

Full Length Research Paper

Medicinal plant use and conservation practices by communities in the Togo Plateau Forest Reserve, Ghana

Gilchrist K. Faith Dogor^{1*}, Ruby A. Nyarko¹, Alexander K. Anning¹ and Alfred Oteng-Yeboah²

¹Department of Theoretical and Applied Biology, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

²Department of Plant and Environmental Biology, University of Ghana, Accra, Ghana.

Received 3 October; Accepted 5 November, 2018

The use of plants for medicine has constituted an important aspect of primary healthcare delivery system of people throughout the world for many centuries. Nonetheless, information on medicinal plants and their conservation are still lacking in some areas, including the Togo Plateau Forest Reserve in Ghana. This paper investigates the ethnobotany of the Togo Plateau Forest Reserve, Ghana, to document the traditional knowledge, uses and conservation of medicinal plants. Information on these plants was sought through a structured questionnaire administered to 384 registered members of the Ghana Federation of Traditional Medicine Practitioners' Association including certified traditional healers, traditional birth attendants (TBAs), vendors of herbal remedies, managers of herbal medicine centers, and local plant collectors from six communities within the catchment area of the Togo Plateau Forest Reserve. The study recorded 114 medicinal plant species, including 14 herbs, 6 lianas, 21 shrubs and 74 trees that are mostly collected from the wild. The most commonly cited medicinal plant species were *Azadirachta indica*, *Alstonia boonei*, *Morinda lucida* and *Nauclea latifolia*, mostly used to treat human conditions such as malaria, jaundice, rheumatism, and cough. Most of the herbal medicines were prepared as decoctions and administered by drinking. Majority of the informants (75%) were within the age bracket of 41-60 years, with males (39%) outnumbering the females (36%). Barks, roots and leaves were the most commonly used plant parts, and these were mostly collected by destructive methods. The unregulated collection of plant parts and harvesting methods may reduce plant species richness and abundance in the area, requiring sustained conservation efforts in order to benefit from them medicinally.

Key words: Medicinal plants, Togo Plateau forest reserve, plant diversity.

INTRODUCTION

The use of plants for medicine has constituted an important aspect of primary healthcare delivery system

of people throughout the world for many centuries (Agbovie et al., 2002; Jeruto et al., 2008; WHO, 2015).

*Corresponding author. E-mail: gilchristdogor@gmail.com. Tel: +233 241418051.

Author(s) agree that this article remain permanently open access under the terms of the [Creative Commons Attribution License 4.0 International License](https://creativecommons.org/licenses/by/4.0/)

Currently, over 80% of the world's human populations rely on medicinal plants for their daily fight for better health (WHO, 2015). In Africa, in particular, medicinal plants are extensively (ca. 90%) used due to limited access to modern medical treatment, either resulting from lack of facilities or unavailability of hospital services (Satpong, 2000; Fyhrquist, 2007; Jeruto et al., 2008; Koduru et al., 2007). Studies show that about 46% of Ghanaians, for example, live in rural communities and depend largely on locally available plant resources for their health care needs (Fyhrquist, 2007).

The high demand for and dependence on traditional medicine (TM) for health care delivery in developing countries have resulted in the proliferation of traditional medicine dealers. According to the Ghana Federation of Traditional Medicine Practitioners Association (GHAFTRAM), there are more than 100,000 TM practitioners in Ghana of which 45,000 are registered. These practitioners are uniformly distributed throughout Ghana, resulting in approximately one TM practitioner for every 400 people, compared to one allopathic doctor for every 12000 people (WHO, 2015).

Several studies have documented the wide spectrum of application of medicinal plants among people (Abbiw, 1990; Addo-Fordjour et al., 2013; Jeyaprakash et al., 2011). Medicinal plants are commonly used to treat human conditions such as malaria, jaundice, migraine, cough, rheumatism and gastrointestinal pain, among others (Addo-Fordjour et al., 2013; Jeyaprakash et al., 2011). These human conditions are treated using diverse plant parts ranging from whole plant, roots, leaves and bark, with the latter being the most commonly used in herbal medicine preparation in Ghana (Addo-Fordjour et al., 2013; Asase et al., 2005; Ziblim et al., 2013) and elsewhere (Kakudidi, 2000; Kala, 2005; Kamatenesi-Mugisha et al., 2008).

Ecologists and conservationists have established that the harvesting methods often used for medicinal plants are critical to their survival (Balemie et al., 2004; Megersa et al., 2013). Destructive methods such as harvesting of the whole plant and roots, coupled with steady decline in customary laws that regulate the commercial collection of medicinal plant resources from the wild, are reportedly to cause the depletion of medicinal plant diversity as well as the indigenous knowledge associated with their conservation and use (Jeruto et al., 2008; Kamatenesi-Mugisha et al., 2008; Schippmann, 2001).

In this light, non-destructive methods of plant harvesting including consideration of the frequency, time, and season of harvesting which could affect natural regeneration (Abbiw 1990) are increasingly being encouraged. Researchers have also recommended harvesting of fruits and other aerial parts instead of the root, stem or the whole plant which could cause defoliation, debarking, root destruction and wounds (Abbiw, 1990; Jeruto, 2008). Extracting plant leaves also provides a more sustainable use strategy through rapid

replacement by re-growt (Dold and Cocks, 2002).

Available records showed that intensive gathering of plants from the wild for medicinal purposes poses serious threat to Ghana's biodiversity (Addo-Fordjour et al., 2013; Asase et al., 2005; Bussmann et al., 2011; Megersa et al., 2013; Ziblim et al., 2013) as it increases the risk of local extinction of plant species in general (Ita and Offiong, 2013) and the scarcity of commonly used medicinal plants in particular (Bussmann et al., 2011; Kamatenesi-Mugisha and Bukenya-Ziraba, 2002; Megersa et al., 2013). Consequently, increasing commitment toward efficient controls and better conservation practices can help preserve medicinal plant diversity in Ghana.

The Togo Plateau Forest Reserve, covering a total land area of 14.763 hectares is the largest forest reserve in the Volta Region of Ghana. This reserve has been recognized as a biodiversity significant area due to its wide topographic range and high elevation (Abbiw, 1990; Agbovie et al., 2002) and thus provides a variety of medicinal plants to the surrounding communities. This has resulted in a high demand for and dependence on TM by the people for their healthcare needs leading to a proliferation of practitioners in the area, whose activities could pose a threat to the medicinal plants biodiversity on the plateau. Moreover, given the diverse plant species reportedly used for medicinal purposes in the area, targeting them for conservation can positively impact biodiversity conservation in the reserve generally. There is, therefore, an urgent need for information on medicinal plant usage and conservation practices by communities fringing the Togo Plateau Forest Reserve, but this is yet to be documented. The objective of this study is to document the traditional knowledge, uses and conservation of medicinal plants among the fringed communities in the Togo Plateau Forest Reserve.

MATERIALS AND METHODS

Study area

The Togo Plateau Forest Reserve was established by the British Colonial Administration in 1929, in the then Trans-Volta-Togoland and gazetted in 1931 as a forest reserve in Ghana. The reserve occupies an area of 14.763 ha, making it the largest reserve in the Volta Region of the country. It lies within longitudes 0°15'E and 0° 45'E and latitudes 6° 45'N and 7° 15' N with elevation between 250 and 2680 m.a.s.l (Figure 1). The reserve is surrounded by several communities, most of which depend on medicinal plant resources mostly from the reserve for their healthcare needs. These communities include Hohoe, Alavanyo, Santrokofi and Akpafu, which are located within the Hohoe Municipality, as well as Bowiri and Nkonya both in the Biakoye District.

The Hohoe municipality has a total land area of 1,172 km², representing 5.6% of the land area of the Volta Region, and has Hohoe as its capital. The municipality lies in the wet semi-equatorial climatic zone, with annual rainfall of 1016-1210 mm and 4-5-month dry season between November and April. Temperatures are high throughout the year and range from 26 to about 32°C. The

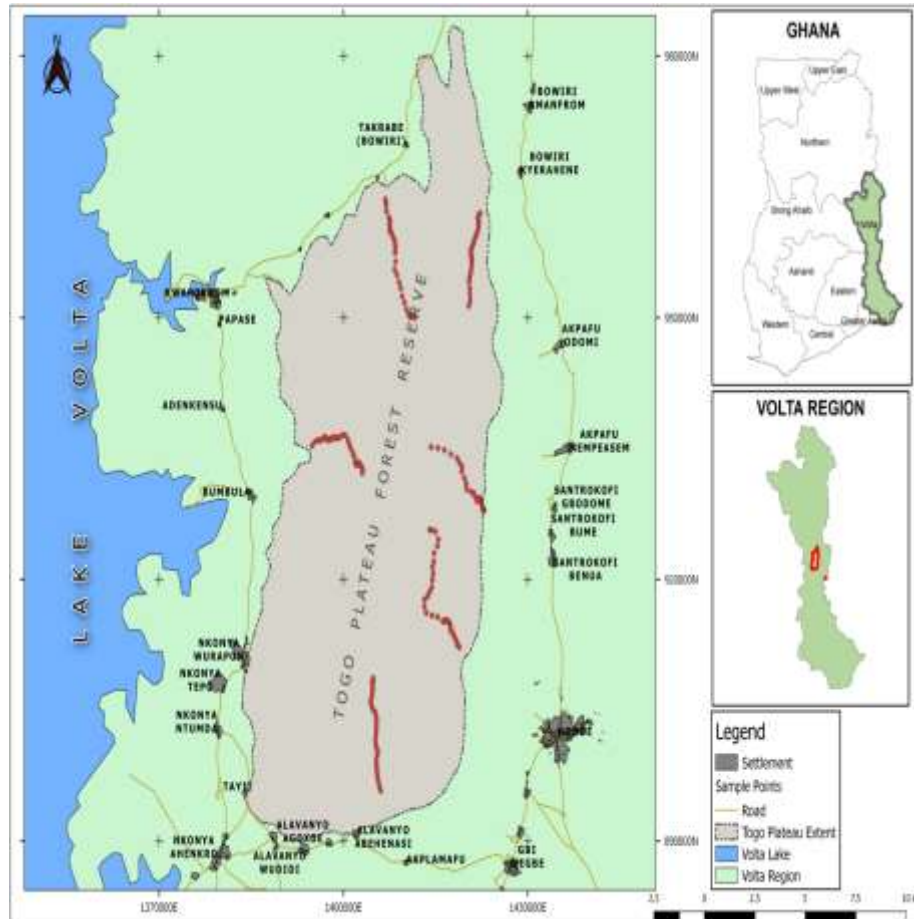


Figure 1. A map of the Togo Plateau Forest Reserve in the District Context.

population of the Municipality in 2010 was 172,950 (Ghana Statistical Service, 2010). Major economic activities include agriculture, forestry and fishery. The Biakoye District, on the other hand, has a total land area of 738.20 km², representing about 4.1% of the total land area of the region. The district capital is Nkonya Ahenkro. The district experiences the wet equatorial rainfall regime with its peak in July and September, respectively. The mean annual rainfall is about 1500 mm. There is a rather short dry season, which is characterized by the cool dry North-East trade winds from early December to mid-March. Temperatures vary between 22 and 34°C. The district is estimated to have 63,645 people (GSS, 2010). Major economic activities of the inhabitants include fishing, lumbering, carpentry, blacksmithing, distilling, palm oil extraction and gari processing.

Ethnobotanical study

Information on medicinal plant knowledge, use and their conservation status was sought through a structured questionnaire (Viertler, 2002) administered to a total of 384 people from six communities around the Togo Plateau Forest Reserve, Ghana. These informants (aged 30-70 years) were purposively and proportionately selected from each community in the order Hohoe (234 informant), Nkonya (42), Santrokofi (40), Bowiri (35), Alavanyo (23) and, Akpafu (10). The selection was done following consultation with opinion leaders, from the following category of medicinal plant

dealers: certified traditional healers, traditional birth attendants (TBAs), vendors of herbal remedies, managers of herbal medicine centers, and local plant collectors. The selected informants were confirmed by GHAFTRAM as registered members. Information on respondents and medicinal plants of the study area including demographics (age, gender and education), growth form and plant parts used, condition before use and major uses constituted the checklist. Other data gathered included preparation methods, mode of administration, location and mode of plant collection, domestication status, and conservation status of these plants. Both local and scientific names of the plants were recorded with the help of experienced taxonomists. Scientific names were verified from the online resource "The Plant List" (2013, v1.1). The survey was conducted between September, 2017 and June, 2018.

Data analysis

All medicinal plants encountered were compiled in a checklist including species name (local name, family, growth form, parts used, condition, and major uses). Descriptive statistics on the human conditions treated with the medicinal plants, the preparation methods, mode of administration and condition before use, availability, harvesting methods, and conservation status or efforts were also presented. The analyses were performed using MS Excel.

Table 1. Socio-demographic profile of respondents.

Description	Frequency (%)
Age	
30-40 years	69 (18)
41-50 years	150 (39)
51-60 years	138 (36)
61-70 years	27 (7)
Gender	
Male	229 (60)
Female	155 (40)
Education	
Basic	279 (73)
Secondary	67 (17)
Tertiary	38 (10)
Duration of practice	
1-5 years	63 (16)
6-10 years	169 (44)
11-15 years	110 (29)
16-20 years	42 (11)
Category of medicinal practice	
Certified traditional healers	114 (30)
Vendor of herbal remedies	102 (27)
Certified managers of herbal medicine centers	97 (25)
Certified traditional birth attendants	55 (14)
Local plant collectors	16 (4)

RESULTS

Socio-demographic characteristics of the studied communities

Majority of the informants (75%) were within the age bracket of 41-60 years, with males (39%) outnumbering the females (36%) (Table 1). Although all respondents had received formal education, only (17%) had reached the secondary school level or beyond. Results also indicated that all the respondents had knowledge of medicinal plants and their uses in the area, with (84%) of them claiming at least 6 years of experience as TM practitioners. Certified traditional healers constituted the largest category (30%) of practitioners identified in the study, followed by vendors of herbal medicine (27%), certified managers of herbal medicine centers (25%) and certified TBAs (14%). A small number of the respondents (4%) were classified as local plant collectors.

Medicinal plants identified in the study area

The study recorded 114 medicinal plant species,

belonging to 42 families and distributed in four growth forms (14 herbs, six lianas, 21 shrubs and 74 trees) in the six communities surveyed (Table 2). Of the 42 families recorded, Leguminosae and Euphorbiaceae emerged as the most important medicinal plant families with 21 and 10 species, respectively, followed by Apocynaceae and Moraceae with seven species each. The remaining 38 families combined contributed 69 species. The medicinal plants identified in the study were reportedly used to treat about 75 human-related conditions (Table 2). Majority of the plants (51 species) were used to treat malaria, followed by jaundice (33), rheumatism (26), cough (25) and stomach pain (22) (Figure 2). Each of the remaining 70 conditions had 1-18 medicinal plant species cited as potential cure for it. The most commonly cited medicinal plant species were *Azadirachta indica* (256), *Alstonia boonei* (230), *Morinda lucida* (212) and *Nauclea latifolia* (193) (Figure 3).

The medicinal plants in the study area were collected from three sources, namely; forest reserve, garden and farmlands. Analysis revealed that (61%) of trees were collected from the forest reserve, (26%) from the farmland and 13% from the gardens. The distribution of

Table 2. Medicinal plants used by communities in the Togo Plateau Forest Reserve, Ghana with their family, growth form, parts used and major uses.

Species Name	Local Name	Family	Growth form	Parts used	Condition	Major uses
<i>Justiciaflava</i> (Forssk.) Vahl	Ligbetovi	Acanthaceae	Herb	L,B	Fresh	dysentery
<i>Cyanthulaprostrata</i> (L.) Blume	Tsiofoganu	Amaranthaceae	Herb	W	Fresh	pain relief, heart human conditions
<i>Lanneaacida</i> A. Rich.	Kuntunkuri	Anacardiaceae	Tree	W	Fresh	Convulsion
<i>Annonasenegalensis</i> Pers.	Mampihege	Annonaceae	Tree	R	Dry	malaria, impotence, whitlow, chest pains, cough, leprosy
<i>Monodoratenuifolia</i> Benth	Yiku	Annonaceae	Tree	B,S	Fresh	malaria, dysentery/ diarrhoea, migraine
<i>Uvariadoringii</i> Diels	Gbanagbana	Annonaceae	Liana	L,B,R	Fresh	jaundice, menstrual problems, piles, sore eye, malaria
<i>Uvariachamae</i> P. Beauv.	Gbanagbana	Annonaceae	Shrub	L,B	Dry	malaria, jaundice, yellow fever, piles, sore eye,
<i>Xylopiiathropica</i> (Dunal) A. Rich	Etso	Annonaceae	Tree	L,S	Fresh	colds, coughs, piles, anaemia
<i>Alstoniaboonei</i> De Wild.	Siaketekre	Apocynaceae	Tree	B	Dry	jaundice, malaria, asthma, cough
<i>Baisseamultiflora</i> A. DC.	Agordati	Apocynaceae	Liana	L	Dry	skin irritations, malaria, asthma, fractures/ dislocation
<i>Funtumia elastica</i> (Preuss) Stapf	Okae	Apocynaceae	Tree	B	Dry	Piles
<i>Holarrhenaflorimbunda</i> (G. Don) T. Durand & Schinz	Aforkpati	Apocynaceae	Shrub	L,R	Fresh	diabetes, jaundice, breastmilk production, urinary infections, aid delivery in pregnant women
<i>Landolphiadulcis</i> (Sabine ex G. Don) Pichon		Apocynaceae	Herb	L	Fresh	indigestion, fatigue, toothache/tooth decay
<i>Rauvolfia vomitoria</i> Afzel	Dodemakpowoe	Apocynaceae	Tree	L,B	Dry	leprosy, rheumatism, fractures/ dislocations, measles
<i>Strophanthussarmentosus</i> DC.	Amatsiga	Apocynaceae	Liana	L,R	Fresh	sore eye, body pain
<i>Voacanga africana</i> Stapf	Ofuruma	Apocynaceae	Tree	W	Fresh	body pains, haenia, cancer, wounds
<i>Vernonia amygdalina</i> Del.	Egborti	Asteraceae	Shrub	L	Fresh	gastrointestinal pains
<i>Newbouldialaavis</i> (P. Beauv.) Seem.	Kpotiyia	Bignoniaceae	Shrub	R	Fresh	fractures/dislocations
<i>Spathodiacampanolata</i> P. Beauv.	Adatsigolo	Bignoniaceae	Herb	B	Dry	appetizer, backache, bladder trouble/kidney human conditions.
<i>Adansoniadigitata</i> L.	Adidoti	Bombacaceae	Tree	W	Fresh	kidney/ bladder human conditions, diuretic, diarrhea
<i>Bombax buonopozense</i> P. Beauv.	Okuo	Bombacaceae	Tree	L	Fresh	placental expulsion, childbirth, breastmilk production
<i>Ceiba pentandra</i> (L.) Gaertn	Ewuti	Bombacaceae	Tree	B	Dry	belly pains, haenia
<i>Canarium scheweinfurthii</i> Engl.	Dunorwiwo	Burseraceae	Tree	B	Fresh	chest pains, cough/ whooping cough, piles, jaundice.
<i>Celtis mildbraedii</i> Engl.		Cannabaceae	Tree	L,B	Fresh	rheumatism, dewormer, abscesses, headache, measles
<i>Myrianthus arboreus</i> Beauv.	Nyankuma	Cecropiaceae	Tree	B	Dry	migraine

Table 2. Contd.

<i>Maytenussenegalensis</i> (Lam.) Exell		Celastraceae	Shrub	W	Fresh	ulcers, wounds, gastrointestinal disorders
<i>Combretummicranta</i> G.Don	Aveto	Combretaceae	Shrub	L,B	Fresh	rheumatism, jaundice, herpatitis, bruises, sprains.
<i>Pteleopsissuberosa</i> Engl. & Diels		Combretaceae	Shrub	B	Dry	clean uterus after delivery/miscariage/abortion
<i>Terminaliamacroptera</i> Guill. & Perr	Petni	Combretaceae	Tree	R	Fresh	gastrointestinal disorders
<i>Bursocarpuscoccineus</i> Schumach	Awennade	Commelinaceae	Tree	L,R	Dry	hypertension, measles, impotence
<i>Palisotahirsuta</i> (Thunb.) K.Schum.	Klugbogbo	Commelinaceae	Herb	L	Fresh	belly pain
<i>Cnestiferruginea</i> Varl. Ex DC.	Akitase	Connaraceae	Liana	L	Fresh	Dysentery
<i>Costusafer</i> Ker Gawl. <i>Costusafer</i>	Eyra	Costaceae	Herb	L	Dry	aids early walking in infants.
<i>Diospyrosmadagascariense</i> Gürke	Kusibiri	Ebenaceae	Tree	B	Fresh	rheumatism, headache, sexual weakness, induce abortion
<i>Alcorniacardifolia</i> (Shumach. &Thonn.) Müll.Arg.	Avovlo	Euphorbiaceae	Herb	L,B	Dry	sore eye, colds, gastrointestinal and liver disorders, rheumatism, dysentery
<i>Brideliaferruginea</i> Benth.	Asaraba	Euphorbiaceae	Tree	B,R	Fresh	diuretic, aphrodisiac, rheumatism, dysentery
<i>Drypetesparvifolia</i> (Müll.Arg.) Pax&K.Hoffm.	Katrika	Euphorbiaceae	Tree	R	Fresh	catarrh
<i>Mallotusoppositifolia</i> (Geiseler) Müll.Arg.	Satadua	Euphorbiaceae	Shrub	L	Fresh	Migraine
<i>Margaritariadisoides</i> (Baill.) Webster	Pepea	Euphorbiaceae	Tree	B	Dry	abscesses, intestinal worms, induce abortion.
<i>Microdesmiapuberula</i> . Hook. F	Ofumai	Euphorbiaceae	Shrub	L,B	Fresh	expel all forms of intestinal worms
<i>Phyllanthustogoensis</i> Brunel & Roux	Kpavidetume	Euphorbiaceae	Liana	L	Fresh	typhoid fever, jaundice, malaria
<i>Ricinodendronheudelotii</i> (Baill.) Pierre ex Heckel	wamma	Euphorbiaceae	Tree	R	Fresh	anaemia, infertility
<i>Securinegavirosa</i> (Roxb. Ex Wille.) Pax.EtHoffn	Nkanna	Euphorbiaceae	Tree	R	Dry	relieve pain
<i>Uapacatogoensis</i> Baill.	Kontannini	Euphorbiaceae	Tree	B,R	Dry	stimulant against fatigue, sterility, jaundice
<i>Garcinia kola</i> Heckel	Tweapea	Guttiferae	Tree	S	Dry	chest pains, migraine
<i>Hymenocardiaacida</i> Tul.		Hymenocardiaceae	Tree	R	Dry	malaria, colds
<i>Hoslundiaopposita</i> Vahl	Akotadzeveti	Lamiaceae	Shrub	L	Fresh	stimulate liver and increase bile production
<i>Napoleonavogelii</i> Hook. & Planch.	Esia	Lecythidaceae	Tree	R	Dry	ashma, cough/whooping cough
<i>Petersianthusmacrocarpus</i> (P.Beauv.) Liben		Lecythidaceae	Tree	B,R	Fresh	bronchial trouble, general cases of cancer
<i>Afzeliaafricana</i> Pers.	wokpa	Leg-Cae	Tree	B	Dry	gastrointestinal pains, piles, pneumonia
<i>Berliniaoccidentalis</i> Keay	Kwatafom	Leg-Cae	Tree	B	Fresh	jaundice
<i>Cassia sieberiana</i> D.C	Agbobladzoe	Leg-Cae	Tree	R	Dry	kidney human conditions/ bladder trouble/ chest pains, aphrodisiac,

Table 2. Contd.

<i>Danielliaoliveri</i> (Rolfe) Hutch. & Dalziel	Sopi	Leg-Cae	Tree	B,R	Fresh	jaundice, burns, migraine, cough, headaches, stiffness, belly pains, anxiety, insanity
<i>Dialiumguineense</i> Willd.	Atortoe	Leg-Cae	Tree	R,S h	Fresh	ashma, body weakness, jaundice, tooth decay, headache
<i>Erythrophloeomsuaveolus</i> (Guill. & Perr.) Brenan	Potrodom	Leg-Cae	Tree	B	Fresh	anaesthetic, scabies, chicken pox, leprosy, guinea worm, rheumatism, migraine
<i>Griffoniasimplicifolia</i> (DC.) Baill.	Kagya	Leg-Cae	Shrub	L	Fresh	kidney/bladder human conditions
<i>Sennasiamea</i> (Lam.) (Lam) H.S.Irwin		Leg-Cae	Tree	R	Dry	malaria, jaundice, sore throat
<i>Acacia kamerunensis</i> Gand.	Nnwere	Leg-Mim	Shrub	B,R	Fresh	kidney /bladder human conditions, fever, colds, aphrodisiac
<i>Albiziazygia</i> (DC.) J.F Macbr.	Toziwa	Leg-Mim	Tree	B	Dry	purgative, intestinal worms, bronchitis, cough
<i>Entadaabyssinica</i> Steud. Ex A. Rich		Leg-Mim	Tree	L	Fresh	malaria, rheumatism, stomach wounds, cough
<i>Parkia bicolor</i> A. Chev.	Dawadawa	Leg-Mim	Tree	B	Fresh	bronchitis, cough, abscesses
<i>Piptadestiarumaffricanum</i> (Hook. f.) Brenan	Yewoye	Leg-Mim	Tree	R	Dry	abortion
<i>Tetrapleuratetraptera</i> (Schum & Thonn.) Taub	Prekese	Leg-Mim	Tree	F	Dry	Malaria
<i>Abrusprecatorius</i> L.	Dedekude	Leg-Pap	Herb	L,F	Fresh	inflammation of small and large intestine
<i>Amphimasptero carpoides</i> Harms	Yaya	Leg-Pap	Tree	R	Dry	blood tonic
<i>Baphianitida</i> Lodd	Toti/Odzori	Leg-Pap	Tree	R	Fresh	gastrointestinal pains
<i>Lonchocarpuscyanescens</i> (Schum. & Thonn.) Benth	Santa	Leg-Pap	Shrub	R	Dry	rheumatism, aphrodisiac, childhood diarrhoea, blood tonic.
<i>Milletiazechiana</i> Harms	Amatike	Leg-Pap	Tree	B	Dry	bronchial trouble
<i>Pterocarpusmalbraedii</i> Harms	Hote	Leg-Pap	Tree	L,R	Fresh	body weakness, dysentery, cough, bronchitis, rashes
<i>Tamarindusindica</i> L.	Tamarind	Leg-Pap	Tree	R	Fresh	snake bite, asthma
<i>Anthocleistadjalonensis</i> A. Chev.	Gboloba	Loganiaceae	Tree	B	Dry	rheumatism, joint pains
<i>Azadirachtaindica</i> A. Juss.	Liliti	Meliaceae	Tree	B,R	Dry	malaria, jaundice, body weakness
<i>Khayaivorensis</i> A. Chev.	Logo	Meliaceae	Tree	B	Fresh	blood supply, gastrointestinal pains, rheumatism
<i>Khayasenegalensis</i> (Desr.) A. Juss.	Logo	Meliaceae	Tree	L,B	Dry	malaria, anaemia, jaundice, gastrointestinal pains
<i>Trichiliaheudelotii</i> Planch. ex Oliv.	Tandro	Meliaceae	Tree	B	Fresh	malaria, gastrointestinal pains, cough, jaundice
<i>Antiaristoxicaria</i> Lesch.	Loko	Moraceae	Tree	B	Dry	cough/whooping cough
<i>Ficusexasperata</i> Vahl.	Tsatsaflala	Moraceae	Tree	L,B	Fresh	migraine, cough
<i>Ficusingens</i> Del.		Moraceae	Tree	R	Fresh	menstrual disorders
<i>Leucaenaglauca</i> (L.) Benth.	Odzimtsui	Moraceae	Tree	R	Dry	prevent miscarriage, body weakness
<i>Milliciaexcelsa</i> (Welw.) C. C Berg	Odum	Moraceae	Tree	B	Fresh	headache, malaria
<i>Treculiaafricana</i> Decne		Moraceae	Tree	R	Fresh	skin irritations

Table 2. Contd.

<i>Trilepisiummadagascariense</i> DC.	Dzekludzi	Moraceae	Tree	B	Dry	cough/ whooping cough
<i>Pycnanthusangolensis</i> (Welw.) Warb.	kpornugbordeti	Myristicaceae	Tree	L,B	Fresh	appetizer, digestive tonic
<i>Eugenia calophylloides</i> DC.	Pepra	Myrtaceae	Shrub	S	Dry	dewormer
<i>Lophiralanceolata</i> Banks ex C.F.Gaertn.	Azobe	Ochnaceae	Tree	R	Fresh	migraine, headache, backache, jaundice
<i>Olaxsuscorpoides</i> Oliv.	Ahoohendedua	Olacaceae	Shrub	L,R	Dry	jaundice, yellow fever, malaria, aphrodisiac
<i>Adenialobata</i> (Jacq.) Engl.	Damalia	Passifloraceae	Herb	B	Dry	aphrodisiac
<i>Piper guineense</i> Schumach. &Thonn.	Kale	Piperaceae	Tree	L,B	Dry	malaria, jaundice, yellow fever, piles, body pains
<i>Cymbopogoncitratu</i> s (DC.) Stapf.	Tigbe	Poaceae	Herb	L	Fresh	malaria, hypertension
<i>Securidacalolongependuculata</i> Fresen.	Kpaliga		Tree	B,R	Fresh	leprosy, sore eye, rheumatism, migraine, snake bite
<i>Crossopterixfabrifuga</i> (Afzel. Ex G.Don) Benth.	Pakyisie	Rubiaceae	Shrub	L,B	Dry	sterility, aphrodisiac, breast milk production, chest pain, cough/whooping cough, gastrointestinal pain
<i>Morindalucida</i> Benth.	Venamakpa	Rubiaceae	Tree	R	Fresh	Malaria
<i>Nauclealatifolia</i> Sm.	Egbesi/Nyimo	Rubiaceae	Tree	R	Fresh	sexual weakness
<i>Pavettacorymbosa</i> (DC.) F. N. Williams	Kronko	Rubiaceae	Tree	L,B	Fresh	syphilis, jaundice, cough, malaria, rheumatism, bronchitis
<i>Rothmanialongiflora</i> Salisb.	samankube	Rubiaceae	Shrub	L,B	Fresh	prevent miscarriage, relief pain,
<i>Cytrusaurantifolia</i> (Christm.) Swingle	Mumoe/Donti	Rutaceae	Tree	R	Fresh	urine retention, gonorrhoea, syphilis, bilharziasis
<i>Clausenaanisata</i> (Willd) Hook.f. exBenth.	Eyira/Amuti	Rutaceae	Shrub	L,R	Fresh	sore eye, measles, cough, sore throat, headache, piles, heart human conditions, rheumatism, body pains
<i>Zanthoxylumleprieurii</i> Guill. & Perr.	Exedza	Rutaceae	Tree	L,B,R	Fresh	appetizer, migraine, haenia, rheumatism
<i>Zanthoxylumzanthoxyloides</i> (Lam.) Waterm.	Xeti/Xeke	Rutaceae	Tree	B,R	Fresh	sore eye, induce pregnancy, gastrointestinal pains, impotence,abscesses, rheumatism, paralysis
<i>Allophylusafricanus</i> P. Beauv.	(Kotamenyati)	Sapindaceae	Tree	R	Fresh	migraine, fracture/dislocation/sprains, rheumatism
<i>Blighiasapida</i> K.D. Koenig	Akye	Sapindaceae	Tree	R,B	Fresh	jaundice, migraine, haenia
<i>Cardiospermumgrandiflorum</i> Sw.	Tooto	Sapindaceae	Shrub	B,R	Fresh	sore eye, appetizer
<i>Deinbolliapinnata</i> (Poir.) Schumach. &Thonn.	Potoke	Sapindaceae	Shrub	L,R	Fresh	aphrodisiac, ashma
<i>Lecaniodiscuscapanoides</i> Planch. Ex Benth.	Dwindwera	Sapindaceae	Tree	B,R	Fresh	jaundice, migraine, fractures
<i>Paulliniapinnata</i> L.	Adifiehotsui	Sapindaceae	Herb	W	Fresh	fractures/dislocations, abscesses ,malaria, yellow fever
<i>Manilkaramultinervis</i> (Baker) Dubard	Yiku	Sapotaceae	Tree	B	Fresh	Cough
<i>Vitellariaparadoxa</i> Gaertn. F.	Yorkuti	Sapotaceae	Tree	R,S	Fresh	diabetes, stroke, waist pain, fracture

Table 2. Contd.

<i>Cola giganteal.</i>	Bisiti	Sterculiaceae	Tree	B	Fresh	waist pains, piles
<i>Pterygotamacrocarpa</i> K. Schum.	kyereye	Sterculiaceae	Tree	L	Fresh	flatulence
<i>Sterculiatragacantha</i> Lindl.	Sofo	Sterculiaceae	Tree	R,Sh	Fresh	boils, malaria, expel intestinal worms, whitlow
<i>GrewiaPubescens</i>	Yuatega	Tiliaceae	Shrub	L	Fresh	measles
<i>Tremaorientalis</i> (Linn.) Blume	Wadzawadza	Ulmaceae	Tree	L,B	Fresh	appetizer, haenia, sterility, high blood pressure,
<i>Centellaasiastica</i> (L.)	Gatigati	Umbelliferae	Herb	L	Fresh	Leprosy
<i>Clerodendrumumbellatum</i> Poir.		Verbenaceae	Liana	L	Fresh	belly pain
<i>Vitexdoniana</i> Sweet	Eforti	Verbenaceae	Tree	R,B	Fresh	colds, chicken pox, leprosy, sterility

NB: Bark (B), root (R), leaf (L), seed (S), shoot (Sh), whole plant (W), fruit (F).

shrubs and herbs followed a similar pattern as the trees, with majority collected from forests. Medicinal lianas were collected from two sources, namely; forest (80%) and farmland (20%) (Table 3).

Considering the domestication status, 65% of the tree species was collected from the wild while 35% was cultivated. From the shrubs, 68% were wild species whilst 32% were cultivated; 53% of the herbs were wild species whilst 47% were cultivated (Table 3). Different plant parts were used for the preparation of the traditional medicines (e.g., barks, roots, leaves, seeds and fruits). Of these, the bark (54 species) was more widely used than the roots (48) and leaves (44), but a few species however, the medicines are derived from the whole plant (6), seeds (5), fruits (3) and shoots (2) respectively (Figure 4).

Methods of preparation and modes of administration of medicinal plants

The most prevalent methods of medicinal plants preparation among the communities in the study area were decoction (51%), pounded (14%),

powder (12%) and boil (10%). Other medicines were seldomly prepared as infusion (4%), concoction (3%), crushed/mashed (2%), balm/ointment (1%) and with juice, tea, tincture and poultice all accounting for less than (1%) (Table 4). With respect to the mode of administration of the drugs, 59% of the respondents reported that the medicines are taken orally. Other modes of administration include rubbing (10%), bathing (7%) and vapour bathing (6%). Few remedy preparations were applied through inhale vapour, drop on eye, ear, nose, sniffed, massage, chewed/swallowed and sit-bath (1–5%) (Table 4).

Medicinal plants and conservation practices

Most of the medicinal plants harvesting methods adopted by the respondents in the study area are destructive (81%) (Table 5). Most people collected the plant parts (59%) for medicine instead of the whole plant (11%) or individual plants (30%). On the availability of medicinal plants, 64% of the people noted that the plants were difficult or very difficult to find these days (Table 5). On whether

the reserve was necessary or not, majority of the people (45%) responded in the affirmative (Table 5). On the feasibility of conserving the medicinal plants, only 36% of the respondents agreed this was possible. The rest either did not agree (43%) or did not even appreciate the benefit associated with it (21%). Half (50%) of the respondent could not tell whether or not any conservation efforts had been made to save the Plateau from total degradation, although 31% acknowledged the initiation of such efforts either by the government or the community.

DISCUSSION

Demographic characteristics of the respondents

The study results confirmed the view that knowledge on medicinal uses of plants is often confined to the elderly (Abbiw, 1990; Addo-Fordjour et al., 2013; Jeyaprakash et al., 2011). This observation might be due to the fact that majority of the people in the study communities mostly spend their early years schooling and only

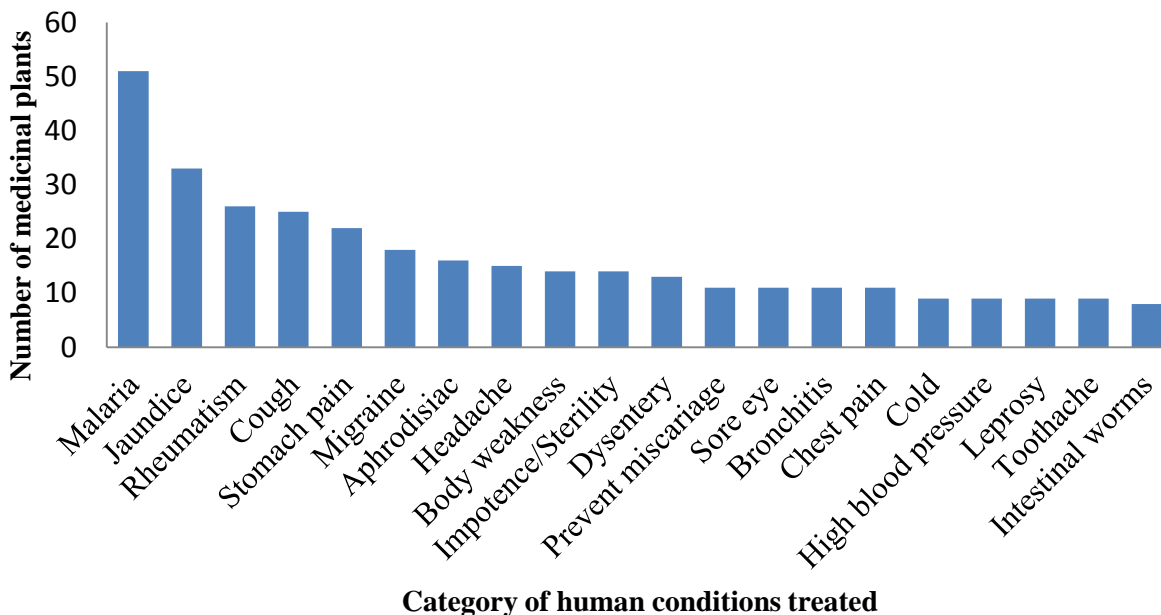


Figure 2. Human conditions cured using the recorded medicinal plants of the study area.

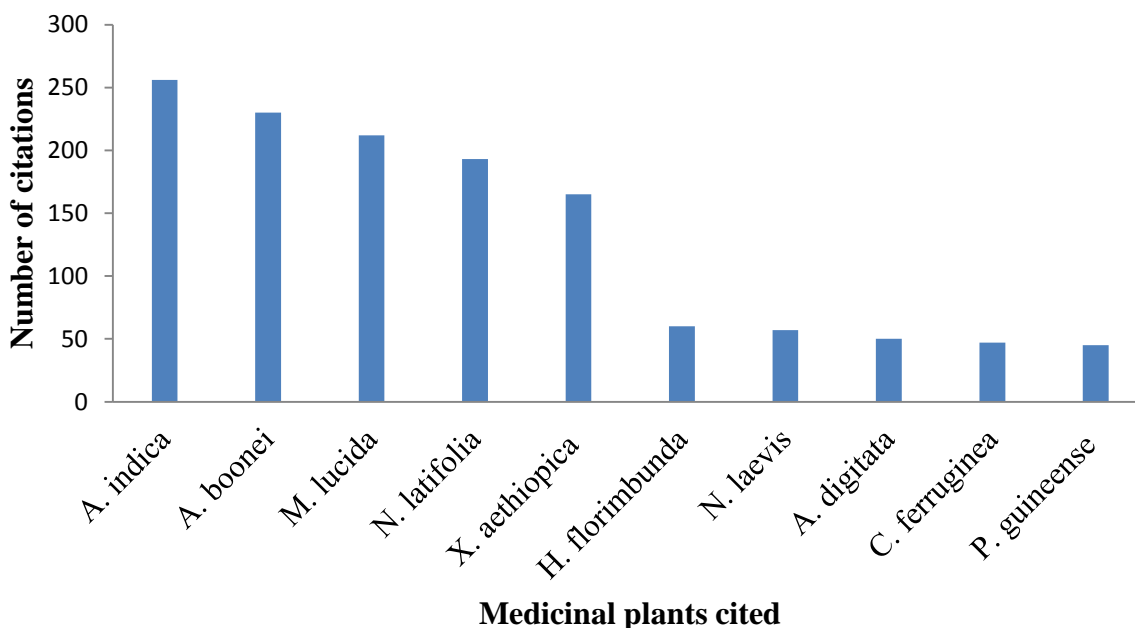


Figure 3. Most important medicinal plants recorded in the study area.

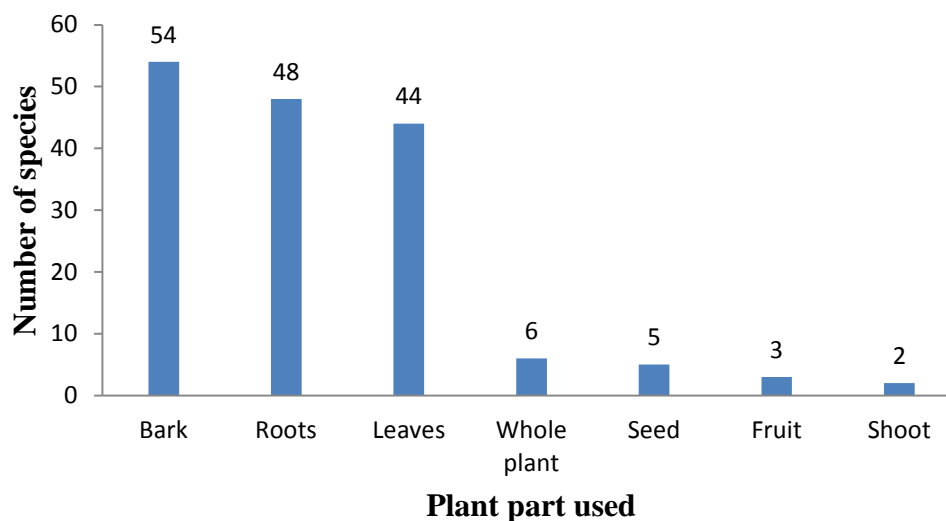
resort to traditional medicine practice if they do not find jobs after school. The younger generation may also be ignorant about the vast medicinal resources available in their surroundings and/or are typically more inclined toward market resources (Addo-Fordjour et al., 2013).

The male dominance in the traditional medicinal practice over their female counterparts in this study could be linked to gender roles. The hectic nature of medicinal

plants collection and processing appears to discourage many women from the practice. The few women encountered were mostly into vendorship (Abbiw, 1990; Addo-Fordjour et al., 2013). The educational status of respondents helps to ascertain their mindset towards conservation of medicinal plant species. People who have higher/tertiary education are believed to have a potential knowledge of conservation of medicinal plants

Table 3. Relationships among growth forms, collection location, and domestication status of medicinal plants (values are percentages).

Growth form	Medicinal		Collection location			Domestication status	
	Uses	Forest	Farmland	Garden	Wild	Cultivated	
Tree	62	61	26	13	65	35	
Shrubs	20	62	25	13	68	32	
Herbs	13	53	31	16	53	47	
Liana	5	80	20	-	80	20	

**Figure 4.** Plant parts used for the treatment of human conditions.

and their use in curing human ailments than those with no or low level of education (Abbiw, 1990; Addo-Fordjour et al., 2013). Thus, the generally low level of education in the area (with 73% ending at the basic level) might have accounted for the limited knowledge on conservation of the medicinal plant species (Abbiw, 1990).

Medicinal plants use in the study area

Medicinal plant species richness (114) recorded by the communities around the Togo Plateau Forest Reserve is within the range recorded by several similar studies. For example, Jeruto et al. (2008) recorded 115 species in the Nandi Forest in Kenya, Okello et al. (2009) recorded 107 species as used by the Sabaot people around Mt. Elgon, Ndegwa (2012) recorded 119 species as used by the Ogiek people in the East Mau forest, and Megersa et al. (2013) also recorded 126 species in WayuTuka District, West Ethiopia. Other studies, however, recorded less than 100 species. For example, e.g., Amri and Kisangau (2012) recorded 82 species in Kimboza Forest Reserve in Morogoro, Tanzania, Ziblim et al. (2013) recorded 47 species in the Northern Region, Ghana whereas Addo-Fordjour et al. (2013) had 52 species in the Aparapi

Forest Reserve also in Ghana. The generally high number of medicinal plants species listed in this study confirms the vast knowledge of the people on medicinal plants in the area and their applications to treat human conditions.

The herbal preparations made from these medicinal plants were mostly used to treat malaria (51 species), jaundice (33), rheumatism (26), cough (25) and stomach pain (22), among others. This is evidenced in most of the informants citing plant species like *Azadirachta indica*, *Alstonia boonei*, *Morinda lucida*, *Nauclea latifolia*, etc. for the treatment of malaria, consistent with a number of previous studies (Addo-Fordjour et al., 2013; Asase et al., 2005; Jeyaprakash et al., 2011).

The greater contribution of the families Leguminosae, Euphorbiaceae, Apocynaceae and Moraceae to the medicinal plant species in this study confirms many similar studies (Abbiw, 1990; Asase et al., 2005). The more frequent use of trees for medicinal purpose by these communities relative to lianas, herbs and shrubs is also well documented by many studies (Amri and Kisangau, 2012; Jeruto et al., 2008; Megersa et al., 2013; Ndegwa, 2012; Okello et al., 2009).

Leguminosae happened to have most abundant and widely distributed component species on the plateau from

Table 4. Method of preparation and mode of administration of medicinal plants.

Description	Frequency (%)
Method of preparation	
Decoction	196(51)
Pounded	55(14)
Powder	46(12)
Boil	37(10)
Infusion	15(4)
Concoction	12(3)
Crushed/Mashed	10(2)
Balm/Ointment	5(1)
Juice	4(0.9)
Tea	2(0.6)
Tincture	1(0.3)
Poultice	1(0.3)
Mode of administration	
Drink	227(59)
Rub	38(10)
Bath	28(7)
Vapour bath	23(6)
Inhale vapour	20(5)
Drop on eye, ear, nose	19(5)
Sniffed	12(3)
Massage	8(2)
Chewed/Swallowed	6(2)
Sitz-bath	3(1)

the inventory study, probably explaining why the people are more familiar with plants from this family and their uses.

The study communities are very close to the reserve and this makes assessing it for medicinal plants an easy task. This has accounted for most of the plants listed being wild species (Abbiw, 1990; Addo-Fordjour et al., 2013; Datta et al., 2014; Ziblim et al., 2013). This practice of collecting most of the medicinal plants from the reserve by these communities is a threat to the survival of the reserve as it is now visibly seen that the wild stock of the reserve is eroded at the base. The practice is against the recommendations made by WHO (2015) that medicinal plant materials should be cultivated in farmlands and gardens to ensure their continual supply and therefore reduce the pressure on wild species. Countries like China have cultivated between 100–250 species of medicinal plants (Schippmann et al., 2002). In Africa, however, South Africa is the only country with records of cultivation of medicinal plants, and even that an estimated 99% of the 400–550 species currently sold for use in traditional medicine originate from wild sources and only 1% are cultivated (Kakudidi et al., 2000).

The collection and use of plant barks and roots for medicinal purposes by the communities are not

compatible with international conservation policies (Bussmann et al., 2011; Kamatenesi-Mugisha et al., 2000; Kamatenesi-Mugisha and Bukenya-Ziraba, 2002; Ziblim et al., 2013), as such practices can affect the survival of plants or may even remove their gene pool from the population. For that matter, harvesting of these plant parts would require careful monitoring to allow sufficient time for regeneration of the medicinal plants. The low level of education of the informants might be the reason why most of them are not adhering to the basic scientific principles of medicinal plants harvesting in a sustainable way.

Method of preparation and mode of administration of medicinal plants

The use of different preparation methods of medicinal plants (e.g., decoction, pounded, powder, boil, infusion, concoction) and modes of administration (either internally or externally) to cure human conditions agree with many similar studies around forest-fringed communities (Abbiw, 1990).

The *decoction* was obtained by boiling the plant parts in water until the volume of the water reduced to minimum

Table 5. Conservation practices in relation to medicinal plant use in the TPF area, Ghana.

Description	Frequency (%)
Mode of plant collection	
Only part collected	227(59)
One/Few individuals collected	117(30)
Whole plant	40(11)
Plant harvesting methods	
Destructive	312(81)
Non destructive	72(19)
Plant availability	
Easy to find	138(36)
Difficult to find	209(54)
Very difficult to find	37(10)
Is the reserve necessary?	
Yes	174(45)
No	118(31)
I don't know	92(24)
Can these medicinal plants be conserved?	
No	165(43)
Yes	139(36)
I don't know	80(21)
Any conservation efforts made by Government/Community?	
I don't know	191(50)
Yes	118(31)
No	75(19)

or required amount. The *powder* was prepared by grinding or pounding of the dried plant parts. The *inhalation* was done by burning of plant parts and inhaling the smoke through the nose or mouth. *Poultices* were done by crushing the plant part and mixing with a little hot water and apply directly over the area. *Rubbing* was done by crushing the plant part and mixing with water or processed as ointment/liniment and rubbed on body.

Tincture was prepared by placing the plant part into alcohol and leaving it to steep for a few days in a tightly sealed container. *Infusion* was done by steeping the plant part in cold water/hot water often overnight, the mixture is then strained.

The herbal remedies commonly used by the studied communities including drinking, rubbing, bathing, vapour bathing and inhalation are in keeping with findings of previous studies in Ghana (Abbiw, 1990; Addo-Fordjour et al., 2013; Asase et al., 2005; Ziblim et al., 2013). The frequent citation of malaria as the human conditions mostly treated with the medicinal plants in this study points to the widespread nature of these human

conditions in the country and the urgent need to reverse this trend not only in the study area but also in other rural areas.

Medicinal plants and conservation practices

The unsustainable harvesting method employed by the respondents in the study area is a major concern as these activities can cause genetic erosion from the population and a general decline of biodiversity (Balemie et al., 2004; Megersa et al., 2013). Other threats to medicinal plants availability reported by the informants include drought, deforestation and firewood collection. Addressing some of these issues would require the domestication of some medicinal plant species which the indigenous people can easily fall on for their traditional remedies. This will reduce the pressure on the wild species. However, opinion on the need for the reserve by the people of the study area was very high. This is good because such reserves provide numerous benefits to

man, including the maintenance of global and regional temperatures within appreciable range through the sequestration of carbon, protection of endangered species by serving as habitats, provision of food, supply of oxygen, etc. (Akerle et al., 1991; Balemie et al., 2004; Bodeker, 2002; Busmann et al., 2011; Kamatenesi-Mugisha et al., 2000; Kamatenesi-Mugisha and Bukenya-Ziraba, 2002; Megersa et al., 2013).

The negative view of conservation of the reserve by some of the informants, citing restricted access to forest products, which serve as the source of their livelihood sustenance and restricted access to medicinal plants leading to loss of traditional botanical/medicinal knowledge is quite a serious issue (Akerle et al., 1991; Balemie et al., 2004; Bodeker, 2002; Kamatenesi-Mugisha et al., 2000; Megersa et al., 2013).

In this regard, the establishment of by-laws by the Ghana Wildlife Society to regulate collection of medicinal plants from the reserve is a step in the right direction. There should be conscious effort by both the government and the community towards the conservation of biodiversity of the plateau.

Conclusion

The study results demonstrated a rich diversity of medicinal plants used to treat a variety of ailments by communities around the Togo Plateau Forest Reserve. Leguminosae is the most represented medicinal plant family in the study area. This is evident from the floristic inventory, which recorded most of the tree species from this family on the landscape. The component species should therefore be targeted and managed sustainably. Crucially, most of the medicinal plants were collected from the reserve, exposing it to the danger of deforestation. Domestication (cultivation of medicinal plants in farmlands and gardens) therefore is the obvious management choice as it could help reduce the pressure on the wild species stock (Bodeker, 2002). The local people have very little knowledge on conservation issues; hence there is an urgent need to include them in resources utilization and management of the reserve. Also there is the need for workshops to be organised periodically by resource persons from either the Ghana Federation of Traditional Medicine Practitioners' Association or Ghana Forestry Services Division to educate these plant poachers on appropriate conservation measures for plant exploitation.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Abbiw D (1990). Useful plants of Ghana. London: Intermediate Technology Publications Ltd. and the Royal Botanic Gardens, Kew.

- Addo-Fordjour P, Anning AK, Belford EJD, Akonnor D (2013). Diversity and conservation of medicinal plants in the Bomaa community of the BrongAhafo region, Ghana. *Journal of Medicinal Plants Research* 2 (9):226-233.
- Agbovie T, Amponsah K, Crentsil OR, Dennis F, Odamttten GT, Ofusohene-Djan W (2002). Conservation and sustainable use of medicinal plants in Ghana: Ethnobotanical survey. <http://www.unepwcmc.org/species/plants/ghana>
- Akerle O, Heywood V, Syngé H (1991). The conservation of medicinal plants: proceedings of an International Consultations 21-27 march 1988 held at Chiang Mai, Thailand.
- Amri E, Kisangau DP (2012). Ethnobotanical study of plants used in villages around Kimboza forest reserve in Morogoro, Tanzania. *Journal of Ethnobiology and Ethnomedicine*, 8:1 <http://www.ethnobiomed.com/content/8/1/1>
- Asase A, Oteng-Yeboah AA, Odamttten GT, Simmonds MS (2005). Ethnobotanical study of some Ghanaian antimalarial plants. *Journal of Ethnopharmacology Department of Botany University of Ghana*. 99 (2):273-279.
- Balemie K, Kelbessa E, Asfaw Z (2004). Indigenous medicinal plant utilization, management and threats in Fentalle area, Eastern Shewa, Ethiopia. *Ethiopian Journal of Biology Science* 3(1):370-58.
- Bodeker G (2002). *Medicinal Plants: Towards Sustainability and Security*. Green College, Oxford, UK.
- Busmann RW, Swartzinsky P, Worede A, Evangelista P (2011). Plant use in Odo-Bulu and Demaro, Bale region, Ethiopia. *J. Ethnobiol. Ethnomed.* 7:28 University Press pp. 337-358.
- Datta T, Patra AK, Dastidar SG (2014). Medicinal plants used by tribal population of Coochbehar district, West Bengal, India. *Department of Zoology, Ananda Chandra College, Jalpaiguri-735101, West Bengal, India*.
- Dold T, Cocks M (2001). The trade in medicinal plants in the Eastern Cape Province, South Africa. *TRAFFIC Bulletin* 18: 11-13.
- Fyhrquist P (2007) Traditional Medicinal uses and biological activities of some extracts of African Combretum, Terminalia and Pteleopsis species 183 p.
- Ghana Statistical Service (GSS) (2010). *Population and Housing Census (PHC)*.
- Ita PB, Offiong EE (2013). *Medicinal Plants Used in Traditional Medicine by Rural Communities in Cross River State, Nigeria* Department of Forestry and Wildlife Resources Management, University of Calabar, Calabar
- Jeyaparakash K, Ayyanar M, Geetha KN, Sekar T (2011). Traditional uses of medicinal plants among the tribal people in Theni District (Western Ghats), Southern India. *Asian Pacific Journal of Tropical Biomedicine* 1(1):S20-S25.
- Jeruto P, Lukhoba C, Ouma G (2008). An ethnobotanical study of medicinal plants used by the Nandi people in Kenya. *Journal of Ethnopharmacology* 116(2):370-376.
- Kakudidi EKZ, Bukenya-Ziraba R, Kasenene JM (2000). The medicinal plants in and around Kibale National Park in Western Uganda. *A Norwegian Journal of Botany (Lidia)* 5:109-124.
- Kala CP (2005). Current status of medicinal plants used by traditional vaidyas in Uttaranchal State of India. *Ethnobotany Research Applied* 3:267-278.
- Kamatenesi-Mugisha M, Bukenya-Ziraba R (2002). Ethnobotanical survey methods to monitor and assess the sustainable harvesting of medicinal plants in Uganda. In Maunder et al. (eds) *Plant Conservation in the Tropics. Perspectives and practice*. Royal Botanic Gardens, Kew. The Cromwell Press Ltd, UK, pp. 467-482.
- Kamatenesi-Mugisha M, Oryem-Origa H, Odyek O, Makawiti DW (2008). Medicinal plants used in the treatment of fungal and bacterial infections in and around Queen Elizabeth Biosphere Reserve, Western Uganda. *African Journal of Ecology* 46:90-97.
- Koduru S, Grierson DS, Afolayan AJ (2007). Ethnobotanical information of medicinal plants used for treatment of cancer in the Eastern Cape Province, South Africa. *Current Science* 92(7):906-908.
- Megersa M, Asfaw Z, Kelbessa E, Beyene A, Woldeab B (2013). An ethnobotanical study of medicinal plants in WayuTuka District, East Welega Zone of Oromia Regional State, West Ethiopia.
- Ndegwa FK (2012). Use, conservation and harvesting of medicinal

- plants by the Ogiek people of East Mau forest, Nakuru district, Kenya. Kenyatta University.
- Okello J, Ssegawa P (2007). Medicinal plants used by communities of Ngaisubcounty, Apac district, Northern Uganda. *African Journal of Ecology* 45:76-83.
- Okello SV, Nyunja RO, Netondo GW, Onyango JC (2009). Ethnobotanical study of medicinal plants used by Sabaots of Mt. Elgon Kenya. *African Journal of Traditional, Complementary and Alternative Medicines* 7(1):1-10.
- Schippmann U, Leaman DJ, Cunningham AB (2002). Impact of Cultivation and Gathering of Medicinal Plants on Biodiversity: Global Trends and Issues. Inter-Department Working Group on Biology Diversity for Food and Agriculture, FAO, Rome, Italy.
- Satpong K (2000). Traditional medicine for the 21st century in Ghana- The role of the scientist/researcher. Commonwealth Lecture Theatre, University of Ghana, as part of traditional medicine week celebrations for the year 2000.
- Viertler RB (2002). Métodos antropológicos como ferramenta para estudo em etnobiologia e etnoecologia. pp. 12-29. In: M.C.M. Amorozo; L.C. Ming & S.M.P. Silva (orgs.). Métodos de coleta e análise de dados em etnobiologia, etnoecologia e disciplinas correlatas. Rio Claro, UNESP/CNPq.
- World Health Organization (WHO) (2015) Traditional medicine – growing needs and potential. *WHO Policy Perspectives Medecine* 2:1-6.
- Ziblim IA, Khan AT, Eledi JD (2013). Exploitation and use of medicinal plants, Northern Region, Ghana University for Development Studies, Department of Range and Wildlife Management, Nyankpala Campus. Tamale, Ghana.