Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 8, No. 3, p. 22-45, 2016
http://www.innspub.net

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RESEARCH PAPER OPEN ACCESS

Biodiversity of woody species and their utilization in a Savannah ecological zone of Northern Ghana

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Article published on March 16, 2016

Key words: Community, Woody species, Uses, Species diversity, Management.

Abstract

Biodiversity composition and usage is fundamental to human existence. We aim in this study to: profile and estimate woody species diversity, identify their preferences, uses and assess local communities' perception on species dominance, density, disturbance and options for biodiversity management. The research employed quantitative and qualitative survey methods. Semi-structured questionnaires, interviews and focus group discussions were used for data collection. Stratified random sampling aided selection of study plots using 10m × 10m quadrat in four major LUs. The Sorenson index aided species similarity levels assessment. Family Importance Value used to determine most important plant families. The Shannon-Weiner Diversity and Evenness index were used to determine species diversity and evenness. Pearson Correlation Coefficient helped establish correlation among dominant, preferred, disturbed species. A total of 66 woody plant species belonging to 26 families and 54 genera were identified. Trend of high species diversity was found in; sacred groves followed by fallow fields, grazed open fields and cultivated fields. Reduction in species densities over the last decade was widely cited as reasons for this trend. Strong significant differences between dominant and preferred species were observed in Kpalgun ($r=0.92$, $p<0.01$), Cheshegu ($r=0.90$, $p<0.01$), Zagua ($r=0.89$, $p<0.01$), Daboshie ($r=0.98$, $p<0.01$) and Fihini ($r=0.79$, $p<0.01$). Most common species uses are food, fuel, income, medicine and construction. In Tolon district, biodiversity management is through enforcement of traditional norms and taboos; though bush fires and species exploitation affect sustainable biodiversity management. The study highlights rarity and commonness of plant species distribution in rarely assessed Savannah Ecological zone.

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Introduction

Beginning from the Pleistocene to the Anthropocene era (Ellis *et al.*, 2013), the rise and expansion of human populations has long not been par with use of environmental resources. Biodiversity from time immemorial, forms an important and basic component of human existence (Norris *et al.,* 2010). As such, its manner of use determines the nexus between humans and their environment. Regardless of the location, biodiversity provides food, fuel, income and a range of ecosystem services for over 200 million of people especially rural households in Africa (Norris *et al.*, 2010). Since biological diversity provides tremendous socio-economic value to present and future generations, continuous management of these resources is required for human wellbeing and environmental sustainability (UN Millennium Report, 2006). The need for the sustainable use and management of these resources have gained attention of the international community since the "Convention on Biological Diversity (CBD)" was adopted at the 1992 Earth Summit in Rio de Janeiro (UNCED, 1992). The savannah zone of Ghana has the most dominant vegetation type covering about 60% of the country's total landmass while serving as livelihood source for about 30% of the population (Yaro, 2008).

Research has shown that rural folks in Northern Ghana heavily depend on the vegetation around them for food, fuelwood, income, medicine, spiritual protection and a host of ecosystem services (Ziblim *et al.*, 2013). The WHO (World Health Organisation 1999; 2002) estimates that about 60% of the world's population depends on traditional medicines for their primary healthcare which are extensively incorporated into the public health system of most traditional and indigenous societies. In certain parts of Ghana, Mali, Nigeria and Zambia, the use of herbal medicine at home remains the first line of treatment for children suffering from malaria (WHO, 2003). In Ghana and other areas around the globe, biodiversity does not only enhance household level food security but provides supplementary income in times of crop failure and drought while reducing household vulnerability and enhancing their capacity to change (Dovie, 2003).

Despite the beneficial role biodiversity plays in human lives, research has shown that widespread poverty, illiteracy and hunger compel most rural populations to exploit natural resources unsustainably for survival (World Bank, 1999). In Ghana a report by the Ministry of Environment Science Technology and Innovation (MESTI, 2011) showed that insurmountable pressure placed on biodiversity is leading to reduction in species composition, dispersion and distribution while affecting ecosystem functions and services. Such disturbance according to McCabe and Gotelli (2000) plays a critical role in determining the species diversity and abundance in an ecosystem.

In some parts of Northern Ghana, evidence suggest that unsustainable land use practices such as reduction in fallow periods, extension of cropping into agriculturally marginal areas, fragmentation of agricultural holdings and slash and burn farming method has rendered large tracts of croplands unproductive (Gyasi and Gordana, 2006). This coupled with high population growth in rural and urban areas have contributed to low income from agricultural activity, food shortage and loss of biological species due to encroachment on reserved areas and sacred groves (Dorm-Adjobu *et al.*, 1991; Blench, 2004). Bushfires in recent years have accelerated environmental degradation in Northern Ghana causing reduction in vegetation cover and destruction of wild life habitats in the fragile savannah ecosystems (Kusimi and Appati, 2012).

In addition to these social and economic pressures, the adoption of "Western civilization and religion" has led to the erosion of traditional knowledge and belief systems that hitherto support natural resource management (Dorm-Adjobu *et al.*, 1991; Ntiamoa-Baidu, 1995). For instance, sacred groves and sanctuaries which harbour most of the local biodiversity have been encroached upon as a result of decline in traditional authority of governance (Gyasi and Gordana, 2006). Aniah *et al.* (2014) has noted that certain indigenous plant species (such as Vitellaria paradoxa, Parkia biglobosa, Diospyros mespiliformis, Detarium microcarpum) which were once held sacrosanct in sacred groves in Northern Ghana is undergoing continuous disturbance.

Several efforts have been made to improve vegetation cover of the Northern savannah landscape in order to boost food crop production and ecosystems functioning (SADA, 2009; Ecosystem Alliance Programme, 2015). However, these are often hampered by the widespread poverty, low precipitation, periodic droughts and bush fires and land degradation leading to households' over reliance on natural resources for survival (Lykke, 2004; Gyasi and Gordana, 2006; World Bank, 1999). It has been noted that the exploitation of certain plant species is based on preference which is linked to either their economic, medicinal or social value. (Tyowua *et al.*, 2012; Tom-Dery *et al.*, 2014). For example certain plant species (e.g. *Vitellaria paradoxa, Parkia biglobosa, Diospyros mespiliformis, Adansonia digitata*) which serves important medicinal and spiritual purpose for the rural folks are also used for fuelwood and charcoal production to nearby urban centers (Gyasi and Gordana, 2006; Ziblim *et al.*, 2013).

Several attempts have been made to assess biological diversity especially at the local level using different approaches. For example, profiling of woody plant species helps determine their pattern of distributions and abundance while providing information on species richness and inventory on disturbed species especially at the family level (Noumi, 2013). Diversity indices have been shown to provide information about rarity and commonness of species in a community (Tom-Dery *et al.*, 2013). Attua and Pabi (2013) used the Shannon-Wiener index to analyze species diversity and evenness in forest ecotone after stratified sampling of plots in these forests. Our approach in this paper is to combine field based species inventory and community based qualitative methods to profile and assess the status and use of biodiversity in selected communities of Northern Ghana.

The Northern savannah landscape, though not richly vegetated as compared to Southern Ghana, holds variable plant resources which are of high socio-economic, cultural and environmental significance to the rural folks (Asase and Oteng-Yeboah, 2012). However, limited scientific work has been done on biodiversity in the human-modified landscapes of Northern Ghana compared to Southern Ghana. For communities in Northern Ghana where dependence on biological resources is very high, there is the need for continuous monitoring and assessment of the status of biodiversity availability, use and functional importance especially at the landscape level. Moreover, with continuous decline in traditional authority management that hitherto ensured the sustainability of biodiversity, such assessment is needed to aid in the search for optimal options for biodiversity management.

Against this background and using selected communities in the Tolon District of Northern region as a case study, this study sought to:

Profile communities' woody plant species and estimate species diversity in selected land use types.

Assess plant species dominance among communities in the Tolon District and identify their perspective on the species density and extent of disturbance.

Identify communities' species preference and use forms.

Identify factors affecting biological resources and communities options for biodiversity management.

Materials and methods

Study area profile

The study was undertaken in the Tolon District of the Northern savannah ecological zone of Ghana. The

District lies between Latitudes 90 151and 100 021 North and Longitudes 00 531 and10 251West. The District covers area of 2741km² constituting about 3.9% of the total land mass of the Northern region (Tolon District Assembly, 2006). It experiences a unimodal rainfall pattern averaging annually between 900 – 1000mm. Temperatures are generally high averaging (25°C - 36°C) annually.

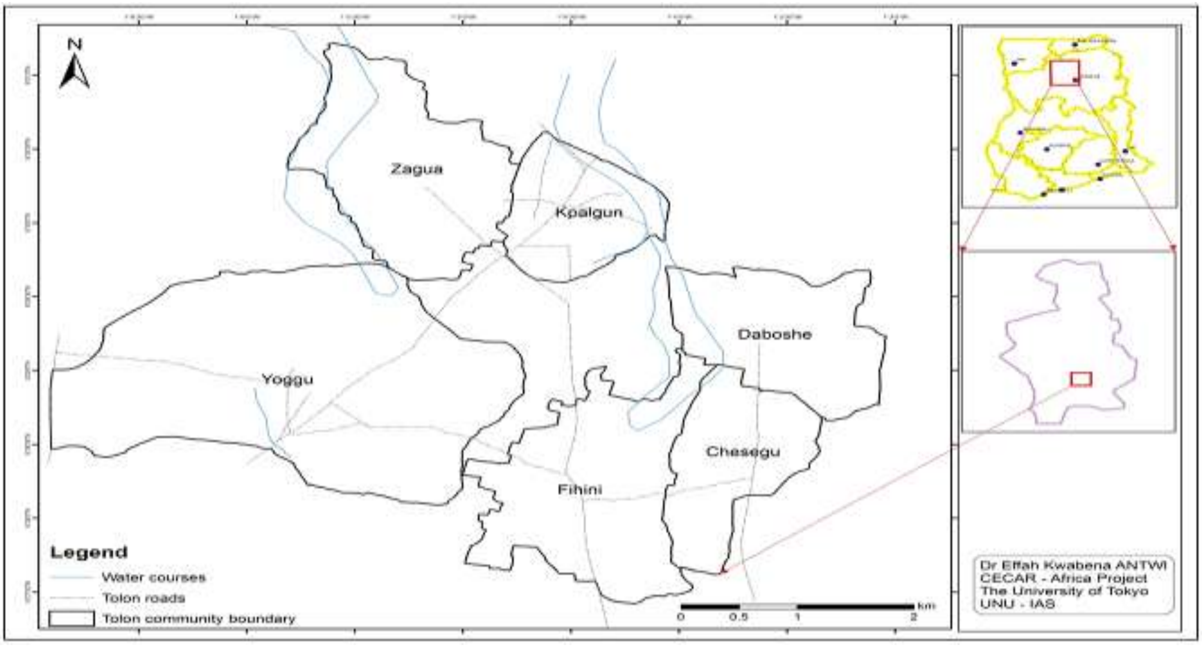

Fig. 1. Map of study communities in the Tolon district and the regional map of Ghana.

The vegetation type of the District lies in the Guinea savannah woodland zone and characterized by tropical savannah woodland species of varying density which are mostly deciduous, drought and fire resistant (Antwi *et al.*, 2014). Prominent tree species of economic and medicinal value includes; Shea (*Vitellaria paradoxa*), Dawadawa (*Parkia biglobosa*), Neem (*Azadiracta indica*), Baobab (*Adansonia Digitata*), Mango (*Mangifera indica*) and *Acacia* (*Acacia Nilotica*). Though communities in the Northern Ghana have varying vegetation composition and density, most of them heavily depend on the vegetation for livelihood sources such as food, fuelwood, income, medicine etc.

Selection of study communities

The Tolon District is among the poorest administrative units in Northern Ghana and Ghana as a whole. The study selected 5 communities namely Kpalgun, Fihini, Cheshegu, Daboshie and Zagua. Fig. (1), shows map of study communities and the Tolon District in the regional map of Ghana. The community Yoggu was not surveyed. The selection of study communities were informed by existing knowledge and reported incidence of their susceptibility to annual changes in floods and droughts event; as well as their higher reliance on agro-ecological systems and its services. In addition, the existence of intervention approaches implemented by governments, locals and non-governmental organizations was also considered.

Fig. 1. Map of the Northern Region (Insert is the Tolon District).

Reconnaissance plant survey was conducted in the five selected study communities to have a fair idea of what exists on the field. Following the reconnaissance survey of existing plant resources in the study communities, Kpalgun community was chosen as a representative community for detailed plant species inventory survey because, it had extra plant species which the other four communities did not have.

Selection of community with most diverse plant species

Distribution of plant species in the study communities are similar though some variation exists with some community endowed with more plant biodiversity resources. In order to conduct detailed plant resource distribution and diversity analysis, it became necessary to select a representative community that reflects the composition and distribution pattern of plant resources in the study area. To do this, we carried out transect walks and field observation to identify at first sight the communities with high plant species diversity and abundance. From our field observations and transect walk, we realised that composition and distribution of plant resources in all the study communities were comparatively similar except in Kpalgun where additional species were found. To verify our observations scientifically, the Sorenson similarity and dissimilarity dice index was used to estimate similarity level in plant species assemblages in all study communities. The formula used is as shown in equation (1) below;

$$Ss = \frac{2a}{2a + b + c} \text{......................................Eq. (1)}$$

Where a = number of species common to both quadrats/regions, b = number of species unique to the first quadrat/region, and c = number of species unique to the second quadrat/ region. Base on this approach, detailed plant resource distribution and diversity analysis was conducted in the Kpalgun community.

Systematic survey of the woody vegetation

Stratified random sampling technique was used to select four different land use types (sacred groves, fallow fields, open graze field and cultivated fields). The criteria used to select the various LU types used for the vegetation sampling were based on the following; land use which undergo high intensive management (farm lands), LU which undergo low intensive management (open graze fields, fallow fields) and reserved areas (sacred groves). A 10metre × 10metre square quadrat plots were set up in these land use types to aid the vegetation inventory survey (Cox, 1990; Kent and Coker, 1992).

The vegetation sampling was done by the study team during the peak vegetation period (month of July-October, 2014). Plot based sampling, popularly identified for ecological research was used to set up plots for the vegetation sampling (Tiner, 1999). A total of twenty four square quadrat plots were constructed constituting 0.6 acres of land size. The first quadrat of 10m×10m was laid at random and the subsequent ones constructed at regular intervals of 10m from each other (Cox, 1990). Sampling was then carried out for the woody species.

Regarding sampling of shrub species, smaller square plots of $1m^2 \times 1m^2$ were laid within the bigger $10m^2 \times 10m^2$ plots for their sampling (Harshberger, 1970). All individual species within these plots and subplots were then counted. Species were counted as inclusive of a quadrat if the whole plant is located within the quadrat or the leaves of the plant has spread outside the edge of the quadrat. Identification of the woody species was based on their physiognomic characteristics and later confirmed using relevant literature (Arbonnier, 2004). This was then compared with already identified specimens at the University for Development Studies Herbarium.

Questionnaire survey and interviews.

In our assessment, a probability proportional to size (PPS) sampling procedure similar to that described by Yansaneh (2005) was applied to determine the sample size for each community. PPS minimizes inaccuracies due to growth or shrinkage of communities and yield overall self-weighting output when combined with appropriate sub-sampling fraction. Each community was selected based on the number of households in the community proportional to the total number of households of the five communities as shown in Table (1). The sampling frame consisted total number of households in all five communities. Table (1) presents a summary of the sampling frame and sample size. A list of all households in each community as already documented in the CECAR-Africa project database showed that 252 households exists in the study area (Cheshegu 26, Fihini 38, Daboshie 32, Kpalgun 112 and Zagua 44). Using the proportional sampling technique, 40% of the total households (i.e. 104 households) were taken as the sample size from which the samples of individual communities were obtained for the questionnaire survey and interview.

We targeted head of households aged 50years above who have good knowledge of the communities' vegetation. In instances where head of households were younger than 50 years, and above, such households were not sampled. Standardized close and open ended questions were administered to individuals at the household level for species identification and uses.

Key Informant Interviews were held in the month of August, 2014 with chiefs, elders and medicinal practitioners believed to have in-depth knowledge of the vegetation in the study communities.

Participatory and focus group discussions

Participatory discussions (Chambers, 2007) in conjunction with focus group discussions in the month of August, 2014 were conducted in order to know the communities knowledge on use of trees species. In each community, two discussions were conducted: one for each gender group. More than 10 participants joined the discussion which was open for all interest groups. The participatory discussion focused first on "free listing" (Theilade *et al.*, 2007) of possible uses of trees, where each use was to a particular tree species. This was followed by a discussion on LU practices in the study communities which helped to analyze their sustainability to biodiversity conservation.

Data analysis

Species Diversity and Evenness were determined using the Shannon-Weiner Diversity and Evenness index. The Shannon -Weiner Diversity index is calculated using equation (2):

$$H' = -\sum_{i=1}^{S} p_i l_n p_i \quad \text{.................................Eq. (2)}$$

Where: H= Shannon Diversity Index, pi= proportion of individuals or the abundance of i^{th} species expressed as a proportion of the total cover in the sample and In= natural logarithms (Kent and Coker, 1992). The evenness index was calculated from the ratio of the observed diversity to maximum diversity using the equation (3);

$$E = \frac{H'}{In\ S} \quad \text{...Eq. (3)}$$

Where; E= Evenness, H'= Shannon-Weiner diversity index, InS; S = total number of species in the sample. According to Magurran (1988), the value of Shannon diversity index is found to usually fall between 1.5 and 3.5, while it rarely surpasses 4.5. The value of evenness index falls between 0 and 1. To determine woody plant species composition at the family level, the Family Importance Value (FIV) index was used. This index basically combines species richness, density and dominance (Mori *et al.*, 1983) and helps to determine the dominant and less dominant families of the plant species thereby influencing conservation measures at the community level. The formula used for FIV is as shown in equation (4) consisting parts (i), (ii), (iii) and (iv) .... Eq. (4)

i)

$$RD_{Fam}(\%) = (\text{Number of individuals in a family} / \text{Total number of individuals of all families}) \times 100$$

ii)

$$RDiv_{Fam}(\%) = (\text{Number of species in a family} / \text{Total number of species of all families}) \times 100$$

iii)

$$RDo_{Fam}(\%) = (\text{Basal area of species in a family} / \text{Total basal area of all families}) \times 100$$

iv)

$$FIV = RD_{Fam}(\%) + RDiv_{Fam}(\%) + RDo_{Fam}(\%)$$

Analysis of the questionnaire survey data was done using descriptive statistics in Statistical Package for Social Scientist (SPSS) environment. The interview data were analyzed qualitatively, using the technique of meaning condensation (Kvale, 1996).

To assess relationships between dominant and preferred species; dominant and disturbed species; preferred and disturbed species respectively in the study communities, the nonparametric Spearman's correlation coefficients in SPSS 20 was used. Statistical significance was two-tailed and set at α = 0.01 and α=0.05.

Results and discussion

Representation of community with most diverse plant species

Composition and distribution of plant resources in all the study communities were comparatively similar except in Kpalgun where additional species were found. Sorenson index results showed moderate similarity among the plant assemblage in all communities except Kpalgun. Composition of Sorenson index in the study communities are given in Table (2). According to Ellenberg (1956), Sorenson index values from 0.26-0.50 indicates moderate form of similarity in plant species assemblage while index lower than 0.26 indicates low similarity level in species assemblages. Comparing plant species assemblages in Kpalgun to Daboshie, Cheshegu, Fihini and Zagua showed low similarity levels in species composition; 0.2; 0.1; 0.2; 0.2 respectively. This gives indication of diversity in the plant species composition in Kpalgun compared to the other four communities. This observation informed our research to select Kpalgun community as representative community for detailed study of plant resource distribution and diversity analysis in the Tolon district.

Table 1. Household sampling frame and size in study communities.

Name of Community	Number of households per community	Number of sampled households based on PPS
Cheshegu	26	10
Fihini	38	15
Daboshie	32	13
Kpalgun	112	45
Zagua	44	18
Total	252	101

Source: Field Survey, 2014.

Profile and composition of woody plant species

Profile of all identified woody tree species in the study area is shown in Table (3) below. In total 66 woody plant species belonging to 54 genera and 26 different families were sampled and identified. Of the 26 families, 27.7% belonged to the Fabaceae, 9.2% Anacardiaceae, Poaceae 7.2% and 6.2% Combretaceae families. Meliaceae and Leguminosae families had equal representation (4.6%). Other families such as the Malvaceae, Annonaceae, Lamiaceae, Sapindaceae, Euphorbiaceae, Tiliaceae, and Commelinaceae collectively formed 3.1% of the species identified whiles the Ebenaceae, Sapotaceae, Capparidaceae represented 1.5% species in the study communities.

The eight most important families for each relative parameter and FIV are shown in Table (4). The value of each relative parameter for the eight families with highest FIV is represented in Fig. 2. The complete results for each family are given in Table (5). Regarding relative density, Fabaceae, Compositaceae, Poaceae, Anacardiaceae, Leguminosae, Combretaceae, Commelinaceae and Meliaceae are the eight most abundant families. Families Poaceae, Compositaceae and Fabaceae form the most dominant by contributing over 50% of all trees in the sampling inventory (Table, 4). The density of each other family does not reach 5%. Attua and Pabi (2013) also identified the Fabaceae, Leguminosae, Meliaceae, Euphorbiaceae, Combretaceae as the most dominant plant species families in the Northern forest savannah ecotone of Ghana.

Relative diversity composed from the species sampling showed the Fabaceae family as the most diverse (Table, 4) due to the highest number of sampled species (18) representing its level of richness (Table, 5). This accounts for the highest relative diversity it recorded. The second most diverse family was the Anacardiaceae having 6 species with a relative diversity of 9.3% followed by the Poaceae having 5 species. The remaining 22 families had less than 5 species representation which resulted in below 5% of relative diversity except the Combretaceae family which had relative diversity of 6.2%. The eight most abundant families in ascending order are; Poaceae, Fabaceae, Meliaceae, Combretaceae, Commelinaceae, Anacardiaceae, Leguminosae and Compositaceae which together accounts for over 60% of the total dominance (Table, 4). The FIV shows Fabaceae is the most important family sampled with an FIV of 58.2. They also have the highest relative density and the highest relative diversity. Poaceae was the second most important family sampled with an FIV of 29.7. Though Poaceae had low relative diversity and relative density compared to the Compositaceae and Anacardiaceae families, its relative dominance was the highest sampled. The FIV of three families; Compositaceae, Combretaceae and Anacardiaceae are quite high though Compositaceae had a higher FIV after having recorded lower values for relative diversity and dominance. The high FIV value for the Compositaceae is due to its high species density. The Leguminosae, Meliaceae and Commelinaceae had a fair representation of FIV as well.

Table 2. Sorenson Dice Similarity Index for study communities.

	Cheshegu	Zagua	Daboshie	Fihini	Kpalgun
Cheshegu	26	21	19	16	10
Zagua	0.4	33	20	23	7
Daboshie	0.4	0.4	28	20	11
Fihini	0.3	0.4	0.4	35	15
Kpalgun	0.2	0.1	0.2	0.2	48

No. of species in each region (bold), no. of shared species between two regions (upper side of the Table) and the coefficient of species resemblance between two regions (lower side of the Table) for the five study areas/regions in Tolon district.

Species diversity in selected land use types

The Shannon-Wiener index showed higher species diversity and evenness in the sacred groves and fallow fields compared to the cultivated fields (Table, 6). This finding is also affirmed by Tom-Dery *et al.*, (2013) who recorded higher species diversity in the Malshegu sacred grove. The reason for the high species diversity in the sacred groves is due to community held beliefs that trees there are sacrosanct and cannot be cut for firewood (Dorm-Adjobu *et al.*, 1991; Blench, 2004). According to Abayie Boateng (1998) and Dovie (2003), sacred groves serve as botanical museums for biodiversity and an important source of herbs for local medicine, social and religious purposes. The low diversity values accounted for in the cultivated fields results from the high agricultural land use and management intensity which prevents the regrowth and succession of diverse plant species (Dorm-Adjobu *et al.*, 1991).

According to Roth (1994) evenness also indicates the level of disturbance in a field and shows how equitable the species are distributed. Following Roth observation, indications are that less intensive land use types such as sacred grove are less disturbed compare to high intensively managed cultivated fields.

Table 3. List of general woody species identified within the study area.

Genus	Scientific Name	Family	Local Name / Common Name
Acacia	*Acacia gourmaensis* A. chev	Fabaceae	Monmogu
Acacia	*Acacia hockii* De Wild.	Fabaceae	Gopuagu
Acacia	*Acacia mellifera* (Vahl) Benth	Fabaceae	Gabligu
Acacia	*Acacia Spp* Steud. Ex. A. Rich	Fabaceae	Guale
Adansonia	*Adansonia digitata* L.	Malvaceae	Tua
Afzelia	Afzelia Africana Smith ex Pers.	Fabaceae	Yoliga
Albizia	Albizia adianthifolia (Schumarch.) W.F. Wight	Fabaceae	Gozee
Anacardium	Anacardium occidentale L.	Anacardiaceae	Cashew
Aneilema	*Aneilema aequinoitiale* (P. Beauv.)	Commelinaceae	Dabolari
Aneilema	*Aneilema beniniense* (P. Beauv.) Kunth	Commelinaceae	Warikawana
Annogeissus	*Annogeissus leiocarpus* (DC) Guill and Perr.	Combretaceae	Shia
Annona	*Annona senegalensis* Pers	Annonaceae	Galinyagu
Azadirachta	*Azadirachta indica* Juss	Meliacea	Neem
Bauhinia	*Bauhinia rufescens* Lam.	Fabaceae	Manpiegu
Berlinia	*Berlinia grandiflora* (Vahl) Hutch & Dalz	Leguminosae	Nie
Blighia	*Blighia sapida* Koenig	Sapindaceae	Gulungung
Bombax	*Bombax costatum* Pellegr. & Vuillet	Malvaceae	Guna / Gua
Borassus	*Borassus aethiopum* Mart.	Arecaceae	Kphikpaliga
Cassia	*Cassia spp*. L.	Fabaceae	Tikulaiku
Ceiba	*Ceiba pentandra* (L.) Gaertn	Malvaceae	Vauga
Chromololaena	*Chromololaena odrata* Linn.	Compositae	Krumea
Cleome	*Cleome rutidosperma* DC	Capparidaceae	Kaa
Combretum	*Combretum collinum* Fresen.	Combretaceae	Susole
Cordyla	*Cordyla pinnata* (Lepr. Ex A. Rich.)	Fabaceae	Paliga
Detarium	*Detarium microcarpum* G. and Perr	Fabaceae	Kpagara
Detarium	*Detarium macrocarpum* Harms	Fabaceae	Nkaa
Diospyros	*Diospyros mespiliformis* Hochst Ex. A. Rich	Ebenaceae	Gaa
Echinochloa	*Echinochloa spp*. Schult.	Poaceae	Pagiviligakushihikum
Elytrophorus	*Elytrophorus spicatus* A. Camus	Poaceae	Kikara
Entada	*Entada Africana* Guill. & Perr	Fabaceae	Chinchienga
Entada	*Entada abyssinica* Steud. Ex A. Rich	Leguminosbae	Doo
Ficus	*Ficus trichopoda* Baker	Moraceae	Zankunga
Fleurya	*Fleurya aestuans* (Linn) ex Miq.	Urticaceae	Pulolemana
Gardenia	*Gardenia erubescens* Statf & Hutch	Rubiaceae	Dazule
Gmelina	*Gmelina arborea* Roxb.	Lamiaceae	Pulumpuu
Grewia	*Grewia barteri* Burret	Tiliaceae	Nobilanini
Grewia	*Grewia cissoides* Hutch. & Dalz.	Tiliaceae	Yugokpali
Hexalobus	*Hexalobus monopetalus* (A. Rich.) Engl. & Diels	Annonaceae	Bulumbugu
Hymenocardia	*Hymenocardia heudelotii* Mull. Arg	Euphorbiaceae	Nyoo
Isoberlinia	*Isoberlinia tomentosa* (Harms) Craib & Stapf	Leguminosae	Izugubetia
Khaya	*Khaya ivorensis*. A.Chev	Meliaceae	Kuka
Khaya	*Khaya senegalensis* (Desr.) A. Juss	Meliaceae	Koyam
Lannea	*Lannea acida* Engl. &. Krause	Anacardiaceae	Sabisabi
Lannea	*Lannea egregia* Engl. &. Krause	Anacardiaceae	Sinsabi Gbietiliga
Lannea	*Lannea humilis* (Oliv.) Engl.	Anacardiaceae	Sinsebga
Lonchocarpus	*Lonchocarpus sericeus* (Poir.) H.B.K.	Fabaceae	Chinchenpieliga
Mangifera	*Mangifera indica* L.	Anacardiaceae	Mango

Melia	*Melia spp*. Linn	Meliaceae	Sigrile
Moringa	*Moringa oleifera* Lam	Moringaceae	Moringa
Ozoroa	*Ozoroa insignis* Del.	Anacardiaceae	Garizee
Axonopus	*Axonopus compresus* (Sw.) P. Beauv.	Poaceae	Kundupia
Parkia	*Parkia biglobasa* L.	Fabaceae	Dawadawa
Paullinia	*Paullinia pinnata* L.	Sapindaceae	Wabiga
Pericopsis	*Pericopsis laxiflora* (Benth.) van Meeuwen	Fabaceae	Kpiliga
Phyllantus	*Phyllantus amarus* Schum & Thonn	Euphorbiaceae	Simidoo
Piliostigma	*Piliostigma thonningii* Milne-Redh	Fabaceae	Banga
Polygonum	*Polygonum salicifolium* Brouss. Ex Willd	Polygonaceae	Simindoo
Santaloides	*Santaloides afzelii* (R. Br. Ex Planch.) Schellenb.	Connaraceae	Gingagoo
Senna	*Senna spp* (L.)	Fabaceae	Bukpunga
Tamarindus	*Tamarindus Indica*	Fabaceae	Puhiga
Tectona	*Tectona grandis* L.f.	Lamiaceae	Teak
Terminalia	*Terminalia albida* Sc. Elliot	Combretaceae	Wobisa
Terminalia	*Terminalia laxiflora* Engl.	Combretaceae	Kualaa
Vepris	*Vepris heterophy*lla (Engl.) Letouzey	Rutaceae	Jangsinsaba
Vitellaria	*Vitellaria Paradoxa* Gaerfn. F.	Sapotaceae	Shea (Tanga)
Vitex	*Vitex doniana* Sweet	Verbenaceae	Naringa

Household's perceptions on woody plant species dominance, density and disturbance

Among the sixty six (66) sampled woody species, respondents were asked to freely list the most dominant species within their vicinity. Dominant species (species that have high value for communities) listed are shown in Fig. 3. Ten species were listed by the communities as dominant of which the Shea ranked highest followed by Neem, Mango, Dawadawa, Ebony, Cashew, Moringa, Kapok, Baobab and Ficus in descending order. Among these, the Shea species remains the most abundant (Attua and Pabi, 2013; Tom-Dery *et al*., 2013). The social and economic value placed on these species has helped their propagation and management making them dominant in the Tolon district. Economically, income is generated through the sale of these species either in their raw or processed forms. Socially they serve as food, fuelwood, fodder, construction materials and medicine for the communities.

Table 4. Representation of important Plant Families and their FIV.

Family	Rel.Density	Rel.Diversity	R. Freq	FIV
Fabaceae	19.8	27.8	10.6	58.2
Poaceae	10.8	6.2	12.8	29.7
Compositae	19.6	1.5	2.1	23.2
Anacardiaceae	8.2	9.3	4.3	21.7
Combretaceae	4	6.2	6.4	16.5
Leguminosae	4.6	4.7	4.3	13.4
Meliacea	2.1	4.6	6.4	13.1
Commelinaceae	3.5	3.1	4.3	10.8

The research sought the view of community members on the status of change (reduction) in density of woody species (Fig. 4). Majority of respondents (60%) indicated reduction in densities of woody species for all the study communities except Fihini with less than 50% of the respondents stating stating reduction in species densities. Furthermore in Fihini and Daboshie, 23% and 16.6% of respondents indicated they have no idea on species decline in their communities.

Table 5. Representation of all Plant Families and FIV.

Family	Species	Individuals	Rel.Density (%)	Rel.Diversity (%)	R. Freq (%)	FIV (%)
Fabaceae	18	218	19.8	27.8	10.6	58.2
Malvaceae	2	8	0.7	3.1	4.3	8.1
Anacardiaceae	6	90	8.2	9.3	4.3	21.7
Annonaceae	2	13	1.2	3.1	4.3	8.5
Leguminosae	3	50	4.6	4.7	4.3	13.4
Sapindaceae	2	24	2.2	3.1	4.3	9.5
Arecaceae	1	22	2	1.5	2.1	5.7
Capparidaceae	1	11	1	1.5	2.1	4.7
Combretaceae	4	44	4	6.2	6.4	16.5
Ebenaceae	1	3	0.3	1.5	2.1	4
Poaceae	4	119	10.8	6.2	12.8	29.7
Moraceae	1	2	0.2	1.5	2.1	3.8
Urticaceae	1	3	0.3	1.5	2.1	3.9
Rubiaceae	1	2	0.2	1.5	2.1	3.8
Lamiaceae	2	19	1.7	3.1	4.3	9.1
Tiliaceae	2	15	1.4	3.1	4.3	8.7
Euphorbiaceae	2	16	1.5	3.1	2.1	6.7
Moringaceae	1	6	0.5	1.5	2.1	4.2
Polygonaceae	1	69	6.3	1.5	2.1	10
Connaraceae	1	45	4.1	1.5	2.1	7.7
Rutaceae	1	9	0.8	1.5	2.1	4.6
Sapotaceae	1	30	2.7	1.5	2.1	6.4
Verbenaceae	1	4	0.3	1.5	2.1	4
Compositae	1	215	19.6	1.5	2.1	23.2
Commelinaceae	2	38	3.5	3.1	4.3	10.8
Meliacea	3	23	2.1	4.6	6.4	13.1

The reduction in densities of woody species reported in this study is consistent with findings by Tom-Dery *et al.*, (2014) who also confirmed that woody species densities have been reducing in some parts of Northern Ghana especially in rural farming communities. Although there is a general decline in all woody specie densities, further analysis showed that some species were perceived to have reduced more in density than others. Ranking of most disturbed woody plant species (species which have reduced in number and no longer commonly seen by community members) are shown in Fig. 5. In all, fourteen plant species were listed as being disturbed. These were then ranked according to the level of disturbance and the species that received the highest score was the most disturbed.

Table 6. Community biodiversity assessment.

Land Use Types	No.	Richness	Diversity Index	Evenness
Fallow Fields	7	33	2.23	0.8
Cultivated Fields	7	24	1.75	0.7
Open Grazed Field	5	18	1.74	0.6
Sacred Grove/Reserved Area	5	29	2.55	0.8

The results show that the species *Parkia biglobosa* was perceived as the most disturbed (54.8%). Apart from this, other species that were perceived as disturbed in descending order include *Khaya senegalensis* (28.4%), *Mangifera indica* (26.6%), *Pericopsis laxiflora* (26.5%), *Detarium microcarpum* (25.4%), *Borassus aethhiopum* (21.4%), *Adansonia digitata* (20.6%), *Vitellaria paradoxa* (18.1%), *Cordyla pinnata* (2.9%), *Tectona grandis* (7.7), *Diospyros mespiliformis* (8.9%) and *Lannea acida* (9.6%) (Fig. 5). Similarly, Aniah *et al.*, (2014) also showed that species such as *Parkia biglobosa*, *Adansonia digitata*, *Vitellaria paradoxa, Diospyros mespiliformis* have been reducing in numbers in the savannah regions in Northern Ghana. The reliance on vegetation resources in the study communities as sources of food, income, forage, fuelwood accounts for the reduction in tree species (Yaro, 2008). The reliance and preference for some of these species over others could have accounted for disturbance level of such species. Below, we look at communities' species preference and use forms.

Species preference and use forms in study communities

Although lots of species were identified in the study communities, preference is given to some species over others. When respondents were asked to name plant species they consider very important in their communities, seven (7) out of the sixty six (66) sampled species were identified as the most preferred species (Table, 7). The most preferred was *Vitellaria Paradoxa* followed by Azadirachta indica, Parkia biglobosa and Mangifera indica, Anacardium occidentale, Ceiba pentandra, Diospyros mespiliformis and Tectona grandis. These species are most preferred due to the multiple benefits and higher economic value derived from them (Hansen *et al.*, 2012). Previous research has indicated that species preference is often linked to either the social, medicinal or palatability value of a particular species (Tyowua *et al.*, 2012; Tom-Dery *et al.*, 2014). During the FGD in all the study sites, it emerged that of the seven most preferred species, the *Vitellaria Paradoxa, Parkia biglobasa, Ceiba pentandra* and *Diospyros mespiliformis* remain indigenous to the communities while *Mangifera indica*, *Azadirachta indica* and *Anacardium occidentale* are considered exotic species. Although *Vitellaria Paradoxa, Parkia biglobasa* and *Ceiba pentandra* have high demand and continue to provide high economic benefit to the communities, the introduction of exotic species have become popular in the communities' in recent times due to the high economic returns associated with cultivating them. During the FGD it was revealed that, although the *Tectona grandis* tree species remains an important economic tree, it recorded low score in terms of specie preference as a result of long gestation period which does not encourage most farmers to cultivate it. Thus there is preference for tree species with short gestation period to support livelihoods. This explains why most of the exotic tree species are becoming more popular with the communities. Gyasi and Gordana (2006) also suggest that because of the high levels of poverty in some communities in Tolon, there is reliance on crops with shorter gestation period.

Table 7. Community woody plant species preference.

Woody Plant Species	Communities				
	Kpalgun	Cheshegu	Zagua	Daboshie	Fihini
Vitellaria Paradoxa	40.6	40	50.6	40.3	23.1
Azadirachta indica	19.5	25.3	16.7	27.3	22
Parkia biglobasa	13	12.4	12.5	12.1	34.6
Mangifera indica	16.7	10	4.2	6.1	9.3
Anacardium occidentale	7.4	0	0	6.1	9
Ceiba pentandra	0.9	6.3	10	6.1	0
Diospyros mespiliformis	1.9	6	6	2	2
Tectona grandis	0.6	0	0	2	1

Woody species uses in the study communities perform various social, economic, cultural and spiritual and ecological functions. Fig. 6 shows the benefits derived from the various plant species in the respective communities. It must be noted that despite the diversity of species identified, they are all basically used in the same way in the study area since the communities are neighbours to each other (Fig. 1) while in some cases, they share common resources (e.g. waterbodies). Responses from both household surveys and FGD suggest that, food had the highest use form. Food gathered from biological resources often includes; fruits, leaves, seeds and nuts, gum and sap. Studies by Asase and Oteng-Yeboah (2012) and Tom-Dery *et al.*, (2014) show similar findings.

Next to food is fuelwood which is crucial for meeting majority of rural households energy needs (Dovie, 2003). Besides, demand on fuelwood has also increased due to the spread of small-scale Pito brewing (Local beer). Moreover, an elder from Fihini during informant interview also indicated that, sale of fuelwood to nearby urban centres has become a major income generating activity for most people although this has increased pressure on fuelwood demand lately.

Table 8. Medicinal uses of identified plant species.

Scientific Name	Diseases/Illness condition Treated	Parts Used
Acacia gourmaensis	Sight problems, stomach pains	Roots, bark, leaves
Acacia hockii	Headache, tooth ache, poor sight	Roots, leaves
Acacia mellifera	Piles, skin rashes, enhance sexual performance,	Fruit, roots, leaves
Acacia Spp	Cure for wildlife & animals	Leaves
Adansonia digitata	Sickling or malnourished child	Leaves, fruit
Afzelia Africana	Blood tonic, terminating of pregnancy (abortion), foetus implantation	Leaves, roots
Albizia adianthifolia	Skin rashes, stop bleeding	Leaves
Anacardium occidentale	Snakes bites, sores, rashes, dysentery, cough, hypertension	Seeds, leaves, fruit, bark, roots
Aneilema aequinoitiale	Fever	Roots, leaves
Aneilema beniniense	Erectile dysfunction	Roots, leaves
Annogeissus leiocarpus	Sores, de-wormer for humans & animals	Leaves
Annona senegalensis	Poison, detoxification	Leaves, roots
Axonopus compresus	General body pains, fever	Leaves
Azadirachta indica	Malaria, mosquito repellent, pesticides, stomach pains	Leaves , seeds
Bauhia rufescens	Piles	Roots, leaves
Berlinia grandiflora	Sight problems	Roots
Blighia sapida	Malaria, piles, convulsion	Leaves, roots
Bombax costatum	Snake bite, pillows, food	Leaves
Borassus aethiopum	General body pains	Fruit, leaves
Cassia spp.		Leaves
Ceiba pentandra	Mental problems (anti-depressant)	Roots, bark
Chromololaena odrata	General body pains, headache	Leaves
Cleome rutidosperma	Stimulant, antiscorbutic, skin rashes	Roots, seeds, leaves
Combretum collinum	Headache, stomach pains, convulsion, body weakness	Roots, leaves
Cordyla pinnata	Rheumatism, headache, body pains	Roots, bark
Detarium microcarpum	Fever, cure baldness	Leaves, roots, barks
Detarium macrocarpum.	Sores treatment	Leaves
Diospyros mespiliformis	Mental illness, epilepsy, convulsion, headache	Roots, leaves, bark
Echinochloa spp.	Body hydration	Fruits, leaves
Elytrophorus spicatus	Cough, chest pains, de-wormer	Leaves, roots
Entada abyssinica	Body wounds, food poison	Leaves , roots
Fluerya aestuans	Skin rashes	Bark, roots
Gardenia erubescens	Gonorrhoea infection	Roots, bark
Gmelina arborea	Skin disease, spiritual protection	Roots, leaves
Grewia barteri	Rheumatism, waist pains, spinal pains, headache,	Leaves,
Grewia cissoids	Rectal sores, piles,	Leaves, roots
Hexalobus monopetalus	Cold, headache, nasal bleeding, Rheumatism, cough mixture	Leaves
Hymencardia heudelotii	Eye treatment	Bark-sap
Isoberlina tomentosa	Headache, stomach pains	Leaves
Keetia venosa	Convulsion	Leaves
Khaya senegalensis	Stomach pains, malaria,	Leaves
Kyllinga squamulata	Fever, stomach pains	Leaves, roots
Lannea acida	Convulsion, fever	Roots, plants, leaves, bark
Lannea egregia	Migraine, malaria	Leaves
Lannea humilis	Cough and generalized body pains	Roots
Lonchocarpus sericeus	Chest pains	Leaves
Mangifera indica	Stomach pains	Root, bark, leaves
Melia spp.	Malaria, stomach pains, tooth ache	Roots and leaves
Moringa oleifera	Blood pressure, malaria, gum bleeding	Bark, leaves

Ozoroa insignis	Body and bone pains, Convulsion	Roots, bark, leaves
Parkia biglobasa	Hypertension, skin rashes,	Leaves, fruits, bark
Paullinia pinnata	Skin rashes & sores	Leaves
Pericopsis laxiflora	Stomach pains, gum bleeding, tooth ache, boils	Roots, leaves, bark
Phyllantus amarus	Ear infections, swells and boils, pain killer, skin diseases,	Leaves, fruits
Piliostigma thonningii	Snake bite	Leaves, roots
Pistia spp.	Dysentery, diarrhoea, pain killer, stomach pains,	Leaves
Polygonum salicifolium	Food poison, stomach pains	Roots, barks
Santaloides afzelii	Rheumatism, stomach pains, free bowels, headaches,	Leaves
Senna spp	Rectum related diseases	Roots
Setaria megaphylla	Convulsion, fever, general pains	Roots, leaves, bark
Tamarindus indica	Stomach pains,	Leaves
Terminalia albida	Diarrhoea, convulsion, stomach pains	Leaves
Terminalia laxiflora	Boils, cold, bleeding (sore treatment)	Leaves,
Vepris heterophylla	Cough, chest pains	Leaves, roots
Vitellaria paradoxa	Diarrhoea, jaundice and stomach-ache, dysentery, counteract snake (cobra) venom	Nut, root, bark
Vitex doniana Sweet	Stomach pains, running stomach	Fruit, leaves, root, bark

Dovie (2003) noted that the sale of fuelwood provide supplementary incomes and serves as safety nets to households especially in times of low crop yield and periods of drought. Earlier studies conducted in Northern Ghana noted that approximately 1280m3 of fuelwood is annually exported which is equivalent to an income of $6400 (Hansen *et al.*, 2012).

Table 9. Correlation matrices for species dominance, preference and disturbance in community.

Kpalgun (N = 18)	Preferred Correlation (Sig. 2-tailed)	Disturbed Correlation (Sig. 2-tailed)	Dominant Correlation (Sig. 2-tailed)
Preferred	1.000	-	-
Disturbed	.067 (.792)	1.000	-
Dominant	.926** (.000)	.039 (.877)	1.000
Cheshegu (N = 18)			
Preferred	1	-	-
Disturbed	.051 (.841)	1	-
Dominant	.903** (.000)	-.110 (.674)	1
Zagua (N = 18)			
Preferred	1	-	-
Disturbed	.221 (.378)	1	-
Dominant	.893** (.000)	.283 (.255)	1
Daboshie (N = 18)			
Preferred	1	-	-
Disturbed	.296 (.233)	1	-
Dominant	.981** (.000)	.342 (.164)	1
Fihini (N = 18)			
Preferred	1	-	-
Disturbed	.410 (.102)	1	-
Dominant	.794** (.000)	.489* (.046)	1

For all community, correlation analyses were restricted to 18 samples.

The use of woody species for construction materials is not an exception to Northern Ghana. Studies has shown that in most rural communities and urban settings of developing countries, materials used for construction, housing and fences for animals are mostly obtained from natural forests and woodlands (Dovie, 2003).

It is estimated that 80% of the world's population relies entirely on local medicines made almost exclusively from plants (Anna, 1990). The use of these woody species for medicinal purposes remains important in the communities studied. In-depth interviews held with community elders and especially local herbalists suggested that, almost all plant species sampled retain some form of medicinal value (Table, 8). The bark, roots, leaves and seeds of the plant species are commonly used for the treatment of one ailment or another. Diseases treated range from headache, stomach ache, snake bite, menstrual pains to impotency. For instance, according to discussants in the FGD the seeds of some indigenous species such as Adansonia digitata, Vitellaria Paradoxa and Parkia biglobosa are used to produce butter, good for treatment of skin and hair problems. As a result, these products are of high value to regions outside the geographical range of such species (Maranz *et al.*, 2004). Our findings confirm previous research on medicinal use of local plant species (Asase and Oteng-yeboah, 2012; Ziblim *et al.*, 2013).

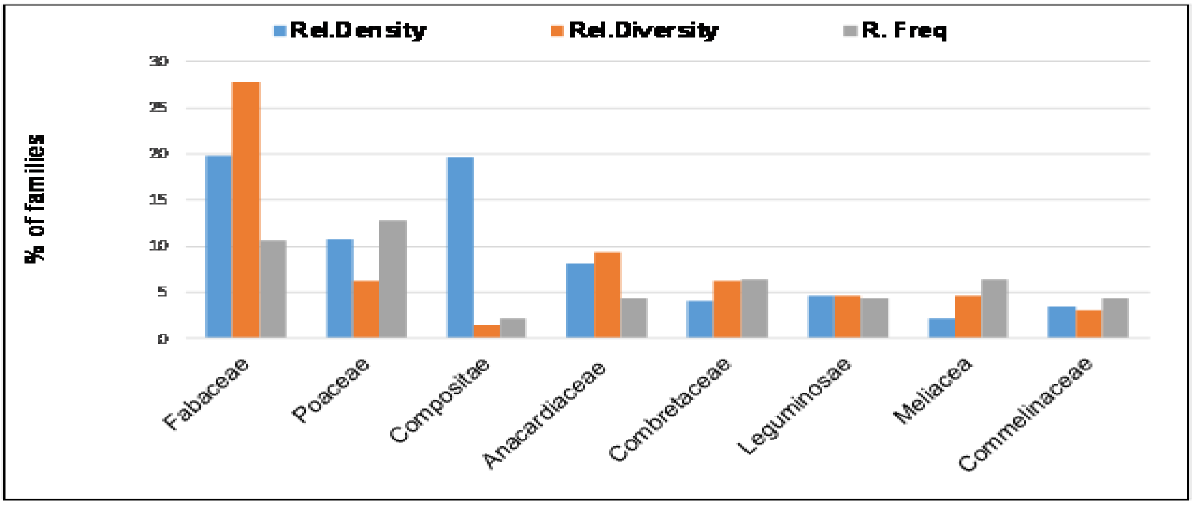

Fig. 2. Relative diversity, density and dominance of the ten most important families in FIV.

The use of woody species to provide spiritual protection was also mentioned as a common use form across all the study sites (Fig. 6). Indigenous species such as *Vitellaria Paradoxa, Parkia biglobasa, Ceiba pentandra, Diospyros mespiliformis* and *Adansonia digitata* were those strongly mentioned as offering spiritual support by the traditional healers interviewed. Moreover, discussants in the FGD also suggested that, the branches of these species are normally hanged in the doorway of a woman who goes into labor, to protect the newborn baby from evil. Also the branch of the *Parkia* species is used to cover the dead (tree chiefs) prior to their burial sites. The spiritual and cultural values attached to these species is very fundamental to traditional way of biological species conservation owing to the fact that these species are naturally protected and the potential for their regeneration is therefore high.

Relationship among plant species preference, dominance and disturbance

After identification and categorisation of the communities' species (dominant, preferred and disturbed), we assessed the relationship existing among them. This analysis is important as it informs the study effect of community preference or use of plant species on species distribution and state of disturbance under the current management. Pearson correlation coefficient was used to evaluate the null hypothesis that there was no relationship between dominant and preferred species, preferred and disturbed species and dominant and disturbed species in the study communities (N=18). Generally across all the study communities, there was enough evidence to reject the null hypothesis and conclude that there exists a strong positive relationship between dominant species and their levels of preference [Thus r>0.79<0.99]. However, a weak to moderate positive correlation was observed between preferred and disturbed species though this relationships could not be proven scientifically in all the study communities (Table, 9).

At the Kpalgun community, observation of both dominant and preferred species yielded a strong positive relationship (r = 0.92, p<0.01). Also a weak positive relationship was observed between preferred and disturbed species (r = 0.06, p>0.05); dominant and disturbed species (r = 0.03, p>0.87) as shown in Table (9). The strong association between dominant and preferred species suggests that most preferred species in Kpalgun are the dominant ones and as such their current level of use does not pose any threat to their abundance and diversity. Amy *et al.*, (2013) noted that preferred species are used more often than less preferred ones even if both species can perform the same function.

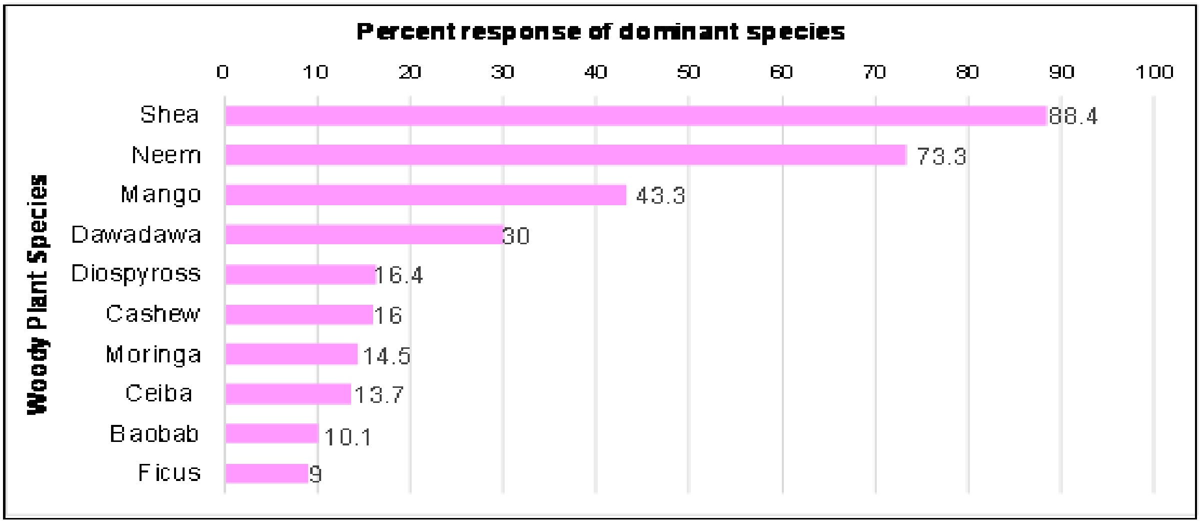

Fig. 3. Community dominant woody plant species.

The weak association between preferred and disturbed species suggests that preferred species currently dominant may be undergoing some level of disturbance which may affect their diversity. It has been found that severe disturbance has the tendency of affecting species diversity on a landscape (Pickett and White 1995; Raupp *et al.*, 2001). As such, caution has to be taken with their current manner of use. As shown in Fig. (8), education of community members will serve as a management strategy to help avoid such future occurrence from taking place.

In Cheshegu community, a strong positive association was identified between dominant and preferred species (r = 0.90, p<0.01). According to Kohjasteh *et al.*, (2012), a consistent positive correlation often exists between dominant and preferred species. Weak positive association was observed between preferred and disturbed species (Table, 9; r =0.05, p>0.05) whereas a weak negative correlation was found between dominant and disturbed species (r = -0.01, p>0.05). The weak association between preferred and disturbed species suggest preferred species in the community could become more disturbed. Research has indicated that preference is often linked to either the social, medicinal or palatability value of a particular species (Tyowua *et al.*, 2012; Tom-Dery *et al.*, 2014). The weak correlation between dominant and disturbed species affirms the earlier finding that preferred species currently dominant may reduce in abundance and diversity if their current level of use bound to cause their disturbance is not regulated (Fig. 6). Disturbances being it natural or anthropogenic characteristically mars species dominance (Wohlgemuth *et al.*, 2002) however if species diversity levels is high, disturbances often have minimal effect on species abundance (Raupp *et al.*, (2001).

At the Zagua community, a strong positive correlation was observed between preferred and dominant species (r = 0.89, p<0.01). There was also a weak positive relationship between dominant and disturbed species (r = 0.28, p>0.05); preferred and disturbed species (r = 0.22, p>0.05). The above observations suggest current or possible future disturbance of these species. According to Gilbert *et al.*, (2009), low disturbance levels does not strongly affect the abundance of a particular species unless the disturbance levels are high enough to do so. Thus the current state of management if not controlled or when prolong could heighten the level of disturbance (Picket and White, 1995). This creates some sort of vulnerability in the ecosystems.

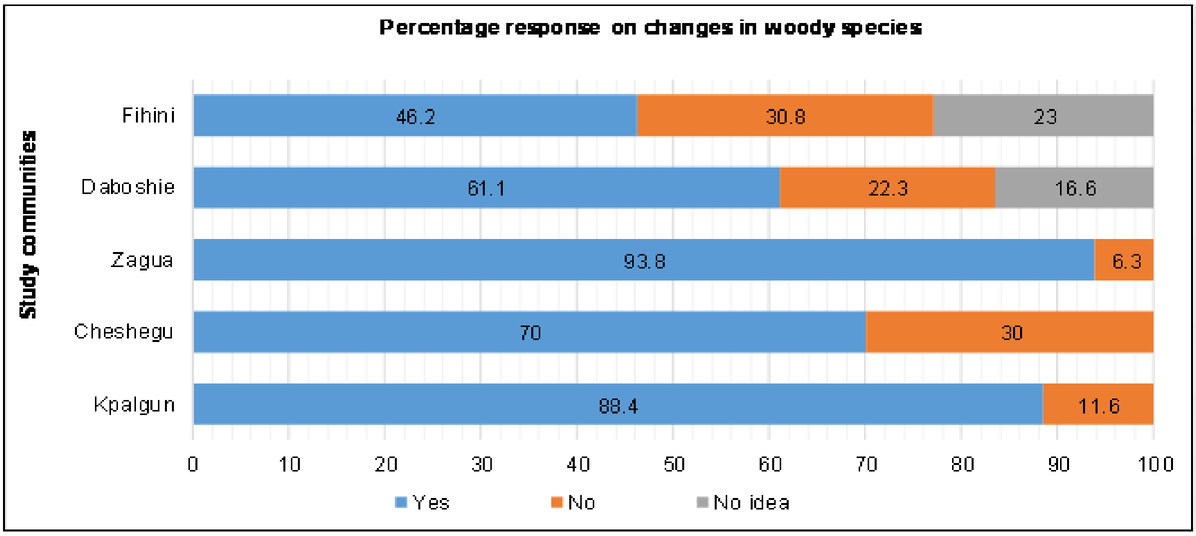

Fig. 4. Representation of Changes in species density.

A strong positive association between dominant and preferred species (r = 0.98, p<0.01) was observed in the Daboshie community. A weak to moderate positive relationship was also identified between preferred and disturbed species (r = 0.29, p>0.05); dominant and disturbed species (r = 0.34, p>0.01). The above denotes future disturbances under the present management though weak to moderate correlation is observed. In Dasboshie and the other communities with similar association the enforcement of traditional norms and taboos need strengthening (Aniah *et al.*, 2014) since the current level of disturbances may vary over spatial and temporal scales at a frequency that could damage large area plant resource (Anderson and Frank, 2003). We propose the enforcement of traditional norms and taboos as a locally doable management option which plays significant role in conservation of community natural resources.

The Fihini community also recorded a strong positive association between preferred and dominant species (r = 0.79, p<0.01) whereas a moderate positive relationship was observed between preferred and disturbed species (r = 0.41, p>0.05); dominant and disturbed species (r = 0.48, p>0.05).

Factors affecting community biological resources

Disturbance or degradation of some woody plant species remains a major concern in the communities studied. In this section, we present results on the factors mentioned by respondents as causes of biodiversity disturbance (Fig. 7). As can be seen in Fig. (7), factors ranging from over exploitation to bush burning were cited. These factors are interlinked and intertwined with each other as the effect of one leads to the effect of another. According to Kristensen and Lykke (2003), increasing population leads to over exploitation and loss of species due to deforestation.

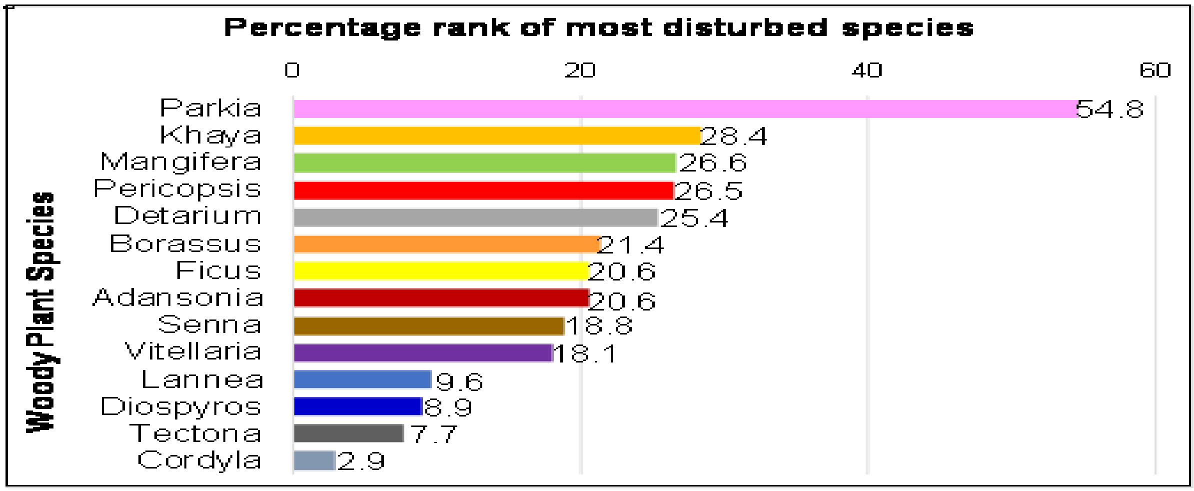

Fig. 5. Most disturbed woody plant species.

Over exploitation of woody species remained the major factor causing species loss over the years. The highest response was from Fihini (53%), followed by Daboshie (31.1%) with least respondents emerging from Cheshegu community (16%). Another important factor (large family size/population growth) which has gained international recognition was mentioned by the respondents. The Cheshegu community identified large family size as a major contributory factor (34.5%) to species loss followed by the Kpalgun community (31.3%) and least response from Daboshie.

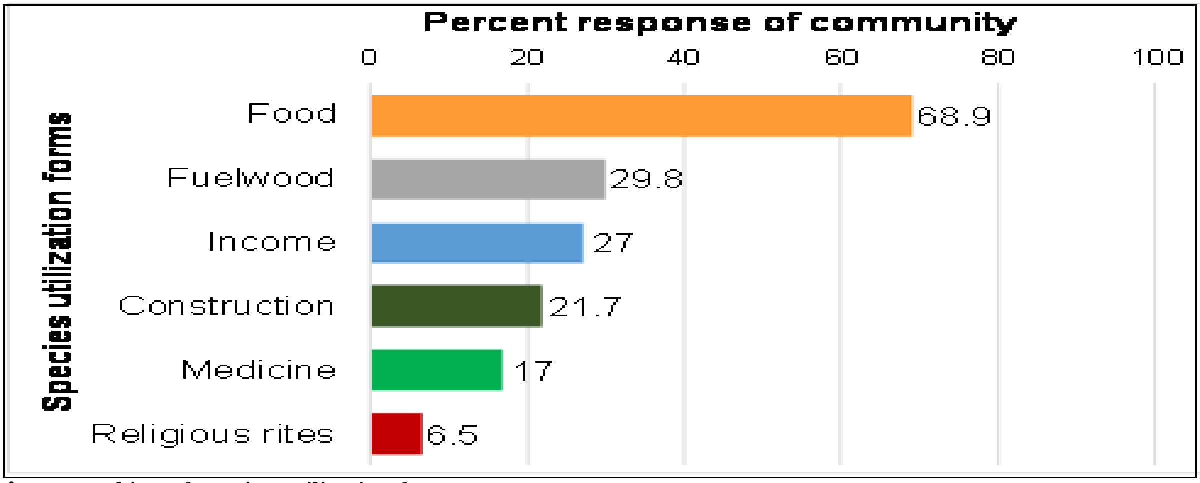

Fig. 6. Ranking of Species Utilization forms.

However, respondents of Fihini did not see large family size as a key factor to species loss in their community. Instead, over exploitation of species and deforestation were seen as key contributory factors to biodiversity loss in their community. Most existing studies have cited increasing population growth and density in Northern Ghana as a major cause of soil degradation and depletion of plant resources (Gyasi and Gordana, 2006; Ziblim *et al.*, 2013). According to Liu *et al.*, (2002) not only do exponential human population growth alter biological habitats but also threaten ecosystem functions and processes as well. Climate change in the form of inadequate rainfall and extreme temperatures was also cited by community members. In the Cheshegu community 28.2% of respondents mentioned lack of rainfall in recent years as a contributory factor to species loss followed by the Kpalgun community (13.5%) and least response from the Daboshie community (4.8%).

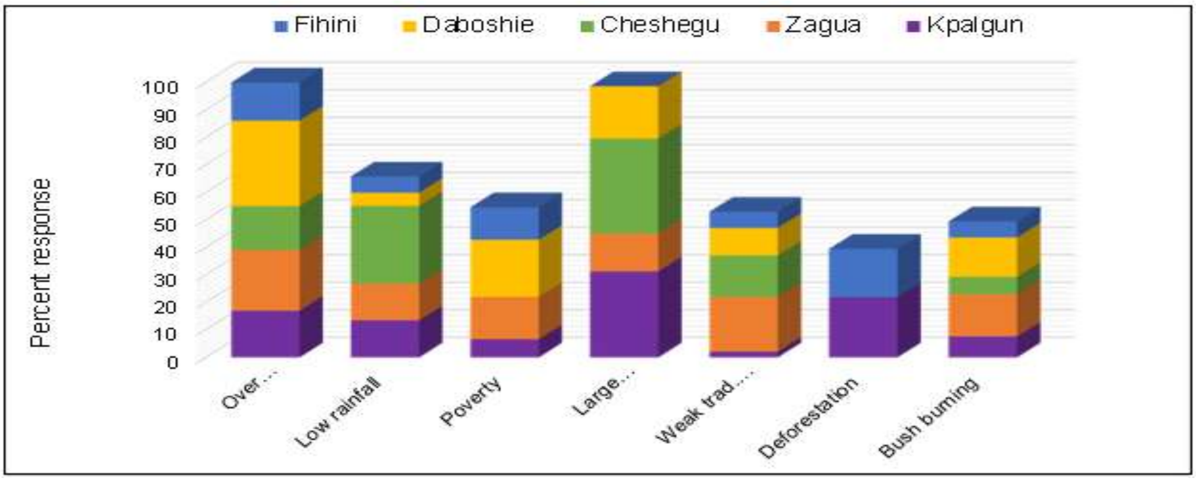

Fig. 7. Factors affecting communities' plant biological resources losses.

Particularly, climate change was cited to have accounted for poor yields, causing the death of livestock and plants species thereby affecting their livelihoods. Though high temperature was not viewed as climate change impact, discussants during focus groups expressed great concern about the negative impact long dry season is having on their rice farming due to water scarcity and drying up of rice valleys. Other unavoidable and equally important factors mentioned by the communities were poverty, breakdown in traditional values and bush fires. In terms of poverty, Daboshie had the highest response (20.8%) while Kpalgun had the lowest response (6.6%). Respondents from Cheshegu did not consider poverty as a key factor in causing loss of biological species. Rather, large family size (34.5%), lack of rainfall (28.2%) and breakdown in traditional values (15%) were the major factors they attributed to causing loss of plant species.

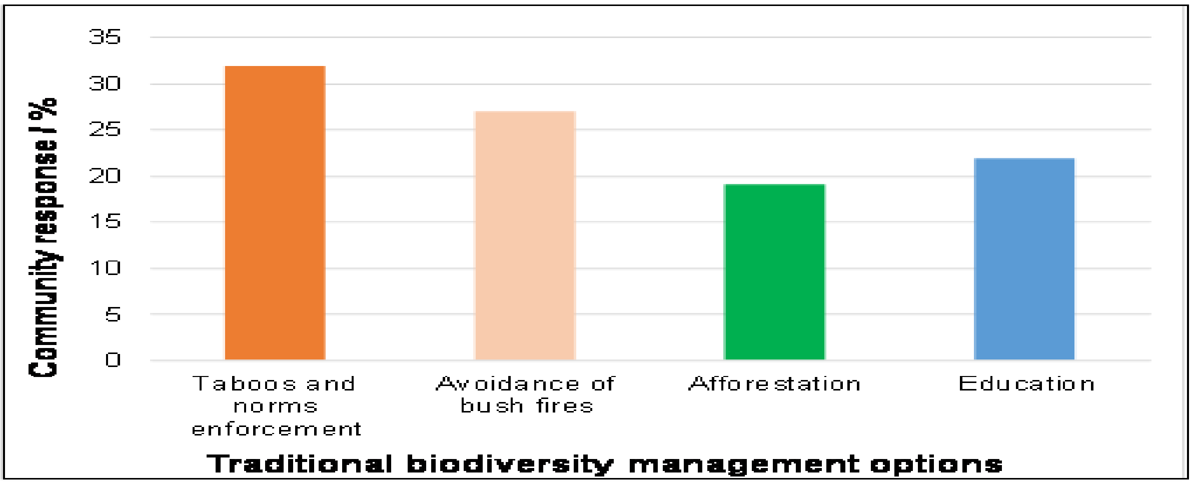

Fig. 8. Traditional options for biodiversity management.

The breakdown in traditional values and its impacts on reduction in biological resources was a major concern particularly for elders and chiefs in all the study communities'. Key informant interviews held with the chiefs and elders showed that adoption of modern Christianity by some community members has led to disregard for traditional values. For instance, the encroachment on sacred groves which hold important biological resources and serve other cultural and spiritual purposes was a major concern for most community elders.

Recent studies conducted in the Tolon area observed how bush fires is affecting the natural regrowth of most plant biodiversity particularly indigenous plant species such as the Baobab hence; reducing the services community members derive from it. The Zagua population opined to bush fires as another key factor (15.4%) as against the other communities. Though breakdown in traditional values was not considered as a major factor (2.1%) by the Kpalgun community, it instead identified deforestation (22%) as the second most important factor to causing loss of biological species apart from large family size (31.3%). The zero scores for Cheshegu, Zagua and Daboshie under deforestation shows their least interest in viewing it as a major factor causing changes in the communities' flora species.

Traditional options for biodiversity management

In recent years, biodiversity management has become a key issue in research literatures and development agenda due to the rapid rate at which species are getting extinct. However, conservation measures that have taken place in management of biological species has often not seen eye-to-eye with resource endowed communities whose livelihood mainly depends on these resources. However, increasingly, the involvement of especially local and indigenous communities in conservation of biological resources has been noted to improve efficiency and equity in resource management (Cox *et al.*, 2010). It is therefore important to learn about existing traditional options for biodiversity management. Fig. (8), shows the traditional options cited for biodiversity management by the study communities. Among the responses that were given are; enforcement of taboos and norms, avoidance of bushfires, afforestation and education. This result reiterates recent research in Northern Ghana which outlined the importance traditional beliefs and practices play in the conservation of community natural resources (Aniah *et al.*, 2014). Moreover, since the erosion of traditional beliefs was mentioned as a threat in biodiversity their continued relevance should be a concern for policy makers interested in community conservation efforts. Avoidance of bush fires by the communities remains a major concern especially as bushfires have been noted to have accelerated environmental degradation causing reduction in plant cover and destruction of wild life habitat in the fragile ecosystem of Northern Ghana (Kusimi and Appati, 2012).

In addition, community led afforestation practices is also preferred as a useful strategy for biodiversity management while helping restore degraded lands. In Zagua, there is a community initiated Shea tree afforestation project using natural regeneration and transplantation to restore degraded and some abandoned agriculture lands in the community. If such an initiative is replicated in the other study communities it will go a long way to help in species management. Finally, education of community members by traditional leaders on the value of these floral resources is also recognised as very important tool to help manage the species (Fig. 8).

Conclusion

This study of plant biodiversity and use forms highlights the rarity, commonness and state of woody species in the Tolon District of Northern Ghana. In total, 66 woody plant species belonging to 26 different families and 54 genera, in four major land use types were identified. Most important plant families identified included; Fabaceae, Anacardiaceae, Poaceae, Commelinaceae, Leguminosae, Combretaceae, Meliaceae and Compositaceae. Biodiversity assessment revealed high species diversity and evenness level in sacred groves followed by; fallow fields, open grazed fields to cultivated fields.

Dominant species identified were; *Vitellaria Paradoxa, Azadirachta indica, Parkia biglobasa, Mangifera indica, Ceiba pentandra, Anacardium occidentale, Moringa oleifera, Adansonia digitata, Ficus trichopoda* and *Tectona grandis*. Notably, these are also the most preferred plant species by the study communities. Strong significant differences between dominant and preferred species were observed in Kpalgun (r=0.92, p<0.01), Cheshegu (r=0.90, p<0.01), Zagua (r=0.89, p<0.01), Daboshie (r=0.98, p<0.01) and Fihini (r=0.79, p<0.01).

Main functional value of woody species noted were; food, source of energy fuel, income, construction material, medicine and religious rites. Common ailments treated included; dysentery, fever, piles, rheumatism, impotency, menstrual disorder among others. These suggest that use of traditional medicines help meet some of their primary health care needs which continuous to serve as an important part of rural livelihood.

Reduction in woody species density remains a major concern with unknown health implication in the study communities. Factors attributed to the species reduction were; over exploitation, large family size, bush burning/bush fires, climate variability in the form of erratic rainfall and extreme temperatures and breakdown in traditional values.

Traditional options cited for biodiversity management, revealed that enforcement of traditional laws, taboos and norms within the communities' together with education could play key role in sustainable use and management of community biological resources.

An in-depth knowledge on plant biodiversity especially at the community level makes it possible to increase food and cash crop production while improving ecosystems functions and services.

Acknowledgement
We want to thank the CECAR-Africa project for the support and opportunity to carry out this study.

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