{2W}{A+B} x100$$

Where:

SSI= Index of similarity

W= Total number of plant species common to both locations (samples or community)

A= Total number of plant species in first location and

B= Total number plant species in second location

The scores are multiplied by 100 to give a percentage scale. A value of zero percent indicates complete dissimilarity whereas a value of 100 percent indicates maximum similarity between locations.

7. RESULT PRESENTATION

7.1. Socio Economic Attributes of Users / Key Informants of Medicinal Plants for Diabetes Treatment

The socio-economic attributes of the users/key informant of medicinal plants for diabetes treatment is presented in Table 1. Majority of the respondents (76.7%) were male while the females were (23.3%). The age distribution shows that half of the respondents (50.4%) were within the age bracket of 20-30 years. Respondents within the age bracket of 31-50 years were (47.5%) while those within the 51-70 years were (2.1%).

In terms of educational background, (26.7%) had no formal education while (73.3%) had formal education. The marital status shows that majority of them (70.8%) were married while (29.2%) were not married. The major occupation of the respondents was farming (67.5%) followed by civil service (32.5%).

7.2. Distribution of Respondents on Diabetes Ailment

More than half of the respondents (59.6%) that provided information were diabetics (Table 2). Respondents that were non diabetics were (40.6%).

7.3. Willingness to Pay for Plants Species for Diabetes Treatment

Majority of the respondents (72.5%) were willing to pay (WTP) for use and conservation of the plants species (Table 3). The respondents not WTP were (27.5%). Table 4 shows the reasons for the respondents WTP for the plants species. The reasons were to support conservation (37.9%) and to compliment orthodox medicine (19%). Others were to ensure sustainability of the plants (11.5%), the plants were more effective than orthodox medicines (10.3%) and 21.3% reported on all the above reasons.

8. SOCIO ECONOMIC ATTRIBUTES OF TRADITIONAL MEDICAL PRACTITIONERS

The socio economic attributes of the Traditional Medical Practitioners (TMPs) is presented in Table 5. Majority of the TMPs (80%) were males while the females were (20%). The age distribution of the respondents shows that the majority of TMPs (95.9%) were within the age bracket of 20-50 years. The TMPs within the age bracket of 51-70 years were (4.1%). The mean age of the TMPs was 34 years. The results on other occupation shows that 47.5% of the TMPs were into farming, 21.7% hunting, 18.3% trading and 12.5 were civil servants. The result on the educational status shows that more than half of the TMPs (52.5%) were non literate while (47.5%) were literate. In terms of the marital status (78.3%) TMPs were married while (21.7%) were not married.

Table1. *Socio demographic Attributes of Users / Key Informant of Medicinal Plants for Diabetes Treatment in the Study Area n = 240*

Attributes	Category	F	%
Sex	Male	184	23.3
	Female	56	76.7
Age (Yrs)	20 – 30	121	50.4
	31 – 40	97	40.4
	41 – 50	17	7.1
	51 – 60	3	1.3
	61 – 70	2	0.8
Mean Age (yrs)			
Educational Status	Non formal	64	26.7
	Primary	98	40.8
	Post secondary	59	24.6
	Tertiary	19	7.9
Marital Status	Married	170	70.8
	Unmarried	70	29.2
Major occupation	Farming	162	67.5
	Civil service	78	32.5

n = Number of Users/key informants

Table2. *Respondents Response to Question of Having Diabetes Ailment*

Response	**F**	**%**
Yes	143	59.6
No	97	40.4
Total	240	100

Table3. *Respondents Response to Willingness to Pay for Conservation for Medicinal Plants for Diabetes Treatment*

Response	F	%
Yes	174	72.5
No	66	27.5
Total	240	100

Table4. *Reasons for Willingness to Pay for Diabetes Medicinal Plants*

Reasons	**F**	**%**
To support conservation	66	37.9
To compliment orthodox medicine	33	19.0
More effective than orthodox medicine	18	10.3
To ensure sustainability of the resource	20	11.5
All the above	37	21.3
Total	174	100

The income distribution of the TMPs shows that the TMPs who earned between ₦1000 -500,000 naira yearly were (75%) while those within the income bracket of ₦501,000 -800,000.00 naira were (25%). The mean annual income of the TMPs was ₦285,250.00 naira.

The years of experience of the TMPs shows that 30.8% TMPs had between 5-10 years, 30% had 11-20 years, 30% had 21-30 years and 9.2% had 31-40 years experience.

In terms of level involvement of the TMPs in herbal practice, majority of them (60.8%) were on full time practice while (39.2%) were on part time practice.

The result on the method of entry in herbal practice shows that 40% TMPs entered the practice through inheritance from parents, 20.8% through training, 30% through inspiration and 9.2% through personal interest.

9. DIAGNOSIS AND TREATMENT OF DIABETES ISN PATIENTS

The methods of diagnosing diabetes in patience by the TMPs were excess urination 100%, loss of weight 100% and the presence of sugar in urine Table 6. Majority of the TMPs (60.8%) treat diabetes by use of plants alone while (39.2%) do so by herbal and diet (Table 7).

9.1. Estimated Economic Values of Medicinal Plants Species for Diabetes Treatment

The monthly estimated economic values of the medicinal plants used for diabetes treatment in the study area are shown in Table 8. Fifty five medicinal plant species were identified as plants used for diabetes treatment in the study area. Prioritization of the plants species in terms of frequency of mention for treatment of diabetes by the TMPs shows the top 10 plants species as follows: *Ocimum basilicum (38), Moringa oleifera (34), Phyllantus amarus (33), Vernonia amygdalina (29), Pennesetum typhoids (28), Zingibar officinale (25).* Others were *Ceiba pentandra (25), Khaya senegalensis (24), Aloe vera (24), and Jathropha Curcas (24).*

The top 10 prioritized plants species in terms of mean economic value of species were *Kigelia africana (*₦158.33*),Trema orientalis (*₦157.14*),Erythrina senegalensis (*₦155.56*),Daniellia oliveri (*₦150.00*),Detarium microcarpum (*₦150.00*), Periscopsis laxiflora (*₦145.45*),Gardenia erubesences (*₦143.75*),Psidium guajava (*₦139.29*) and Lipia multiflora (*₦135.71*)and Euphorbia hetophylla (*₦133.33*).*The total estimated economic value of the plants species was (₦69090) while the mean economic value was (₦88.80).

9.2. Families and Life Forms of Medicinal Plant Species for Diabetes Treatment in the Study Area

The fifty five medicinal plants species identified as plants for diabetes treatment in the study area belong to 32 different families with the Euphorbiaceae (9.09%) being the most occurring (Table 9). The other families which occurred frequently were: Liliaceae (7.27%), Anancardiace (5.45%), Asteraceae (5.45%), Papilionoideae (5.45%), Caesalpiniodeae (3.64%) and Cochlospermaceae (3.64%). Others are Cucurbitaceae (3.64%), Fabaceae (3.64%), Longaniaceae (3.64%), Meliaceae (3.64%), Myrtaceae (3.64%), Rubiaceae (3.64%), Solanaceae (3.64%) and Verbanaceae (3.64%).

Table 10 shows that majority of the life forms of the plants species form diabetes treatment were trees (60%). Herbs were (32.7%), shrubs (5.5%) and grass (1.8%).

9.3. Similarity Index of Plants in the Study Area

The result on the Similarity Index (SI) of plants in the study area (Table 11) shows that the plants species in Ukum and Gwer East LGAs were more similar with (SI = 97.5%). Other LGAs with high SI were Ogbadibo and Apa (85.2%), Ukum and Katsina Ala (80%), Ukum and Makurdi (75%) and Ukum and Ogbadibo (74%). The LGAs with least SI were Gwer East and Makurdi (63.2%) and Gwer East and Apa (61.8%)

Table5. *Socio demographic Attributes of Traditional Medical Practitioner n = 120*

Attributes	**Category**	**F**	**%**
Sex	Male	96	80.00
	Female	20	20.00
Age (Yrs)	20 – 30	44	36.7
	31 – 40	62	51.7
	41 – 50	9	7.5
	51 – 60	3	2.5
	61 – 70	2	1.7
Mean age (yrs)	34		
Educational Status	Non formal	63	52.5
	Primary	18	15.0
	Post secondary	27	22.5
	Tertiary	12	10.0
Marital Status	Married	94	78.3
	Unmarried	26	21.7
Major occupation	Farming	57	47.5
	Hunting	28	21.7
	Trading	22	18.3
	Civil service	15	12.5
Estimated annual income (₦)	1000-100000	50	41.7
	101000 – 200000	17	14.2
	201000 – 300000	6	5.0
	301000 – 400000	13	10.0
	401000 – 500000	4	3.3
	501000 – 600000	14	11.7
	601000 – 700000	4	3.3
	701000 – 800000	12	10.0
Mean annual income (₦)	285,250.00		
Years of experience	1-10	37	30.8
	10-20	36	30.0
	21-30	36	30.0
	31-40	11	9.2
Mean years of experience	19		10.0
Involvement in Herbal practice	Full time	73	60.8
	Part time	47	39.2
Method of entry in herbal practice	By inheritance	48	40.0
	By training	25	20.8
	By inspiration	36	30.0
	By personal interest	11	9.2

n = Number of TMPs.

Table6. *Method of Diagnosing Diabetes in Patience in the Study Area*

Method	F	%
Excessive urination	120	100
Loss of weight	120	100
Presence of sugar in urine	120	100

Table7. *Method of Treating Diabetes in the Study Area*

Method	F	%
Herbal alone	73	60.8
Herbal and diet	47	39.2
Total	120	100

9.4. Families and Life Forms of Medicinal Plant Species for Diabetes Treatment in the Study Area

The fifty five medicinal plants species identified as plants for diabetes treatment in the study area belong to 32 different families with the Euphorbiaceae (9.09%) being the most occurring (Table 9). The other families which occurred frequently were: Liliaceae (7.27%), Anancardiace (5.45%), Asteraceae (5.45%), Papilionoideae (5.45%), Caesalpiniodeae (3.64%) and Cochlospermaceae (3.64%). Others are Cucurbitaceae (3.64%), Fabaceae (3.64%), Longaniaceae (3.64%), Meliaceae (3.64%), Myrtaceae (3.64%), Rubiaceae (3.64%), Solanaceae (3.64%) and Verbanaceae (3.64%). Table 10 shows that majority of the life forms of the plants species form diabetes treatment were trees (60%). Herbs were (32.7%), shrubs (5.5%) and grass (1.8%).

9.5. Similarity Index of Plants in the Study Area

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Table8. *Frequencies and Monthly Estimated Economic Values of Medicinal Plants Species for Diabetes Treatment in the Study Area*

	Botanical	**Family**	**Local**	**Total**	**Est. Value**	**Mean Value**	**%of Total**
S/N	**Name**	**Name**	**Name(in Tiv)**	**Freq**	**of Spp (₦)**	**of Spp (₦)**	**Spp Value**
1	*Acacia microsperma*	Mimosoideae	Saa u anura	12	950	79.17	1.38
2	*Ageratum conyzoides*	Asteraceae	*Huhu u tamen*	11	900	81.82	1.30
3	*Allium sativum*	Alliaceae	Alabusa u pupuu	19	1250	65.79	1.81
4	*Aloe vera*	Liliaceae	Agbadu	13	950	73.08	1.38
5	*Anacardium occidentale*	Anacardiaceae	Ishase	10	1150	115.00	1.66
6	*anthocleista vogilii*	Longaniaceae	Kor korso	6	800	133.33	1.16
7	*Asparagus africanus*	Liliaceae	Kpabelakpa	5	450	90.00	0.65
8	*Aspilia nelianthoides*	Asteraceae	Gbochambu	2	200	100.00	0.29
9	*Bridelia ferrugenea*	Euphorbiaceae	Nom Ikpine	12	900	75.00	1.30
10	*Bukea Africana*	Caesalpiniodeae	Gbagbongom	12	1100	91.67	1.59
11	*Capsicum frutensis*	Solanaceae	Mkem	8	600	75.00	0.87
12	*Carica papaya*	Caricaceae	Mbuer	18	1950	108.33	2.82
13	*Ceiba pentandra*	Bombaceae	Vambe	25	1900	76.00	2.75
14	*Citrus aurantifolia*	Rutaceae	Alun u angen	21	1950	92.86	2.82
15	*Cochlospermum planchoni*	Cochlospermacea e	Ihwelegh	12	950	79.17	1.38
16	*Cochlospermu\ tinctorium*	Cochlospermacea e	Kpavande	18	1600	88.89	2.32
17	*Crimum jagus*	Amaryllidaceae	Alabusa u toho	8	800	100.00	1.16
18	*Daniellia oliveri*	Fabaceae	Chiha	4	600	150.00	0.87
19	*Detarium microcarpum*	Papilionaceae	sAgashi	10	1500	150.00	2.17
20	*Diospyros mesipiliformis*	Caesalpiniode e	Kuhwe kya	5	650	130.00	0.94
21	*Erythrina senegalensis*	palmae	Ishough	9	1400	155.56	2.03
22	*Eucalypthus camaldulensis*	Myrtaceae	Vanage awundega	8	750	93.75	1.09

23	*Euphorbia hetophylla*	Euphorbiaceae	Tondokpan	9	1200	133.33	1.74
24	*Ficus thornigii*	*Ficus thornigii*	Akinde	17	2130	125.29	3.08
25	*Gardenia erubesences*	Rubiaceae	Ishondu; Ibohogh	8	1150	143.75	1.66
26	*Gilricidia sepium*	Papilionaceae	Citsawagh	5	650	130.00	0.94
27	*Hymennocardia acida*	Euphorbiaceae	Irkwarto; Likwar	9	900	100.00	1.30
28	*Jathropha Curcas*	Euphorbiaceae	Gyedan u Utiv	24	1950	81.25	2.82
29	*Khaya senegalensis*	Maliaceae	Haa u kiriki	25	1630	65.20	2.36
30	*Kigelia Africana*	Bignoniaceae	Tyembegh	6	950	158.33	1.38
31	*Lipia multiflora*	Verbanaceae	Uosu	7	950	135.71	1.38
32	*Lophira lanceolata*	Orchnaceae	Ikyura i nomso	17	1050	61.76	1.52
33	*Mangifera indica*	Anacardiaceae	Mungur	18	1100	61.11	1.59
34	*Moringa oleifera*	Moringaceae	Jegelejege	38	2630	69.21	3.81
35	*Musa paradisiacal*	Musaceae	Kokombo	9	800	88.89	1.16
36	*Ocimum basilicum*	Libiaceae	Kunguleku u kiriki	40	2440	61.00	3.53
37	*Ocimum grasstimum*	Libiaceae	Kunguleku u utamen	18	2190	121.67	3.17
38	*Pennesetum typhoides*	Poaceae	Amine	29	1970	67.93	2.85
39	*Periscopsis laxiflora*	Papilionoideae	Jilagba	11	1600	145.45	2.32
40	*Phyllantus amarus*	Euphorbiaceae	Kpan ityimbatsegh	34	1750	51.47	2.53
41	*Physalis angulata*	Solanaceae	Tamkpur; Tampue	6	500	83.33	0.72
42	*Piliostigma thornigii*	Fabaceae	Nyihar/Yakpande	19	1850	97.37	2.68
43	*Psidium guajava*	Myrtaceae	Gova	14	1950	139.29	2.82
44	*Sarcocephalus latifolia*	Rbiaceae	Ikyura u kase	18	950	52.78	1.38
45	*Spondias mombis*	Anancardiace	Konkwaa	10	1100	110.00	1.59
46	*Sterculia setigera*	Steculiaceae	Kumendur	6	650	108.33	0.94
47	*Strychnos innocua*	Loganiaceae	Amaku	9	1050	116.67	1.52
48	*Telferia occidentalis*	Cucurbitaceae	Ugu	13	1500	115.38	2.17
49	*Terminalia avicennoides*	Combretaceae	Kuegh	3	350	116.67	0.51
50	*Trema orientalis*	Ulmaceae	Chiese	7	1100	157.14	1.59
51	*Trichilia ematica*	Meliaceae	Nom Gbur; Ikyurauchi	9	950	105.56	1.38
52	*Vernonia amygdalina*	Asteraceae	Ityuna	33	2200	66.67	3.18
53	*Vitellaria paradoxa*	Sapotaceae	Ichamegh	13	1400	107.69	2.03
54	*Vitex doniana*	Verbanaceae	Hulugh	18	1600	88.89	2.32
55	*Zingibar officinale*	Zingiberaceae	Seta/Sita	28	1600	57.14	2.32
	Mean			778	69090	88.80	100.00

Table9. *Families of Medicinal Plant Species for Diabetes Treatment in the Study Area*

Family Name	**F**	**%**
Alliaceae	1	1.82
Amaryllidaceae	1	1.82
Anancardiace	3	5.45
Asteraceae	3	5.45
Bignoniaceae	1	1.82
Bombaceae	1	1.82
Caesalpiniodeae	2	3.64
Caricaceae	1	1.82
Cochlospermaceae	2	3.64
Cucurbitaceae	2	3.64
Euphorbiaceae	5	9.09
Fabaceae	2	3.64
Liliaceae	4	7.27
Longaniaceae	2	3.64
Meliaceae	2	3.64
Mimosoideae	1	1.82
Moraceae	1	1.82
Moringaceae	1	1.82
Musaceae	1	1.82
Myrtaceae	2	3.64
Orchnaceae	1	1.82
Palmae	1	1.82

Papilionoideae	3	5.45
Poaceae	1	1.82
Rubiaceae	2	3.64
Rutaceae	1	1.82
Sapotaceae	1	1.82
Solanaceae	2	3.64
Steculiaceae	1	1.82
Ulmaceae	1	1.82
Verbanaceae	2	3.64
Zingiberaceae	1	1.82
Total	55	100.00

Table10. *Life Forms of Medicinal Plants Species for Diabetes Treatment in the Study Area*

Habit	**Frequency of Occurrence**	**%**
Grass	1	1.82
Herb	18	32.73
Shrub	3	5.45
Tree	33	60.00
Total	55	100.00

Table11. *Similarity Index of Plants in the Study Area*

	Location		**Plants in**	**Plants in**	**Plants common to**			**(2*W/A+B)*100**
S/N	**A**	**B**	**location A**	**location B**	**Location A and B (W)**	**2*W**	**A+B**	**(%)**
1	Ukum	Katsina Ala	43	42	34	68	85	80.0
2	Ukum	Gwer East	43	37	39	78	80	97.5
3	Ukum	Makurdi	43	39	31	62	82	75.6
4	Ukum	Ogbadibo	43	30	27	54	73	74.0
5	Ukum	Apa	43	31	26	52	74	70.3
6	Katsina Ala	Gwer East	42	37	24	48	79	60.8
7	Katsina Ala	Makurdi	42	39	30	60	81	74.1
8	Katsina Ala	Ogbadibo	42	30	23	46	72	63.9
9	Katsina Ala	Apa	42	31	25	50	73	68.5
10	Gwer East	Makurdi	37	39	24	48	76	63.2
11	Gwer East	Ogbadibo	37	30	22	44	67	65.7
12	Gwer East	Apa	37	31	21	42	68	61.8
13	Makurdi	Ogbadibo	39	30	22	44	69	63.8
14	Makurdi	Apa	39	31	25	50	70	71.4
15	Ogbadibo	Apa	30	31	26	52	61	85.2

10. DISCUSSION

10.1.Medicinal Plants for Diabetes Treatment

The medicinal plants species documented for diabetes treatment in the study area cannot be said to be exhaustive and variations in the use of the medicinal plants amongst the people are attributed to differences in knowledge base of the people. Similar observations have been reported by Eddouks *et-al.,* (2002 in the North East region of Morocco, Grover and Yadav (2002) in India and Abo *et-tal.,* (2008).

Comparative analysis of this study with other ethnobotanical surveys of plants used for traditional for treatment of diabetes revealed some similarities with the plants cited in the study area. Of the 31 plants used in treating diabetes in South Western Nigeria (Abo *et al.,* 2008), 9 plants (*Ocimum graitssiimum, Spondias mombin, Vernonia amygdalina, Carica papaya, Capsicum frutensence, Citrus aurantium, Musa paradisiacal, Phyllanthus amarus, Zingiber officinale*) were cited in this study. In the ethnopharmacological survey of plants used for traditional treatment of diabetes in Tafilalet province, South East region of Morocco (Eddous *et al.,* 2002), of the 37 plants cited in the study, 3 plants (*Allium sativum, citrus aurantium* and *Aloe Spp)* were common to this study. In the survey of medicinal plants of India with anti-diabetic potentials by Grover and Yadav (2002), of the 41 plants cited, 6 plants (*Allium sativum, Mangifera indica Eucalyptus spp, Ficus spp, Ocimum spp* and *Phyllanthus spp*) were identical to this study. In the study of natural medicines used for traditional Chinese medical system for therapy of diabetes mellitus (Li *et al.,* 2004), of the 13 plants being used

in diets for diabetes treatment one plant (*Allium sativum)* is common to this study. Also, of the 18 plants with outstanding diabetes potentials in the study, one plant (*Spidium guajava*) is cited in this study.

The differences in the number and type of plant species for diabetes treatment in this study compared to the plants surveyed in different geographical location could be attributed to differences in climatic condition of those places and the knowledge of medicinal plants uses amongst the people. For example, amongst the 12 plants used by the Marakh sect of the Garo tribe of Megmensingh district of Bangladesh (Rahmatullah, *et al.*, 2012) two plants *Terminalia chebula* and *Phyllanthus emblica* were similar to *Terminalia avicennoides* and *Phyllanthus amarus* since they belong to the family Combretaceae and Euphorbiaceae respectively. Since they plants differ only in the species, it then means they have similar genes that can perform same action.

10.2.Economic Values of the Medicinal Plants species

The estimated monthly economic values of the medicinal plants used for diabetes treatment such as *Kigelia africana (*₦158.33*), Trema orientalis (*₦157.14*), Erythrina senegalensis (*₦155.56*), Daniellia oliveri (*₦150.00*)* and *Detarium microcarpum (*₦150.00*)* is an indication of the value in exchange for these species in the study area. This situation can be attributed to high demand and exploitation of the plant species. The economic values obtained in this study for medicinal plants use to treat diabetes is an indication of the values society place on such plant species. This values in terms of their Willingness to Pay (WTP) for use and conservation of the resources is viewed as indicative rather than absolute. Adekunle (2005), reports that where significant positive economic values are obtained, they do represent genuine positive values of the species indentified.

The findings of this study also have implication for decision making and management of plant resources. The result of this study could help in assessing economic values of other non marketed forest resources or forest resources whose values do not reflect their real economic cost and benefit due to market imperfections. According to Adekunle, 2005), failure to place proper values on forest non timber goods and services could result to excessive exploitation, conflicts with local communities, loss of economic and social values as well as environmental damages.

The findings on the use of CVM to value medicinal plant species used for diabetes treatment in this study agree with the works of Pradeep *et-al.,* (2007). They use the CVM to assess non-market economic valuation in India. They reported that the mean WTP for tourist for environmental fund was (Rs 6.73). Overall, 73.58% of tourist agreed to contribute towards environmental fund. Also Kim *et-tal.,* (2007) used CVM to value the World Cultural Heritage (Changdeok palace complex) in South Korea. They reported a mean WTP value of 5706 Won ($5.70) and aggregate use value of 1.93million Dollars. Jianjiun *et-al.,* (2008), also used the CVM to value respondents' willingness to pay for conservation of black-faced spoonbill conservation in Macao, China. An estimated household WTP for conservation of the birds ranges from US$2.25 to US$4.82 per household per in five years depending on the payment schemes.

10.3.Prioritization of the Medicinal Plants Species

Some of the medicinal plants species for diabetes treatment such as *Vernonia amygdalina, Ocimum basilicum, moringa oleifera* and *Sarcocephalus latifolia* were prioritized more than others. This finding could be attributed to high knowledge of their uses and importance to society. The findings on economic values and prioritization of these plant species have implication for management decision. Within given resources plants species identified for diabetes treatment cannot be selected for further investigation. So, it is pertinent to prioritize and select species for improvement. According to Franzel and Jannssen, (1996), the major objective of multipurpose specie prioritization is to determine the species for which improvement research would likely have the highest impact.

The high number of diabetes respondents observed in the study area call for concerned. His situation could be attributed to increase in consumption of energy diet and sedentary lifestyle and obesity. WHO publication (global burden of disease) estimates diabetes in adults to be around 173 million (Wild *et al.,* 2003) and around two thirds of these live in developing countries. The American Diabetes Association (ADA, 1997) reported that Asia and Africa as regions with the greatest potential where diabetes could rise to two or threefold above the present level.

10.4. Similarity Index of the Plants Species in the Study Area

Twelve plants species for diabetes treatment *(Carica papaya, Ficus thornigii, Jathropha curcas, Moringa oleifera, Ocimum basilicum, Ocimum grasstimum and Periscopsis laxiflora. Others are Phyllantus amarus, Piliostigma thornigii, Psidium guajava, vitex doniana and Zingibar officinale*) were observed to be common to the six LGAs. The high similarity index observed between some localities indicates high presence of the plants species in such localities and knowledge base in the use of the plants species.

11. CONCLUSION

The use of plants for diabetes treatment in the study area is an accepted practice amongst the people. Differences in use of plant for diabetes treatment locations are attributable to knowledge base of the people in the area. The economic values of the medicinal plants indicates the value the society place on such plants species and can not be said to be absolute values. This study therefore call for government, non-governmental organizations and private individuals to ensure sustainability of this plants species by embarking at both in-situ and ex-situ conservation of the resources.

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