Algerian Journal of Biosciences
ISSN: 2716-9375
Journal homepage: http://www.ajbjournal.periodikos.com.br

Original Article

Plant-Based Agrobiodiversity In Home Gardens Of Tubah Sub-Division, North-West Region, Cameroon

Wujung Lizby-Joy Mbi[a], Azibo Roland Balgah[b], Ndam Walter Tacham[a], Fungwa Sandra Fru[a], Forchu Melo Seidou[a], NjouonkouAndré-Ledoux[a*]

[a]*Department of Biological Sciences, Faculty of Science, The University of Bamenda, Cameroon*
[b]*Department of Agribusiness Technology, College of Technology, The University of Bamenda, Cameroon*

ARTICLE INFO

Article history:
Received 06 April 2021
Revised 19 Jun 2021
Accepted 25 Jun 2022

Keywords:
Biodiversity;
Useful Plants;
Home Garden;
Mezam Division;
Western Highlands;
Cameroon.

ABSTRACT

Home gardens are subsistent agricultural production systems consisting of diverse crop plants which are easily accessible and adjacent to homesteads. They sustainably contribute to livelihoods in developing countries. Regarding the modernization in tropical Africa, there are changes in plant composition of urbanizing areas like Tubah Sub-Division, North West Region, Cameroon while the useful plant diversity in home gardens are poorly or not documented. This study aims to assess the diversity of useful plant species and identify key factors that influence diversity. 120 selected home gardens from Tubah Sub-Division were surveyed using two complementary field sampling approaches: interaction with selected households head through the use of structured questionnaires on garden plants and direct field observation. To assess plant abundance, the entire home garden was considered as a sample plot for tree, shrub, climber and epiphytic plant species while for herbaceous species, five quadrats of 1 m^2 were used to count each species. A total of 133 useful plant species belonging to 108 genera and 47 families were recorded, with the number of species varying among the villages. The dominating families were Solanaceae, Fabaceae and Asteraceae. Age of household head and age of home garden were the key factors which significantly influenced the plant diversity. As home gardens in Tubah Sub-Division consist of diverse garden plants which are of great importance, we suggest that home gardening should be promoted, through education and extension services. This study should also be extended to other parts of the North West Region.

Faculty of Natural Sciences and Life, University of El Oued.

Introduction

The cultivation of small portions of land around the homesteads or within walking distance from the family home is a common characteristic of subsistence agriculture widely practiced worldwide [1]. In such an agricultural system or form of land use, diverse genetic resources including crops, livestock, trees/shrubs or fish are deliberately managed for food, fodder, fuel, medicine and incomes of the household [2]. The mix of useful plants, animals and micro-organisms species and their variability contributes to promote the agro-biodiversity and gene conservation with plant organisms made of annual and perennial crops being the most viewed thanks to their morphology and abundance that have more impact on the landscape [3, 4].

Developing countries especially those in Africa are facing a rapid urbanization that comes with environmental and social changes. Construction of buildings and other infrastructures lead to the destruction of natural habitats and changes in the local biodiversity often leading to biodiversity loss, and/or introduction of new species [5].Urbanization also induce rapid population growth with people of various background and

* *Corresponding author :* ***NjouonkouAndré-Ledoux*** Tel.: 00000000000000
E-mail address: *alnjouonkou@yahoo.fr*
Peer review under responsibility of University of El Oued.
Doi : https//doi.org/10.57056/ajb.v3i1.50

consumption habits, coming from different areas and tribes. Hence, there is an increase in demand of food and other commodities to sustain the life of new citizens of which the majority have low purchasing power and sometimes would prefer to maintain old consumption habits. To over come these problems and increase the family income, some of them invest in the subsistence agriculture around their homes putting in place agroforestry systems or home gardens with various species including native and exotic plant species for different purposes [6,7,8]. In addition to contributing to food security, home gardens can potentially impact plant diversity of the emerging towns and villages [5].

The North-West region of Cameroon is part of the Western Highlands region known as a great area of agricultural production. The economic activity in this region is dominated by small and medium-sized enterprises in its capital Bamenda, and agriculture in neighbouring Sub-Divisions and Divisions, with practices of urban agriculture where gardening in most cases is done in home gardens [9,10]. Tubah Sub-Division is in the vicinity of Bamenda hosting the campuses of many schools and universities including the University of Bamenda that constantly increase its population. Hence, it has been engulfed by modernization, especially since the beginning of the last decade. A key determination of this urbanization has been the increase transformation of natural and agricultural lands into building sites, following the establishment of higher institutes of learning. This may induce changes in plant diversity in local home gardens with losses and introduction of crop genetic variety and the increase of external output as predicted by Peyre *et al*. [11]. So far, very little has been done to document plant and crop diversities in Tubah Sub-Division. The few exceptional studies suggest the presence of 54 plant species used to treat respiratory diseases and 108 woody plant species including 74 trees, 28 shrubs and 5 lianas in the Kedjom Keku montane forest [12, 13]. Up to date, no attempt has been done to study the plant diversity in home gardens or this agricultural system in general in the North West region where gardening is part of the daily life activity of the community. It is obvious that a study of the useful plant diversity in various compounds of the area can contribute to the acknowledgment of agrobiodiversity and plant diversity in this area and in the North West region of Cameroon in general. Thus, the purpose of this study was therefore to assess the plant-based agrobiodiversity in home gardens of Tubah Sub-Division, North West Region of Cameroon. Specifically this study assesses the diversity of useful plants species found in home gardens of the four villages that constitute the Sub-Division; and identify key factors which have influenced the crop diversity and richness of those home gardens studied.

1. Materials and Methods

2.1. Study area

Tubah Sub-Division is located in Mezam Division, Northwest Region of Cameroon between latitudes 4°50´ to 5°20´N and longitudes 10°35´ to 11°59´E, with an altitude ranges between 950-1500 m above sea level [14]. It is made up of four main villages; Bambili, Bambui, Small Babanki or Kedjom-ketinguh, and Big Babanki also known as Kedjom-keku (figure 1). Bambili and Bambui are characterized by small enterprises and higher institutes of learning while Small Babanki and Big Babanki are mainly characterized by vegetable farming and marketing. This zone has two seasons, the dry season from November - February and the rainy season from March - October. The mean annual rainfall and temperature is about 2200 mm and 20.67°C respectively [15]. The vegetation consists of savannah grassland and patches of forests. Overall, the main economic activity carried out in Tubah Sub-Division is agriculture.

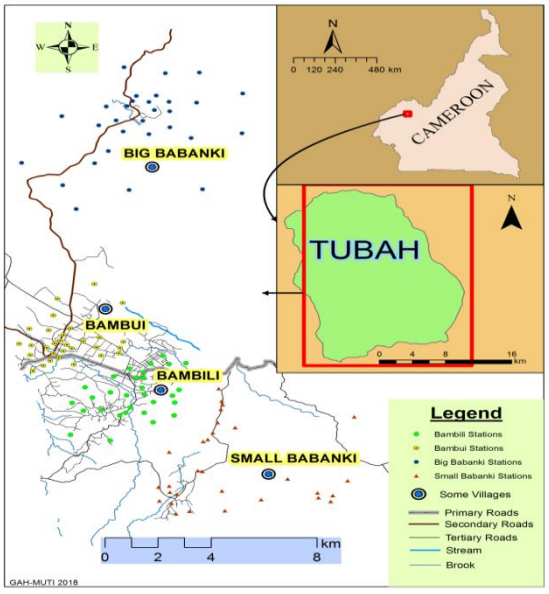

Figure 1: Location of Tubah Sub-Division in the North West Region

2.2. Data collection and species identification

Data collection was carried out in the four villages that constitute Tubah Sub-Division from March – May, 2018. In each village, 30 households were randomly selected for the study. In each home garden, the garden head gave his/her informed consent before they were interviewed using a structured questionnaire and information about the home garden was recorded. The same questionnaire was used in the different villages. The questionnaire was divided into two sections; information from the garden head on the characteristics of the home garden and list of plants found in the home garden. The home garden of each household was considered as a sample plot for the useful plant diversity survey. The dimension of the home garden was taken, after which the home garden was visited during which vital data such as the age of the home garden and the age of the home gardener (household head) were collected; and the plants in the home garden identified. The gardener showed the various useful plant species (cultivated or intentionally allowed to grow) present in his/her garden giving the common name according to Martin [16] and Alexiades and Sheldon [17]. Some species were identified by scientific name on site using literature on useful plants in the tropics [18, 19]. For species that were not identified *in situ*, samples were collected and preserved for identification by taxonomists at the national herbarium of Cameroon (YA).

Following Tynsong and Tiwari [20], individuals of each tree, shrub and climber was counted in the whole home garden (considered as a plot) to determine their number. For herbs in each compound, five quadrats of 1 m x 1 m were randomly made per home garden in which individuals of each useful herb species was counted.

2.1. Analysis of plant diversity

To assess and compare the plant diversity in the Sub-Division and among the villages, some parameters were evaluated. The number of species, genera and family in each village was considered and compared. Also, following Evrad [21], the genera diversity index (GDI) was calculated using the formula:

$$GDI = Ns/Ng$$

Ns: Number of species
Ng: Number of genera

To evaluate the distribution pattern of each species among the different villages their frequency of distribution was calculated using the formula:

$$F = n/N$$

n: number of home gardens in which the species was found
N: total number of home gardens survey.

It should be recalled that N was 30 for each village and 120 for the entire sample. Following Raunkiaer [22], these frequencies were used to classify species into five classes of frequency (A, B, C, D, and E) according to the percentages of distribution, as follows: Class A: 0%-20% (Very rarely distributed/present), Class B: 21%-40% (Rarely distributed/present), Class C: 41%-60% (Averagely distributed/present), Class D: 61%-80% (Highly distributed/present), Class E: 81%-100% (Very highly distributed/present). This was used to establish the frequency diagram of Raunkiaer [22]. Based on the nature of perenating buds/parts of the plant body, the life form of each species was determined. Then, species were grouped into five life form classes,

based on Raunkiaer [22]. Consequently, Phanerophytes, Chamaephytes, Hemicryptophytes, Cryptophytes and Therophytes were used to establish the biological spectrum of life forms of useful plants species in home gardens.

For abundance, the Shannon Weaver index of diversity (H´) and the Simpson diversity index (D) were used. The Shannon Weaver Index of diversity [23] and the Simpson diversity index were calculated using respectively the formula:

$$H' = -\Sigma\, p_i \ln p_i$$

$$D = \Sigma\, p_i^2$$

p_i: proportion or number of individuals found in species "i".

In addition, the Sorensen similarity coefficient (Ss) was used to calculate the level of similarity among the four villages [24]. The Sorensen similarity was calculated using the formula:

$$Ss = [2C/ (A+B) \times 100.$$

A: Total number of species in village A,
B: Total number of species in village B
C: Number of common species to both villages.

2.2. Determination of factors influencing diversity in home gardens

To determine factors influencing diversity and richness of plant species in home gardens of Tubah Sub-Division, the Multiple Linear Regression Model was used by modeling the independent variables. These included age of the garden head, age of the home garden, household size, estimated home garden area, gender, income from home garden and number of use category and the dependent variable (R=0.501).

Information on the independent variables was collected from the head of the household owning the home garden. It is noticed that, the age of the garden head influenced home garden diversity [25]. In each locality, the number of plant species in the HG of the oldest and youngest owners was considered and the average calculated for the Sub-Division. Similarly the number of species in the oldest and youngest HG was considered for each village and the average for the Sub-Division calculated.

3. Results and Discussion

3.1. Diversity of plants in home gardens of Tubah

A total of 133 useful plant species belonging to 108 genera and 47 families were recorded in home gardens in the four villages of Tubah Sub-Division. The list of species is provided in Table 1. Here 18 genera had more than one species with *Brassica*, *Dioscorea*, *Duranta* and *Solanum* having 4 species each while *Allium*, *Citrus* and *Xanthosoma* recorded 3 species. It was noticed that, some species were represented by several varieties. For instance, *Xanthosoma sagittifolium* (macabo) was represented by red, yellow and white varieties, *Zea mays* (corn) was represented by many varieties including Popcorn and *Duranta erecta* was represented by green, white and yellow varieties.

The total number of useful plant species recorded in home gardens in Tubah Sub-Division is more or less similar to that recorded in other localities of the Tropical region. In Asia,122 plant species were listed in home gardens of the Kandal province in Cambodia while 116 plant species were documented from 100 home gardens in Jharkhand (India) [26,27]. In Ethiopia, number varies from 69, 138 and 258 useful plant species were recorded respectively in Jabithenan District, Arba Minch Town and Hawassa city [28, 29, 30]. In Indonesia, Pamungkas and Hakim documented 99 ethnospecies in home gardens of Tambakrejo, Sumbermanjing Wetan and Malang region [31]. In Cameroon recent studies reported 61 plant species in the peri-urband zone of Bafia, center region of Cameroon and 212 plant species from 150 home gardens in Galim-Tignere, Adamawa region [32, 33]. Of the 47 families, 14 were represented by 1 species while 9 had 5 species or more (Figure 2). The family Solanaceae was the most diversified with 12 species for the whole Sub-Division; it was dominant in Bambili, Big Babanki and Small Babanki with respectively 11, 9 and 8 species. It was followed by the families Fabaceae and Asteraceae represented each by 9 species. Fabaceae were dominant family in Bambui with

9 species. The families Brassicaceae, Cucurbitaceae, Euphorbiaceae, Lamiaceae, Malvaceae and Verbanaceae recorded 5 species each. In many studies of useful plants in home gardens, the families Asteraceae, Brassicaceae, Euphorbiaceae, Fabaceae, Lamiaceae and Solanaceae are generally listed among the most diversified [28, 29, 30, 32, 33].

It is similar to the results of home gardens documented by other researchers though the family positions are different. For instance Fabaceae was documented as the dominant family with the highest number of species followed by Euphorbiaceae and Asteraceae in Arba Minch Town, Ethiopia while Moraceae was documented as the dominant family followed by Orchidaceae and Asteraceae in War Khasi Community of Meghalaya, North-east India [29, 20].

Table 1. Checklist of plant species, location and life forms in home gardens of Tubah Sub-Division (B_1 = Bambili, B_2 = Bambui, BB = Big Babanki, SB = Small Babanki, Ph = Phanerophytes, Ch = Chamaephytes, He = Hemicryptophytes, Cr = Cryptophytes and Th = Therophytes)

	Botanical name	Common name	Location	Life Form
Alliaceae				
1	*Allium fistulosum*L.	Shallot leeks	B_1, B_2, BB, SB	Cr
2	*Allium ampeloprasum*L.	Poiro leeks	B_1, B_2, SB	Cr
3	*Allium cepa* Linn.	Onion	B_1, B_2, SB	Cr
Amaranthaceae				
4	*Amaranthus hybridus* L.	Green amaranth	B_1, B_2, BB, SB	Th
5	*Beta vulgaris* L.	Beet root	B_1	Cr
6	*Celosia cristata* L.	Cockscomb	B_1	Th
7	*Spinacia oleracea* L.	Spinach	B_1	Th
Amaryllidaceae				
8	*Agapanthus africanus* (L.) Hoffmanns	African lily	B_1	Cr
Anacardiaceae				
9	*Mangifera indica* (Linn.) R. Br.	Mango tree	B_1, B_2, BB, SB	Ph
Annonaceae				
10	*Annona muricata* L.	Soursop	B_1, BB,	Ph
Apiaceae				
11	*Apium graveolens* L.	Celery	B_1, B_2, BB,	He
12	*Daucus carota* L.	Carrot	B_1, B_2, SB	He
13	*Petroselinum crispum*(Mill.) Fuss	Percely	B_1, B_2, BB,	He
Apocynaceae				
14	*Asystasia vogiliana*	Blood medicine	B_1, B_2, BB, SB	He
15	*Catharanthus roseus* (L.) G.Don	Periwinkle	B_2	Ch
Araceae				
16	*Colocasia esculenta* (L.) Schott	Ibo cocoyam	B_1, B_2, BB, SB	Cr
17	*Caladium bicolor*	Jonny waka	BB	He
18	*Xanthosoma sagittifolium* (L.) schott	Macabo cocoyam	B_1, B_2, BB, SB	Cr
19	*Xanthosoma* nigrum L.	Metang Cocoyam	B_1, B_2, BB, SB	Cr
Arecaceae				
20	*Roystonea regia* O.F. Cook.	Royal palm	B_1, B_2, BB	Ph
21	*Elaeis guineensis* Jacq.	Palm oil tree	B_1, B_2, BB,	Ph
22	*Raphia africana* Otedoh	Raphia palm	B_1, B_2, BB, SB	He
Asparagaceae				
23	*Dracaena diesteliana* Engl.	Peace plant	B_1, B_2, BB, SB	He
24	*Aloe vera* (L.) Burm.f.	Aloe vera	B_1, B_2, BB, SB	Cr
Asteraceae				
25	*Achillea millefolium* L.	Yaro	B_1, B_2	He
26	*Ageratum conyzoides* Linn.	King grass	SB	Th
27	*Bidens pilosa* (Blume.) Sherff.	Black jack	B_1	Th
28	*Chromolaena odorata* (Linn.) King	Ancha cazara	B_1, B_2	Ch
29	*Emilia coccinea* (Sims.) G.Don,	Emilia	BB	He
30	*Helianthus annuus* L.	Sunflower	SB	Th
31	*Taraxacum officinale* (L.) Weber ex F.H. Wigg	Dandelion	B_2	Ch
32	*Vernonia amygdalina* Delile	Bitter leaf	B_1, B_2, BB, SB	Ph
33	*Zinnia angustifolia* Kunth	Zinia	B_1	Th

Bignoniaceae				
34	*Crescentia cujete* L.	Calabash tree	B_2	Ph
Brassicaceae				
35	*Alyssum maritimum*(L.) Desv.	Alysium	B_1	Th
36	*Brassica juncea* (L.) Czern	Chinese cabbage	B_1, BB, SB	Th
37	*Brassica oleraceae* L.	Brocolli	B_1	Th
38	*Brassica oleraceae* L.	Cabbage	B_1, B_2, SB	Th
39	*Brassica* sp.	Kale	B_1,	Th
40	*Lepidium sativum* L.	Water crest	B_1	Cr
Bromeliaceae				
41	*Ananas comosus* (L.) Merr.	Pineapple	B_1, B_2, BB, SB	Cr
Burseraceae				
42	*Canarium schweinfurthii* L.	Black tree	B_1, B_2, SB	Ph
43	*Dacryodes edulis* Eng.	Plum	B_1, B_2, BB, SB	Ph
Caricaceae				
44	*Carica papaya* Linn.	Pawpaw	B_1, B_2, BB, SB	Ph
Casuarinaceae				
45	*Casuarina equisetifolia* L.	Whispering pine	SB	Ph
Combretaceae				
46	*Terminalia mantaly* H. Perrier	Terminalia	B_2	Ph
Commelinaceae				
47	*Commelina benghalensis L.*	Benghal day flower	B_1, B_2, BB	Ch
48	*Commelina* sp.	Red Commelina	B_1	Ch
49	*Tradescantia pallida* (Rose) D.R. Hunt	Tradescantia	BB	Ch
Convolvulaceae				
50	*Ipomoea batatas* (L.) Lam.	Sweet potato	B_1, B_2, BB, SB	Th
51	*Ipomoea nil* (L.) Roth	Morning glory	BB	Th
Cucurbitaceae				
52	*Citrullus vulgaris* Schrad	Water melon	B_1, B_2, BB, SB	Th
53	*Cucumis sativas* L.	Cucumber	B_1	Th
54	*Cucurbita maxima* Duchesne	Pumpkin	B_1, B_2, BB, SB	Th
55	*Cucurbita pepo* L.	Zokini	B_1	Th
56	*Lactuca sativa* L.	Lettuce	B_1	Th
57	*Telfairia occidentalis* Hook.f. H. perrier	Okongabong	B_1, B_2, BB, SB	Th
Cupressaceae				
58	*Pilgerodendron uviferum* (D.Don)	Guaitecas cypress	SB	Ph
Dioscoreaceae				
59	*Dioscorea esculenta* (Lour.) Burkill	Sweet yam	B_1, B_2, BB, SB	Cr
60	*Dioscorea bulbifera* L.	Aerial yam	B_1, B_2, SB	Ph
61	*Dioscorea cayenensis* Lam.	Yellow yam	B_1, B_2, BB	Cr
62	*Dioscorea rotundata* (Poir.) J.Miege	White yam	B_1, B_2, BB	Cr
Euphorbiaceae				
63	*Acalypha Ceylon* Mull.Arg.	Acalypha	B_2	Ph
64	*Euphorbia hirta* Linn.	Euphorbia	B_1	Th
65	*Manihot esculenta* Crantz.	Cassava	B_1, B_2, BB, SB	Cr
66	*Ricinodendron heudelotii* (Baill.) Heckel	Njangsa	BB	Ph
67	*Ricinus communis* L.	Castor oil plant	B_1, B_2, BB, SB	Ph
Fabaceae				
68	*Albizia lebbeck* (L.) Benth.	Beans tree	B_1, B_2	Ph
69	*Arachis hypogaea* L.	Groundnut	B_1, B_2, BB, SB	Th
70	*Arachis pintoi* Krapov. & W.C. Gregory	Pinto Peanut	B_2, SB	He
71	*Calliandra surriniamensis* Benth.	Calliandra	B_1, B_2	Ph
72	*Desmodium uncinatum* (Jacq.) Kuntze	Desmodium	BB	Th
73	*Glycine max* (L.) Merr.	Soya beans	B_1	Th
74	*Phaseolus vulgaris* L.	Beans	B_1, B_2, BB, SB	Th
75	*Phaseolus* sp.	Green beans	B_1, BB	Th
76	*Vigna unguiculata* (L.) Walp.	Cowpea	B_1, B_2, BB, SB	Th
Huaceae				
77	*Afrostyrax lepidophyllus* Mildbr.	Country onion	SB	Ph
Lamiaceae				
78	*Mentha piperita* L.	Pepper mint	B_1	Th
79	*Mentha spicata* L.	Mint	B_1	Th
80	*Ocimium bacilucum* L.	Cutmanjo	B_1, B_2, BB, SB	Th
81	*Ocimum gratissimum* L.	Masopo	B_1, B_2, BB, SB	Ch
82	*Rosmarinus officinalis* L.	Rosemary	B_1, B_2, BB	Th
Lauraceae				
83	*Persea americana* Mill.	Pear tree	B_1, B_2, BB, SB	Ph

Liliaceae				
84	*Crinum* cf. *powellii* hort. ex Baker	Harmattan lily	B_1	Cr
Malvaceae				
85	*Abelmoschus esculentus* (L.)Moench	Okra	B_1, B_2, BB	Th
86	*Hibiscus mechowii* Garcke	Folere	B_1, B_2, BB, SB	Th
87	*Hibiscus rosa-sinensis* L.	Hibiscus	B_1, BB, SB	Ph
88	*Sterculia quadrifida* R.Br	Groundnut tree	B_2, SB	Ph
89	*Triumfetta* sp.	Nkwi	B_1, B_2, BB, SB	He
Moraceae				
90	*Ficus carica* L.	Fig tree	B_1, B_2, BB, SB	Ph
Moringaceae				
91	*Moringa oleifera* Lam.	Moringa	B_1	Ph
Musaceae				
92	*Musa sapientum* L.	Plantain	B_1, B_2, BB, SB	Cr
93	*Musa paradisiaca* Walker &Sillans.	Banana	B_1, B_2, BB, SB	Cr
Myrtaceae				
94	*Psidium guajava* L.	Guava	B_1, B_2, BB, SB	Ph
95	*Callistemon viminalis* (Sol. exGaertn.)	Bottle brush	B_1, B_2, BB, SB	Ph
96	*Eucalyptus globulus* Labill.	Eucalyptus	B_1, B_2, BB, SB	Ph
Nyctaginaceae				
97	*Bougainvillea spectabilis* Willd.	Bourgainvilla	B_1	Ph
Passifloraceae				
98	*Passiflora edulis* Sim.	Adam fruit	B_2, BB	Ph
Pinaceae				
99	*Pinus kesiya* Royle ex Gordon	Khasi pine	B_1, B_2, BB, SB	Ph
Poaceae				
100	*Cymbopogon citratus* (D.C) Stapf.	Fever grass	B_1, B_2, BB, SB	He
101	*Cynodon dactylon* (L.) Pers.	Carpet grass	B_1, B_2, BB, SB	He
102	*Saccharum officinarum* L.	Sugar cane	B_1, B_2, BB, SB	He
103	*Zea mays* L.	Maize	B_1, B_2, BB, SB	Th
Portulacaceae				
104	*Talinum triangulare* (Jacq.) Willd.	Water leaf	B_1, B_2, BB, SB	Th
Rhamnaceae				
105	*Ziziphus mauritiana* Lam.	Chinese apple	B_1, B_2, SB	Ph
Rosaceae				
106	*Alchemillia vulgaris* L.	Ladies herb	B_1	Ch
107	*Fragaria* sp.	Berry	B_1, B_2, BB, SB	Ch
108	*Prunus africana* (Hook.f.) Kalkman	Planticam	SB	Ph
109	*Rosa sinensis* L.	Chinese rose	B_1	Ph
110	*Rosa sinensis* L.	Rose plant	B_1, B_2, BB	Ph
Rubiaceae				
111	*Coffee arabica* L.	Coffee	B_1, B_2, BB, SB	Ph
Rutaceae				
112	*Citrus aurantiifolia* (Christm.) Swingle	Lime tree	B_1, B_2, BB, SB	Ph
113	*Citrus lemon* (L.) Burn. F.	Lemon tree	B_1, B_2, BB, SB	Ph
114	*Citrus sinensis* (L.) Osbeck	Orange	B_1, B_2, BB, SB	Ph
Solanaceae				
115	*Brugmansia arborea* L.	Trumpet plant	BB, SB	Ph
116	*Capsicum annuum* L.	Pepper	B_1, B_2, BB, SB	Th
117	*Capsicum* sp. L.	Sweet pepper	B_2,	Th
118	*Cestrum nocturnum* L.	Queen of the night	B_1, B_2, BB, SB	Ch
119	*Cyphomandra betacea* (Cav.) Sendtn	Tree tomato	B_1, B_2	Ph
120	*Lycopersicon esculentum* Mill.	Tomato	B_1, B_2, BB	Th
121	*Nicotiana tabaccum* L.	Tobacco	B_1, BB, SB	Th
122	*Physalis alkekengi* L.	Chinese latin	B_1	Th
123	*Solanum melongena* L.	Garden egg	B_1, B_2, BB, SB	Th
124	*Solanum nigrum* L.	Huckleberry	B_1, B_2, BB, SB	Th
125	*Solanum tuberosum* L.	Irish potato	B_1, B_2, BB, SB	Th
126	*Solanum* sp.	Anchia	B_1, B_2, BB, SB	Th
Sterculiaceae				
127	*Cola acuminate* (P. Beauv.) Schott	Colanut tree	B_1, B_2, BB, SB	Ph
128	*Theobroma cacao* L.	Cocoa	BB	Ph
Verbenaceae				
129	*Duranta repens* L.	Yellow bush	B_1, B_2, BB, SB	Ph
130	*Duranta erecta* L.	White Duranta	B_1, B_2, BB, SB	Ph
131	*Lantana camara* L.	Lantana	B_1, B_2, BB, SB	Ph
132	*Vitex diversifolia* Kurz ex C.B. Clarke	Vitex	B_2	Ph

Zingiberaceae				
133	*Zingiber officinale* Roscoe.	Ginger	B_2, BB	Cr

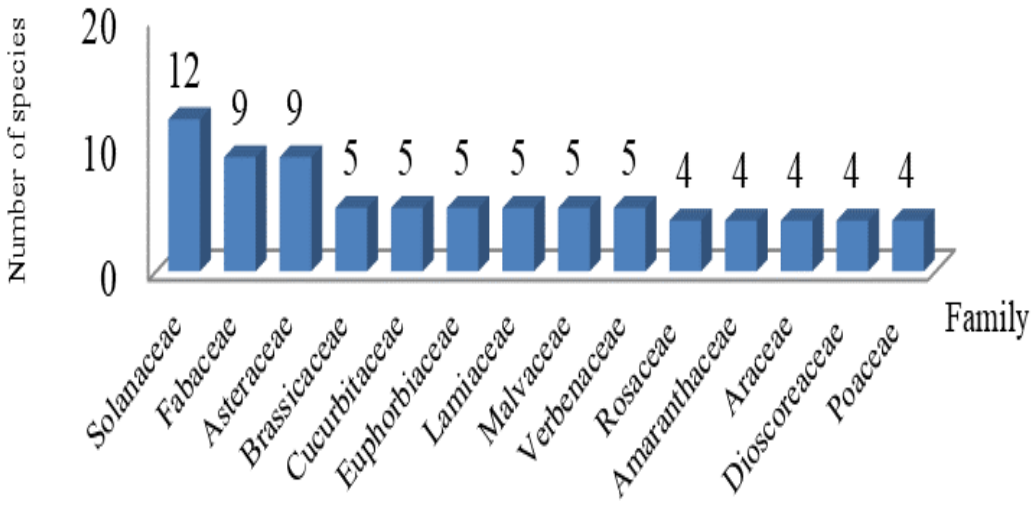

Figure 2. Top family diversity of useful plant species in the home gardens in Tubah Sub-Division

3.2. Variation of taxonomic indices in Tubah Sub-Division

The number of species varied between 73 and 106 plants species in Small Babanki and Bambili respectively; this was also the case with the number of genera and family (Table 2). The lowest number of plants per home garden was recorded in Small Babanki (7), while the highest was obtained in Bambui (55). The genera represented by the highest number of species in the Sub-Division in general and almost all villages were *Dioscorea, Solanum* (4 species) and *Citrus* (3 species).

In all the 4 localities the GDI was superior to 1 but inferior to 2 demonstrating that the majority of genera were represented by only one species. Bambui had the highest ratio and Small Babanki the lowest. The Shannon index (H´) in Tubah Sub-Division ranges from 1.6 in Small Babanki to 2.8 in Bambili while Simpson index (D) ranges from 0.09 to 0.19, with Bambui having the highest value and Bambili the smallest. The Shannon indices fall within the range of the mean reported in home gardens of the tropics which ranges from 0.93 in rural Zambia to almost 3.0 in West Java, Indonesia [4].

Table 2. Some parameter of taxonomic diversity of useful plants of Tubah home gardens

	Bambili	Bambui	Big Babanki	Small Babanki	Whole subdivision
Number of species	106	94	84	73	133
Number of genera	86	76	68	61	108
Number of family	43	43	39	39	47
Genera diversity index (GDI)	1.23	1.25	1.24	1.20	1.23
*Variation of number of species /HG	18 –*28* ± *7*– 52	17 – *29* ± *8*– 56	12 – *23* ± *6* – 35	8 – *20* ± *6* – 31	14 –*25* ± *7*– 44
Percentage of species in the Sub-Division	78%	69.3%	62%	54%	65.8%
Shannon index (H´)	2.8	2.4	2.6	1.6	2.35
Simpson index (D)	0.09	0.19	0.14	0.12	0.14

*lowest number of species, mean, standard deviation and highest number of species per home garden

According to these results, Bambili and Bambui villages that are more urbanized due to the presence of many national higher learning institutions and administrative structures had respectively the highest taxonomic diversity than Small Babanki and Big Babanki that are more rural villages. This seems logical, given the tendency to optimize land use through intensification, as a result of transformation of agricultural lands to other uses. Such domination of useful plant diversity in more urbanized areas than less urbanized were also observed in the Coastal quilombola communities of Santa Catarina in Brazil [34]. In addition, as Bambili and Bambui are urbanizing rural areas, the agglomeration of people from various areas there can contribute to the enrichment of the useful plant diversity with introduction of exotic species. It has been observed that, in the process of urbanization, exotic plants are widely introduced [35]. The lowest taxonomic diversity in more rural areas in this study could also be due to the massive cultivation of few plant species for generation of income as it is known that, lower diversity and simplification in many home gardens result from intensive crop production for generating income [36,11, 37].

3.3. Similarity of useful plant species among villages

The Soreson similarity coefficient among the 4 villages varies between 68.5% - 80% respectively between Bambili/Small Babanki and Bambui/Big Babanki (Table 3). As the similarity values among the localities of the Sub-Division are greater than 50%, it can be concluded that communities of the Sub-Division are cultivating similar useful plants in their home gardens due to their closeness. In Yucatan Peninsula (Mexico), it was also found that floristic composition of useful plants in home gardens was relatively similar within closed localities, but varied among distant regions [38].

Table 3: Soreson similarity coefficient among villages

	Bambili	Bambui	Big Babanki	Small Babanki
Bambili	100			
Bambui	72.3	100		
Big Babanki	72.9	80	100	
Small Babanki	68.5	71	73	100

3.4. Life forms of useful plant species in home gardens of Tubah Sub-Division

All the five life form classes of Raunkiaer were found among the useful plant species identified. The Phanerophytes were the majority and the Chamaephytes were the minority (Figure 3). Phanerophytes and Therophytes dominating as trees, shrubs and annual plants are generally the most common source of food and medicines. Hence, the dominance of these two classes is commonly observed in home garden all over the world [22]. Even though home gardens are not more natural ecosystems, the Phanerophytes are still the dominant life form as reported by Raunkiaer in natural ecosystem. The dominance of Therophytes (33%) on the Hemicryptophytes (10%) is evidence that anthropogenic activities had caused Tubah to be under heavy biotic pressure as reported by Barbero *et al* [39]. Hence, it will be necessary to think about conservation strategies while developing gardening activities here.

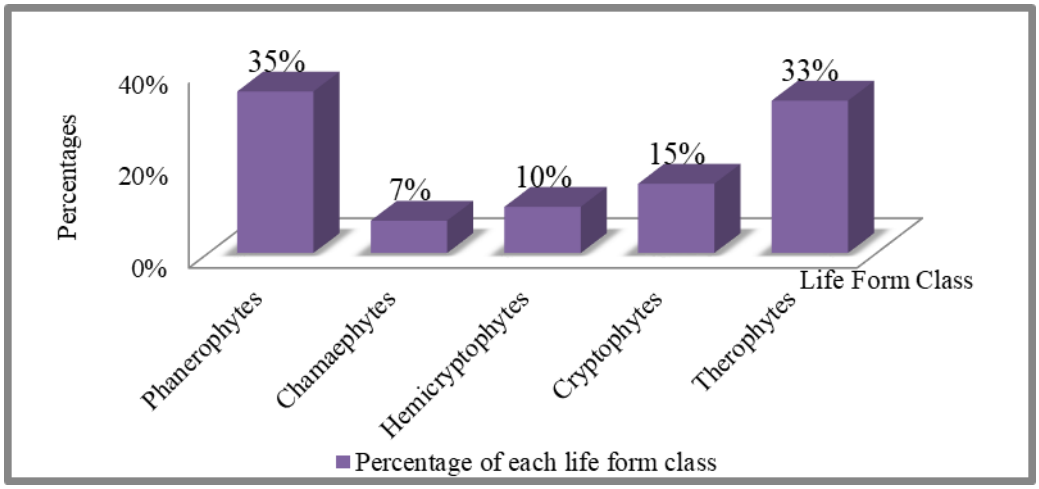

Figure 3. Raunkiaer's biological spectrum of life form plant species classes in home garden in Tubah Sub-Division

3.5. Frequency of distribution of useful plant species

The frequency of distribution of species within villages and in the whole of Tubah Sub-Division is presented in Table 1. It showed that across the different villages, the plant frequency were different. Among the species 36 were found in all the 4 villages while 45 were reported exclusively in home gardens of one village with 37 found in only 1/120 home gardens. Bambili recorded the highest number of such exclusive species with 24 species. The first five most widely distributed plants species in home gardens of Tubah Sub-Division were *Musa sapientum* (97.5%), *Zea mays* (95.9%), *Phaseolus vulgaris* (90.8%), *Vernonia amygdalina* (87.4%) and *Musa paradisiaca* (86.7%). These plants species are the component of the main local traditional food; they are widely cultivated primarily for household nutrition. The same set of crops was also found to be the most frequent in home gardens of Galim-Tignere in the Adamawa region of Cameroon [33]. The number of species per frequency class is presented in Figure 4. It reveals that the frequency class distribution analysis presented in Figure 4 has a double reversed J shaped curve with Class A > Class B < Class C > Class D < Class E respectively. This indicated that the community of useful plant of Tubah HG is relatively homogenous. It was found that in Lauris in the Provence- Alpes- Côte d'Azur region in France, most of the taxa in home gardens have low frequency [40]. Here class A consist of 98 plant species, with species like *Ageratum conizoides, Bidens pilosa, Chromoleana odorata, Commelina benghalensis, Emilia coccinea* and *Euphorbia hirta* that are common local medicinal grasses were cited by few tenants. Hence, this shows that despite their commonness in the area, these species are of interest for some members of communities. Also, it should be noticed that *C. odorata* is considered in Cameroon as an invasive species [41]. Frequency class B constitutes 12 species including *Aloe vera, Amaranthus dubius* and *Solanum nigrum.* Frequency class C consist of 19 species such as *Capsicum annuum, Carica papaya, Duranta repens, Mangifera indica* and *Psidium guajava.* In the frequency class D, it constitutes 3 useful plant species which are *Colocasia esculenta, Persea americana, Saccharum officinarum* while frequency class E constitutes 5 useful plant species for example *Musa sapientum, Musa paradisiaca, Phaseolus vulgaris, Vernonia amygdalina* and *Zea mays.*

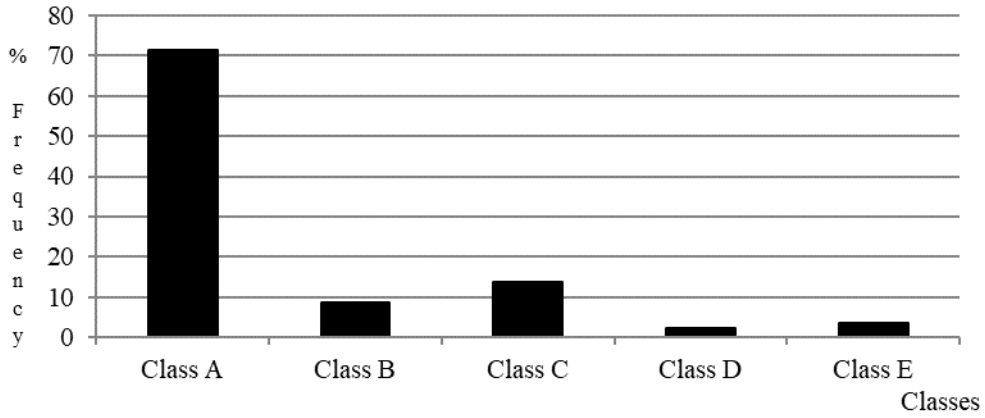

Figure 4: Raunkiaer's percentage frequency class of useful plant species in home gardens in Tubah Sub-Division

3.6. Key factors influencing plant species diversity and richness of home gardens

The study revealed an R Square value of 0.251 (coefficient of determination) as seen in Table 4 below which implied that the model could only explain 25.1% of the variables that influence plant species diversity in home gardens of Tubah Sub-Division. As presented in Table 5, two factors were influential to plant diversity in home gardens: namely the age of the home garden (Beta = 0.081, p = 0.683) and the age of the garden head (Beta = 0.028, p = 0.890). This was supported in the field as the mean number of plant species in the oldest home garden and oldest home garden owner were greater than that of the youngest home garden and youngest home garden owner respectively (Table 6). Interestingly the sex of the household head negatively but significantly influenced plant diversity in home gardens (Beta = -0.306, p = 0.041). In other words, home gardens managed by male household heads demonstrated less plant diversity than those of female household heads. This result tends to suggest that in their effort to produce for home consumption and for the market, female household heads who are generally largely responsible for feeding their families tend to diversity the choices of plants, to meet both home consumption and market needs, compared to men, who are likely to be more income oriented. This result whose tendency has been previously mentioned in other research in the Northwest Region of Cameroon [42] seems to put women in the forefront in increasing plant species diversity in Tubah Sub-Division.

This corroborates with the finding of Coomes and Ban and Quiroz *et al*. who also reported that home garden characteristics like age, influence diversity, species richness and abundance of plants grown in home gardens [43, 44]. It has been reported over time, there are accumulation of species in older home gardens resulting to higher diversity and species richness with suitable conditions for growing more species [45, 46]. However, it is necessary to mention that other variables like function, level of education and social status of the HG owner influence plant diversity and richness in home gardens [25]. Hence, it is necessary to also investigate on other parameters in order to know more about the factors that affect plant diversity in the study area.

Table 4. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.501[a]	0.251	0.126	7.608

Table 5: Regression coefficients of putative influential factors on plant diversity in home gardens in Tubah Sub-Division

Model	Un Std Coefficients		Std Coefficients		
	B	Std. Error	Beta	t-test	P-value
(Constant)	41.662	8.103		5.142	0.000
Age of garden head	0.018	0.126	0.028	0.140	0.890
Garden area	-0.589	1.406	-0.062	-0.419	0.677
Age of garden	0.042	0.102	0.081	0.411	0.683
Income from garden	-1.149	0.000	-0.157	-0.964	0.341
Number of use categories	-4.292	2.575	-0.266	-1.667	0.103
Sex	-5.616	2.662	-0.306	-2.110	0.041
Household size	-0.401	0.285	-0.217	-1.407	0.167

Table 6. Variation of the number of species according to some factors influencing the diversity of useful plant species in home garden in Tubah

Variables	Number of species				
	Bambili	Bambui	Big Babanki	Small Babanki	Mean
Oldest HG	31	24	22	24	25
Youngest HG	32	30	20	16	24
Oldest HG owner	29	28	29	25	27
Youngest HG owner	19	31	22	17	22

4. Conclusion

This study gives an overview of the plant diversity in home gardens of Tubah Sub-Division with urbanizing areas (Bambili and Bambui villages) that are richer than rural areas (Big Babanki and Small Babanki). The higher number and diversity of the useful species in home gardens, demonstrate the importance of this agricultural system to the local community. The most frequent plant species in home gardens of Tubah Sub-Division were maize, beans and plantain which served as food. The study also revealed that, the age of the household head and the age of the home garden were the key factors which significantly influenced the plant diversity in these home gardens. Moreover, the number and diversity of plant species in these home gardens suggest that agricultural systems are important in the promotion and conservation of agrobiodiversity in Tubah Sub-Division. Hence, it is important to investigate on their management in this area. Also, it will be interesting to extend the study to other parts of North West Region and even the whole of the Western Highland of Cameroon.

Acknowledgements

The authors are grateful to the home garden owners for sacrificing their time and knowledge, thus making this study possible.

Conflict of Interest

The authors declare that they have no conflict of interest

Reference

1. Odebode OS. Assessment of home gardening as a potential source of household income in Akinyele Local Government Area of Oyo State. Nigeria J Horti Sci. 2006, 2:47-55. DOI:10.4314/NJHS.V11I1.3398
2. Kumar BM, Nair PKR. Tropical Home Gardens: A Time-Tested Example of Sustainable Agroforestry. India: Environmental Experts. 2006.
3. FAO [Food and Agriculture Organization of the United Nations]. What is agrobiodiversity? In: Building on gender, agrobiodiversity and local knowledge. FAO. 2004.
4. Karyono. Home gardens in Java: their structure and functions. In: Landauer K, Brazil M. (eds.): Tropical Home gardens. Tokyo, Japan, United Nations University Press. 1990, 138-146.
5. Concepción ED, Moretti M, Altermatt F, Nobis PM, Obrist KM. Impacts of urbanisation on biodiversity: the role of species mobility, degree of specialisation and spatial scale. Oikos. 2015, 124: 1571–1582. doi.org/10.1111/oik.02166
6. Mapongmetsem PM, Nkongmeneck BA, Alexandre YD, Salbai A, Haoua M. Jardins de case et sécurité alimentaire dans les savanes soudano-guinéennes (Adamaoua, Cameroun). Com. Sympo. Méga-Tchad. 2002.
7. Akrofi SPC, Struik, Price LL. Interactive effects of HIV/AIDS and household headship determine home garden diversity in the Eastern Region of Ghana, NJAS–Wageningen. J Life Sci. 2008, 56(3):201–217. doi:10.1016/S1573-5214(08)80008-5
8. Balooni K, Gangopadhyay K, Kumar BM. Governance for private green spaces in a growing Indian city. Landscape and Urban Planning. 2014, 123:21–29. doi:10.1016/j.landurbplan.2013.12.004
9. Asongwe GA, Yerima BPK, Tening SA. Vegetable Production and the Livelihood of Farmers in Bamenda Municipality, Cameroon. Int J Curr Microbiol App Sci. 2014, 3(12): 682-700.
10. Njoh BD, Feldt T, Seeger C *et al*., Urban and Peri-Urban Agriculture in Bamenda: A Policy Narrative. SHUMAS UrbanFood^{Plus} RUAF Foundation and the Bamenda Multi-Stakeholder Platform. 2018.
11. Peyre A, Guidal A, Wiersum KF, Bongers F. Dynamics of home garden structure and function in Kerala, India. AgroforestrySystems, 2006, 66:101–115.
12. Focho DA, Nkeng EAP, Fonge BA, Fongod CN, Muh TWN, Afegenui A. Diversity of plants used to treat respiratory diseases in Tubah North West Region, Cameroon. Afr J Pharm Pharmacol. 2009, 3(11):573-580.
13. Tsitoh P, Bechem EET. Floristic Diversity, Distribution and Analysis of Forest Cover Change in the Kedjom Keku Forest, NW Cameroon. Open J Ecol. 2019, 9: 273-292.
14. Ndenecho EN. Implications of Fuel Wood Yield, Availability and Harvest in Tubah Mountain Forest, Cameroon. Glob J Hum Soc Sci. 2009, 10: 49-55.
15. Yuninui NM. Initiation practical report on Bambili Village. Research report, Regional College of Agriculture, Bambili. Cameroon. 1990, p.45.doi.org/10.1111/oik.02166
16. Martin GJ, *Ethnobotany: A people and plants' conservation manual.* London: Chapman & Hall. 1995.
17. Alexiades MN, Sheldon JW. Selected guidelines for ethnobotanical research: A field manual. New York: The New York Botanical Garden Press**.** 1996.
18. Latham P. Useful plants of bas-Congo province, democratic republic of Congo. Second edition. Congo: Paul L. 2004.
19. Perez RJA. Flore exotique des iles canaries. Deuxieme edition. Imprime en Espagnes. 2003.
20. Tynsong H, Tiwari BK. Plant Diversity in the Home gardens and their Significance in the Livelihoods of War Khasi Community of Meghalaya, North-east India. J Biodivers. 2010, 1(1): 1-11. doi.org/10.1080/09766901.2010.11884713
21. Evrad C. Recherches écologiques sur le peuplement forestier des sols hydromorphes de la Cuvette central congloaise. Institute pour l'étudeagronomique du Congo.1968.
22. Raunkiaer C. The Life form of Plants and Statistical Plant Geography. The Clarendon Press, Oxford. 1934.
23. Shannon CE, Wiener W. The Mathematical Theory of Communication. Urbana: University Illinois Press. 1963.
24. Sorensen T. A method of establishing groups of equal amplitude in plant sociology based on similarity of species content, Biological Science, 1948, 5: 1-34.
25. Panyadee P, Henrik B, Prasit W, Angkhana L. Woody Plant Diversity in Urban Home gardens in Northern Thailand. Economic Botany. 2016, 70(3):285-302. doi.org/10.1007/s12231-016-9348-9
26. Mapongmetsem PM, Diédhio L, Constant P, Layaida N, Wérémé A, Alexandre DY. Situation et dynamique des jardins de case en Asie du Sud -Est : cas de la province de kandal (Cambodge). In:Mbofung CM, Etoa F.X (eds) Proceed Bioscience. 2000, 7:396-402.
27. Shukla G, Vineeta, Anjali K, Chakravarty S. Plant diversity, structure and uses of the plants in home garden of Jharkhand, India. Indian J Trop Biodivers. 2017, 25(1): 40-50.
28. Mekonnen EL, Asfaw Z, Zewudie S. Plant species diversity of homegarden agroforestry in Jabithenan District, North-Western Ethiopia. Int J Biodivers Conserv. 2014, 301-307. doi.org/10.5897/IJBC2013.0677
29. Reta R. Useful plant species diversity in home gardens and its contribution to household food security in Hawassa city, Ethiopia. Afr J Plant Sci. 2016, 10(10):211-233. doi:10.5897/AJPS2016.1439
30. Kebebew M. Diversity and Management of Useful Homegardens Plant Species in Arba Minch Town, Southern Ethiopia: Implication for Plant Diversity Conservation and Food Security. Int J Econ Plants. 2018, 5(3):137-148.
31. Pamungkas RN, Hakim L. Ethnobotanical investment to conserve home garden species of plants in Tambakrejo,

Sumbermanjing Wetan, Southern of Malang. J Trop Life Sci. 2013, 3 (2): 96-103.
32. Mapongmetsem P, Etchiké MD, Ngassoum MB. Conservation et valorisation de la biodiversité dans les agroforêts de la zone périurbaine de la ville Bafia (Région du Centre au Cameroun) Revue Scientifique et Technique Forêt et Environnement du Bassin du Congo. 2016, 6:60-69.
33. Hamawa Y, Mapongmetsem PM. Crops diversity and typology of home gardens of Galim- Tignere (Adamawa, Cameroon). Int J Agrofor Silvicul. 2018, 6 (2):343-353.
34. Ávila JVC, Mello AS, Beretta ME, Trevisan R, Fiaschi P, Hanazaki N. Agrobiodiversity and in situ conservation in quilombola home gardens with different intensities of urbanization. Acta Botanica Brasilica. 2017, 31(1): 1-10. doi.org/10.1590/0102
35. McKinney ML. Urbanization, Biodiversity and Conservation. Biological Science. 2002, 52(10):883-890.doi.org/10.1641/0006-3568(2002)052[0883:UBAC]2.0.CO;2
36. Nair PKR. Whither home gardens? In: Kumar BM, Nair PKR. (eds). Tropical home gardens: a time-tested example of sustainable agroforestry, Dordrecht: Springer Science. 2006, 355–370.
37. Wiersum KF. Diversity and change in home garden cultivation in Indonesia. In: Kumar BM, Nair PKR. (eds.), Tropical home gardens: A time-tested example of sustainable agroforestry. Springer, Netherlands. 2006, 3:13-24.
38. Caballero J. Maya home gardens: Past, present and future. Etnoecológica. 1992, 1:35-54.
39. Barbero M, Bonin G, Loisel R, Quzel P. Changes and disturbance of forest ecosystems caused by human activities in the western part of the Meditterranean basin. Vegetation. 1990, 87: 151-173.
40. Marco A, Dutoit T, Deschamps-Cottin M, Mauffrey J-F, Vennetier M, Bertaudière-Montes V. Gardens in urbanizing rural areas reveal an unexpected floral diversity related to housing density. CR Biologies 2008, 331: 452–465.
41. Tchiengue B, Neumann K, Wittig R, Becker U. *Chromolaena odorata* thickets in forest recovery in southern Cameroon. Scripta Botanica Belgica. 2013, 50: 121-129.
42. Balgah RA. A gender analysis of vulnerability to climate-related food shortages in developing countries. The case of Cameroon, Int J Dev Res. 2017, 7(9): 15065-15074.
43. Coomes OT, Ban N. Cultivated plant species diversity in home gardens of an Amazonian peasant village in northeastern Peru. Economic Botany. 2004, 59:420-434.
44. Quiroz C, Gutiérrez M, Rodríguez D et al. Home gardens and insitu conservation of agrobiodiversiy-Venezuelan component. In: J.W. Watson & Eyzaguirre P. (eds). 17-19 July 2001: Second International Home Garden Workshop, Witzenhausen, Germany, International Plant Genetic Resources Institute (IPGRI). 2001; 73-82. doi:10.1023/A:1023973623247
45. Bannister ME, Nair PKR. Agroforestry adoption in Haiti: The importance of household and farm characteristics. Agroforestry Systems, 2003, 57(2):149-157.
46. Blanckaert L, Swennen R, Paredes-Flores M, Rosas LR, Lira-Saade R. Florstic composition, plant uses and management practices in home gardens of San Rafael Coxcatlán, valley of Tehuacán-Cuicatlán, Mexico. J Arid Environ. 2004, 57:179-202.

Recommended Citation

Wujung L. J. M., Azibo R. B., Ndam W. T., Fungwa S. F., Forchu M. S., Njouonkou A.L. Plant-Based Agrobiodiversity In Home Gardens Of Tubah Sub-Division, North-West Region, Cameroon. *Alger. j. biosciences.* 2022, 03(01):005-018.