Medicinal plant use and integration of traditional healers into health care system: A case study at Ankasa Forest Reserve and catchment communities in Ghana

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Research

Abstract

Background: The study documented the medicinal plants used to treat diseases and assessed the level of integration of traditional medicine practice (TMP) into the health care delivery system in the study area.

Methods: A structured questionnaire was purposively used to select informants from Ghana Federation of Traditional Medicine Practitioners Association. The ethnographic method using a semi-structured questionnaire, interviews and group discussions was employed to collect data for assessing level of integration. The Relative Frequency of Citation (RFC) and Used Value (UV) of the species were determined.

Results: A total of 132 medicinal plant species was recorded. The most dominant family was the Fabaceae (19 species), growth form was the tree (76 % of species), the commonly used plant part was the bark (81 species), a disease commonly treated was malaria (34 species), and most common method of drug preparation was decoction (46.1 %). The medicinal plants with the highest RFC (0.90) and UV (1.72) values were *Morinda lucida* Benth. and *Nauclea latifolia* Sm. respectively. The low level of integration of TMP into the care health system was mainly due to poor collaboration between TMPs and biomedical staff.

Conclusion: Traditional communities rely on medicinal plants for primary healthcare but poor conservation practices put the knowledge and practice of traditional healing at a risk. The integration of TMP into the health care system needs Ghana government`s attention in the study area.

Key words: Medicinal plants, Ankasa Forest Reserve, Traditional medicine practice

Background

The global use of plant medicine is ascending, forming an important part of the primary health care delivery system especially in the developing world (Ssenku *et al*. 2022; Sanchez *et al*. 2020). Medicinal plants are readily available, widely accepted by many traditional cultures and perceived to be safe and efficacious (Sanchez *et al*. 2020). Due to the high demand for plant

medicine globally, it is necessary to document them for effective conservation and cultivation (Salmeron-Manzano *et al*. 2020).

The use of plants for medicine has gradually been refined over the generations and has become known in many countries as traditional medicine. According to WHO (2000), traditional medicine encompasses the total of knowledge, skills and practices based on the beliefs and experiences of indigenous to different cultures, whether explicable or not, used in the maintenance of health, as well as in the prevention, diagnoses, improvement or treatment of physical and mental illness. Over 80 % of the world`s population depends on medicinal plants for better health (Tugume & Nyakoojo, 2019). In Africa, reliance on alternative medicine is partly due to the high cost of modern medicine and the lack of access to health facilities (Rahman *et al*. 2022). About 70 % of Ghanaians depend on traditional complementary and integrative medicine practices (TCIM) for primary health care needs (Kenu *et al*. 2021). TCIM was integrated into the mainstream health care delivery system in 2012 (Kenu *et al*. 2021). The relatively large portion of the Ghanaian population that depends on traditional medicine, has led to the proliferation of traditional medicine practitioners (TMP) and the consequent setting up of the Federation of Traditional Medicine Practitioners Association (GHAFTRAM), with over 45,000 registered members distributed throughout Ghana (WHO 2015).

Several studies have been conducted in Ghana to document the use of medicinal plants (Addo-Fordjour *et al*. 2013) to treat human ailments such as cough, asthma, rheumatism, jaundice, malaria and migraine (Addo-Fordjour *et al*. 2013; Jeyaprakash *et al*. 2011). Plant parts used to treat these human ailments include roots, shoot, leaves, fruits, bark and whole plant (Addo-Fordjour *et al*. 2013; Ziblim *et al*. 2013). The most commonly used part for herbal medicine preparation in Ghana is the bark (Addo-Fordjour *et al*. 2013), which is corroborated by other countries` work (Aremu & Pendota, 2021; Jaradat & Zaid, 2019). The methods employed in harvesting medicinal plants are critical to their survival (Ssenku *et al*. 2022). Over-exploitation, destructive harvesting techniques and the continuous decline in the enforcement of customary laws that regulate the commercial collection of medicinal plants from the wild; have been identified as significant threats affecting the sustainability of medicinal plants (Papageorgiou *et al*. 2020). This has led to reduced medicinal plant diversity and a decline in the indigenous knowledge associated with use and conservation of medicinal plants (Singh *et al*. 2022; Arjona-Garcia *et al*. 2021). Researchers have stated that defoliation, root destruction, debarking and creation of wounds on medicinal plants could be reduced by harvesting fruits and other aerial parts of the plants. Moreover, non-destructive methods for harvesting medicinal plants considering the season, time, and frequency will assist the natural regeneration of the plants (Papageorgiou *et al*. 2020; Pandey & Savita, 2017). Local extinctions of medicinal plant species leading to scarcity of the most commonly used plants, have been reported by several authors (Ssenku *et al*. 2022; Howes *et al*. 2020, Addo-Fordjour *et al*. 2013). This calls for sustainable use and cultivation of medicinal plants. In this light, better conservation practices would help preserve medicinal plant diversity in Ghana.

Traditional healing is the most common alternative health care delivery system in Ghana, with a traditional healer-patient ratio of 1: 400 while that for doctors (orthodox) to the population is 1: 12000 (Ampomah *et al*. 2022). In response, the government of Ghana since 2012 has implemented interventions that integrate traditional medicine into its national health delivery system. However, the empirical evidence on the level of integration of TM into the health system, including that of the study area, is scanty. The integration would help preserve herbal medicines for relatively longer periods because of the improved packaging, thereby, reducing the pressures on the forest reserve. Again, organized and supervised harvesting of essential medicinal plants from the reserve could be formalized to make the communities part of the conservation processes.

The Ankasa Forest Reserve was logged until 1976 (Tilahun *et al*. 2016) and had challenges with encroachers, though the government is very committed to securing the reserve. The large number of medicinal plants in the reserve has contributed to increasing TMPs in the area. Thus, there is a need for information on medicinal plant usage and conservation practices by the surrounding/ fringe communities of the Ankasa Forest Reserve. This study was undertaken to document the traditional knowledge, uses and conservation of medicinal plants among the surrounding/ fringe communities around the Ankasa Forest Reserve; and to assess the challenges hindering TM integration into the health system, while emphasizing opportunities.

Materials and Methods

Study area

The Ankasa Conservation Area, which is located in the Jomoro Municipality, incorporates the Nini Suhien National Park in the north, and the Ankasa Forest Reserve in the south. The Ankasa Conservation Area covers 492 square kilometres of which 332 square kilometres form the Ankasa Forest Reserve (Tilahun *et al*. 2016). Several communities within the catchment area of the reserve depend on medicinal plant resources partly from the reserve for their health care needs. These include Half

Assini, Elubo, Asamkrom and Tikobo No. 1 located in the Jomoro Municipality as well as Nkroful and Esiama in the Ellembelle District.

The Jomoro Municipality (Figure 1) is located in the Southwestern part of the Western Region of Ghana. It lies between latitudes 4^0 80" N and 5^0 21" N and longitudes 2^0 35" W and 3^0 07" W with a total land area of 1,495 square kilometers, and a population of 126,576 (GSS, 2021). The Municipal capital is Half Assini. The climate is classified as equitorial moonson with a variable weather, including moderate to heavy rainfall. The municipality is noted as the wettest part of the country with mean annual rainfall exceeding 1.732mm. The temperature is generally high with monthly mean of 26^0 C. The major economic activity is farming (cocoa, coconut and oil palm). The Ellembelle District, on the other hand, is located between longitude 2^0 05" W and 2^0 35" W and latitude 4^0 40" and 5^0 20" N. It covers a total land area of 995. 8 km^2 with a population of 120,893 (GSS, 2021). The district capital is Nkroful. The district lies within the semi-equatorial climatic zone with mean annual rainfall ranging from 26.8 mm to 46.6 mm. The average mean temperature is 29.40^0 C. Major economic activities include farming (cocoa, coffee, rubber and coconut), fishing and mining.

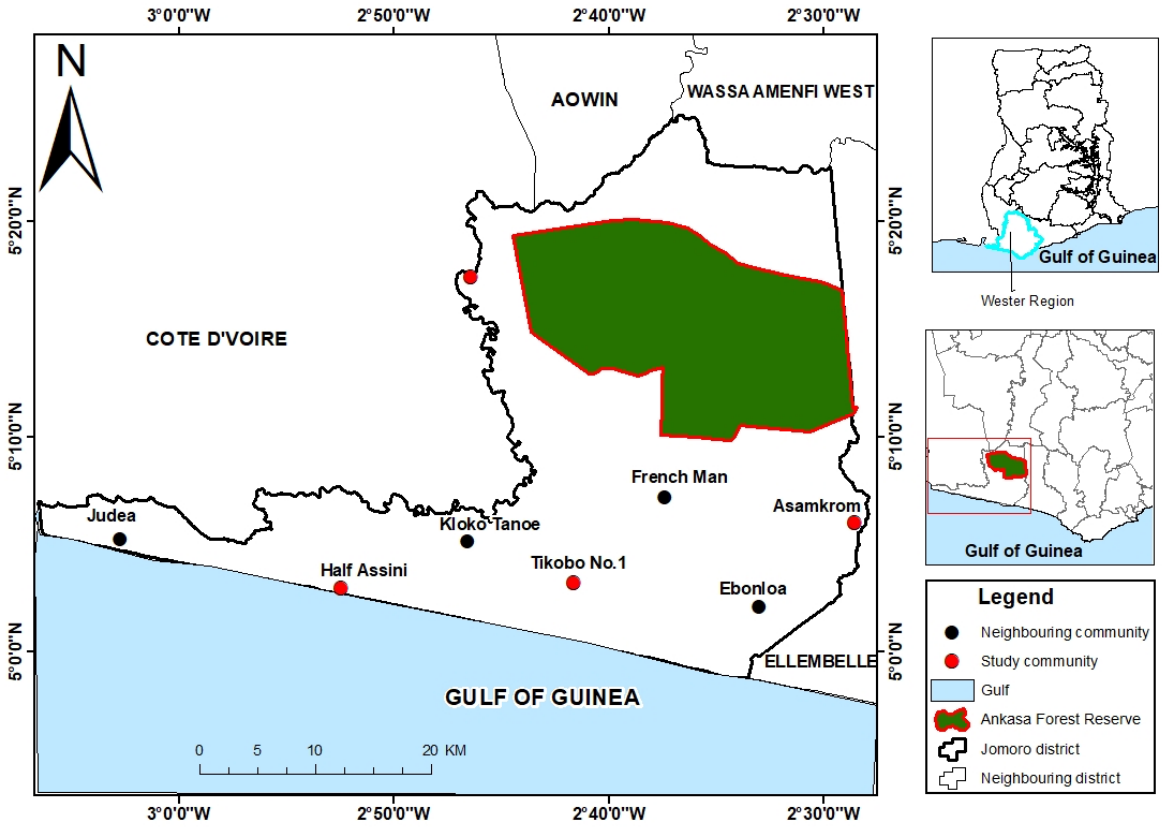

Figure 1. Map of study area showing Ankasa Forest Reserve

Ethnobotanical study

A semi-structured questionnaire was used to obtain information about medicinal plant knowledge, use and conservation status. The questionnaire was administered to a total of 304 people from six communities around the Ankasa Forest Reserve. The respondents (aged 30-68 years) were selected in consultation with leaders of the following categories of medicinal plant dealers; certified traditional healers, vendors of herbal remedies, managers of herbal medicine shops, traditional birth attendants and local plant collectors. These informants who were confirmed as registered members by leaders of GHAFTRAM, were purposively and proportionately selected from each community in the order Half Assini (120 informants), Elubo (68), Esiama (40), Nkroful (34), Asemkrom (22), and Tikobo No. 1 (20). The checklists for this study constituted information on respondents and medicinal plants of the study area. These included demographics of respondents (age, gender and education) and plant parts used, growth form, condition before use and major uses. Data on preparation methods, mode of administration, mode of plant collection, domestication status and conservation status of the medicinal plant species were also collected. The local and scientific names of the plant species were recorded with the help of taxonomists from the Herbarium Unit at University of Cape Coast, Ghana. The scientific names were verified using published

flora (Hawthorne & Jongking 2006; Dokosi 1998; Hawthrone 1993; Hall & Swaine 1981; Innes 1977; Hutchinson & Daizel 1963; Irvine 1961; Hutchinson & Daizel 1958). The survey was done between January and November, 2022.

Integration of traditional healers into the health delivery system

The ethnographic research method was used to obtain insight into traditional healers` practices and beliefs, Traditional Medicine Practitioners (TMP) and Traditional Birth Attendants (TBA), and their patients. The study selected three groups of participants namely; biomedical health care staff, traditional healers and patients. The traditional healers were purposely selected with the consent of GHAFTRAM while a convenient sampling method was used in selecting the patients. Two assistants were employed for the study. One assistant who was from GHAFTRAM facilitated entry and served as gate-keeper and the other a female, assisted with translation especially with TBAs who mainly were women. Twenty in-depth individual interviews were conducted with the traditional healers; ten semi-structured interviews were organized with biomedical staff (nurse, midwife, hospital coordinators) from Half Assini Government Hospital and Esiama Community Health Centre, and twenty informal patient interviews (10 each from traditional and orthodox care facilities) were also conducted. Observational data was obtained from visits to the biomedical health facilities and homes of healers where they attend to their patients.

Data analysis

The medicinal plants obtained from the study were compiled into a checklist showing species name, local name, family, growth form, parts used, condition, and major uses. Simple descriptive statistics were adopted for data analysis using STATA version 15.0. The results were summarized in the form of bar graphs and tables.

Relative frequency citation (RFC)

The local significance of each plant species was determined through the relative frequency of citation (which does not consider the "use-category").

$$RFC = FC/N \qquad \text{(Chismale } et\ al\text{. 2023)}$$

Where:

FC = the number of informants who mentioned the use of the species

N = the total number of informants participating in the study.

Use value (UV)

The index is used to find out the relative importance of each species locally used for treating ailments.

$$V = \sum U/n \qquad \text{(Hani } et\ al\text{. 2022).}$$

Where:

∑U = the number of uses told by each informant for the given plant species,

n = the total number of informants interviewed for that particular plant.

The value of *UV* is high when more uses are reported for a plant and low when fewer uses are reported for a plant (Hani *et al*. 2022)).

Results

Socio-demographic characteristics of the communities

Most of the respondents (76 %) fall within the age bracket of 41-60 years with the men (40 %) and 36 % women (Table 1). The average age of the respondents was 49.9 years. All the respondents had received formal education, however, only 9 % were up to the tertiary level. The knowledge of medicinal plants and their uses in the study area is appreciable, with 81% having at least six years of experience as traditional practitioners. This field in the study area is dominated by certified traditional healers (32 %), followed by vendors of herbal medicine (29 %) and then certified managers of herbal medicine shops (23 %). Certified traditional birth attendants formed 13 % of the respondents and a small percentage of the respondents (3 %) were certified as local plant collectors. From the data, age and duration of practice (Table 1) influenced traditional medicine practice in the study area as respondents between 51-70 years with considerable number of years in practice (11-20 years) dominated the certified traditional healing (20 %) and TBA (8 %) categories.

Table 1. Socio-demographic profile of respondents

Description	Frequency (%)
Age	
30-40 years	50 (16)
41-50 years	122 (40)
51-60 years	109 (36)
61-70 years	23 (8)
Gender	
Male	194 (64)
Female	110 (36)
Education	
Basic	216 (71)
Secondary	61 (20)
Tertiary	27 (9)
Duration of practice	
1-5 years	58 (19)
6-10 years	122 (40)
11-15 years	94 (31)
16-20 years	30 (10)
Category of medicinal practice	
Certified traditional healer	97 (32)
Vendors of herbal medicine	88 (29)
Certified managers of herbal medicine shops	70 (23)
Certified traditional birth attendants	40 (13)
Local plant collectors	9 (3)

Medicinal plants identified in the study area

One hundred and thirty-two medicinal plant species belonging to 47 families and distributed into four growth forms (trees, shrubs, lianas and herbs), were identified in the six communities surveyed during the study (Table 2). The Fabaceae (19 species) distributed in 5 subfamilies, Caesalpinioideae (6 species), Cercidoideae (1 species), Detarioideae (7 species), Dialioideae (1 species) and Papilionoideae (4 species); and the Euphorbiaceae (13 species) and Rubiaceae (10 species) were identified as the most important medicinal plant families. The medicinal plants were reportedly used to treat 88 human-related conditions (Table 2). Most of the medicinal plants were used to treat malaria (34 species), cough (26 species), rheumatism (15 species), stomach pain (14 species), anaemia (14 species), body pain (13 species) and jaundice (13 species) (Figure 2). The Relative Frequency of Citation (RFC) ranged from 0.9 to 0.03. The most frequently mentioned medicinal plants included *Morinda lucida* Benth. (RFC = 0.90), *Nuclea latifolia* Sm. (RFC = 0.88), *Dialium guineense* Willd. (RFC = 0.87), *Alstonei boonei* De Wild. (RFC = 0.74) and *Dacryodes klaineana* (Pierre) H. J. Lam. (RFC = 0.65) (Figure 3). The results from the study indicated that the Used Values (UV) ranged from 1.72 to 0.04 (Figure 4). The most commonly used medicinal plants included *Nuclea latifolia* (1.72), *Morinda lucida* (1.64), *Tiliacora dinklagei* Engl. (1.54*), Alstonei boonei* (1.52) and *Dialium guineense* (1.48). The study identified forest reserve, farmlands and gardens as the three main sources for the collection of medicinal plants. From the data, 65% of the medicinal plants obtained from trees were collected from the reserve, 17% from farmlands and 13% from the gardens (Table 3). This pattern was also observed in the collection of shrubs and herbs, with majority collected from the forest. Medicinal lianas were collected from two sources, the forest (82 %) and farmland (18 %) (Table 3). The domestication status of the medicinal plants showed that 68 % of the tree species was collected from the wild while 32% was cultivated (Table 3). For the herbs, 56 % were wild whilst 44 % were cultivated; 70 % of the shrubs were wild, whilst 30% were cultivated (Table 3). Plant parts used for the preparation of traditional medicines included barks, roots, leaves, seeds and fruits (Figure 5). The most widely used parts were the bark (81 species), root (57 species) and leaves (49 species). In some cases, the traditional medicines were obtained from seeds (8 species), whole plant (6 species), fruit (6 species) and shoot (4 species) (Figure 5).

Table 2. Medicinal plants used for treatment of diseases by communities around the Ankasa Forest Reserve, Ghana

Pant families and scientific names	Local Name	Growth form	Voucher Specimen	Parts used	Condition	Diseases Treated	IUCN status
Acanthaceae							
Justicia flava (Forsk.) Vahl.	Ntumunum	Herb	UCC-38	L	Fresh	Haemorrhoids, Stomach disorder	VU
Amaranthaceae							
Cyathula prostrata (L.) Blume	Apupua	Herb	UCC-158	W	Fresh	Body weakness, Human heart condition	NA
Annonaceae							
Monodora tenuifolia Benth.	Motokuradua	Tree	UCC-446	B, S	Fresh	Diarrhoea, Migraine, Malaria	LC
Piptostigma fasciculatum (De Wild) Boutique ex R. E. Fr.	Dankwakyere	Tree	UCC-193	L	Dry	Malaria, Cough	LC
Xylopia aethiopica (Dunal) A. Rich	Hwentia	Tree	UCC-560	L, S	Fresh	Anaemia, Catarrh, Piles, Malaria, Typhoid	LC
Apocynaceae							
Alstonia boonei De Willd.	Sinuro	Tree	UCC-876	B, L	Dry	Malaria, Cough, Bronchitis, Asthma	LC
Funtumia elastica (Preuss) Stapf	Fruntum	Tree	UCC-85	B, R	Dry	Asthma, Piles	LC
Holarrhena floribunda (G. Don) T. Durand & Schinz.	Sese	Tree	UCC-97	L, R	Fresh	Jaundice, Diabetes, Sterility, Urinary infection, Snake bite	LC
Picralima nitida (Stapf.) Durand & Durand	Akuama	Tree	UCC-3037	L,	Fresh	Intestinal worm, Jaundice, Constipation, Malaria	NA
Rauvolfia vomitoria Afzel.	Kakapenpen	Tree	UCC-1006	L, B	Dry	Rheumatism, Dislocation, Measles, Leprosy	LC
Tabernaemontana africana A. DC.	Obonawa	Tree	UCC-465	L	Fresh	Malaria, Body weakness, Headache	LC
Voacanga africana Stapf.	Ofuruma	Tree	UCC-1205	B, R	Fresh	Wound, Cancer, Hernia, Malaria	LC
Araceae							
Culcasia falcifolia Engl.	-	Herb	UCC-1398	W	Fresh	Diarrhoea, Skin swelling	LC
Asclepiadaceae							
Parquetina ingrescens (Afzel.) Bullock	Amo	Herb	UCC-5299	W	Fresh	Asthma, Jaundice, Lumbago	NA
Asteraceae							
Acanthospermum hispidum DC.	Sharaha-nsoe	Herb	UCC-3673	W	Fresh	Malaria, Stomach disorder	NA
Biden Pilosa L.	Gyinantwi	Herb	UCC-3611	W	Fresh	Hypertension, Anaemia	NA
Synedrella nodiflora (L.) Gaertn.	Mamponfo	Herb	UCC-800	L	Fresh	Epilepsy	NA
Wedelia africana P. Beauv.	Mfofo	Herb	UCC-817	L	Fresh	Asthma, Cataract, Ulcer, Styptic	NA
Vernonia amygdalina Del.	Awonwene	Shrub	UCC-4009	L	Fresh	Induces vomiting, Gastrointestinal disorders	NA
Bignoniaceae							
Spathodia campanolata P. Beauv.	Aninsu	Herb	UCC-4001	B, R	Dry	Kidney/ bladder human condition, Appetizer	NA

Bombacaceae							
Bombax buonopozense P. Beauv.	Okuo	Tree	UCC-2916	L	Fresh	Eases childbirth/ Placental expulsion, Breastmilk production	LC
Ceiba pentandra (L.) Gaertn.	Onyina	Tree	UCC-1828	B	Dry	Hernia, Belly pains	LC
Rhodognaphalon brevicuspe (Sprague) Roberty	Akye	Tree	UCC-4511	B, R	Dry	Rheumatism, Stomach wound, Malaria	VU
Burseraceae							
Canarium schweinfurthii Engl.	Esa	Tree	UCC-67	B, R	Fresh	Piles, Jaundice, Cough, Bronchitis, Malaria	LC
Dacryodes klaineana (Pierre.) H. J. Lam.	Adwea	Tree	UCC-3030	B, R	Dry	Menstrual disorders, Belly pain, Cough, Malaria	LC
Cecropiaceae							
Myrianthus arboreus Beauv.	Nyankumabere	Tree	UCC-701	B, R	Dry	Headache, Migraine, Relieve pain	LC
Clusiaceae							
Allanblackia parviflora A. Chev.	Sonkyi	Tree	UCC-1542	B, F	Dry	Asthma, Dysentery, Toothache, Elephantiasis	NA
Garcinia afzelia Engl.	Nsokodua	Tree	UCC-742	R	Fresh	Aphrodisiac, Cough	VU
Garcinia kola Heckel	Tweapea-akoa	Tree	UCC-677	L, B	Dry	Malaria, Dysentery, Chest pains, Migraine	VU
Pentadesma butyracea Sabine	Abotoasebie	Tree	UCC-1506	S	Fresh	Cough	LC
Combretaceae							
Pteleopsis suberosa Engl. & Diels.	Possinkpo	Shrub	UCC-1461	B, R	Dry	Washing of uterus after delivery/ Miscarriage	LC
Terminalia ivorensis A. Chev.	Emire	Tree	UCC-900	B	Dry	Kidney/Bladder human condition, Aphrodisiac, Skin ulcer, Body pains	VU
Terminalia macroptera Guill. & Perr.	Senufo	Tree	UCC-1463	R	Fresh	Syphilis, Gastrointestinal disorder, Boil, Anaemia	LC
Commelinaceae							
Palisota hirsuta (Thunb.) K. Schum.	Mpentem	Herb	UCC-207	R	Dry	Dysentery, Anaemia	NA
Tiliacora dinklagei Engl.	Susanfo	Herb	UCC-278	L, B	Fresh	Stomach pain, Sexual impotence, Waist pain, Fracture	NA
Connaraceae							
Cnestis ferruginea Varl. ex DC.	Apose	Liana	UCC-4789	L	Fresh	Body weakness, Dysentery, Cough, Malaria	NA
Crassulaceae							
Kalanchoe crenata (Andrews) Haw.	Egoro	Herb	UCC-222	L, R	Fresh	Catarrh, Tonic, Inflammation	NA
Cucurbitaceae							
Cucumis melo L.	Kuradonton	Herb	UCC-313	B	Dry	Cough, Blood tonic, Stomach pains, Malaria	NA
Momordica charantia	Nyanya	Herb	UCC-244	L, S	Fresh	Diabetes, Hypertension	NA
Ebenaceae							
Diospyros madagascariense Gurke	Tweto-menewa	Tree	UCC-5028	B, R	Fresh	Induce abortion, Migraine, Headache, Sexual weakness	NA
Diospyros sanza-minika A. Chev.	Kusibiri	Tree	UCC-5018	B, R	Dry	Body weakness, Inflammation, Epilepsy	LC

Euphorbiaceae								
*Discoglyprema caloneura (*Pax) Prain		Fetefre	Tree	UCC-315	B, R	Dry	Cough, Stomach wound	LC
Drypetes aubrevillei Leandri		Duamoko	Tree	UCC-5077	L, B	Dry	Bronchitis, Rheumatism, Body weakness	LC
Drypetes gilgiana (Pax.) Pax. & Hoffm.		Katrikanini	Tree	UCC-5144	B	Dry	Bronchitis, Rheumatism, Pneumonia, Malaria	NA
Drypetes parvifolia (Mull. Arg.) Pax & K. Hoffm.		Katrikabere	Tree	UCC-4272	R	Fresh	Catarrh	NA
Elaeophorbia grandifolia (Haw.) Croizat		Kanne	Tree	UCC-421	L, R	Fresh	Contraceptive, Boils	NA
Maesobotrya barteri (Bail.) Hutch.		Apotrewa	Tree	UCC-388	B. R	Fresh	Jaundice, Cough, Aid delivery in pregnant women, Urethal discharge	NA
Mallotus oppositifolius (Geiseler) Mull. Arg.		Satadua	Shrub	UCC-3738	L, R	Fresh	Lumbago, Migraine, Dysentery, Measles, Whitlow, Styptic	LC
Margaritaria discoidea (Baill.) Webster		Pepea	Tree	UCC-4999	B, R	Dry	Gastrointestinal disorders, Intestinal worms, Induce abortion	LC
Microdesmis puberula Hook. f.		Ofema	Shrub	UCC-217	B	Fresh	Intestinal worms	LC
Pycnocoma macrophylla Benth.		Kafiekafie	Tree	UCC-300	B	Dry	Infertility, Aphrodisiac	LC
Ricinodendron heudelotii (Bail.) Pierre ex Heckel		Wama	Tree	UCC-3781	B, R	Fresh	Anaemia, Female infertility, Stomach pains	LC
Scaphopetalum amoenum A. Chev.		Nsoto	Tree	UCC-3187	L	Fresh	Facilitates Delivery/ Abortion, Diarrhoea, Dysentery, Cough	LC
Uapaca guineensis Mull. Arg.		Kontan	Tree	UCC-5199	B, R	Dry	Migraine, Rheumatism, Malaria, Aphrodisiac, Piles, Joint pains	LC
Fabaceae	**Subfamily**							
	Caesalpinioideae							
	Albizia ferruginea (Gull. & Perr.) Benth.	Awiemfosamina	Tree	UCC-944	B, R	Dry	Jaundice, Wound, Dysentery	NT
	Albizia glaberrima (Schum. & Thonn.) Benth.	Kora-akoa	Tree	UCC-614	B	Fresh	Anaemia, Migraine, Cough, Malaria	LC
	Cassia occidentalis L.	Mbofrabrode	Herb	UCC-531	L, F	Fresh	Hypertension	LC
	Parkia bicolor A. Chev.	Asoma	Tree	UCC-808	B	Dry	Asthma, Bronchitis, Abscesses, Whooping cough	LC
	Piptadeniastrum africanum (Hook.f.) Brenan	Dahoma	Tree	UCC-3299	B, R	Fresh	Hernia, Piles	LC
	Tetrapleura tetraptera (Shum &Thonn.) Taub.	Prekese	Tree	UCC-1204	F	Dry	Malaria, Anaemia	LC
	Cercidoideae							
	Griffonia simplicifolia (Vahl. ex DC.) Bai	Kagya	Shrub	UCC-135	L, R	Dry	Fracture, Congestion, Pelvis, Impotence	NA
	Detarioideae							
	Afzelia africana Pers.	Papao	Tree	UCC-616	B, R	Dry	Pneumonia, Piles, Malaria	VU
	Berlinia occidentalis Keay.	Okoo	Tree	UCC-4801	B	Fresh	Malaria, Jaundice	VU

	Cynometra ananta Hutch. & Diaz.	Okoo	Tree	UCC-141	B	Fresh	Malaria, Jaundice	LC
	Daniellia ogea (Harms.) Rolfe ex Holland	Ehyedua	Tree	UCC-171	R	Dry	Asthma, Snake bite, Gonorrhoea	NT
	Daniellia thurifera J. J. Bennet	Sopi	Tree	UCC-312	B, R	Fresh	Skin irritation, Anaesthetic	LC
	Gilbertiodendron limba (Scott-Elliot) J. Leonard	Kotoprepre	Tree	UCC-3308	L	Dry	Inflammation, Ulcers, Body weakness	NT
	Pellegriniodendron diphyllum (Harms.) J. Leonard	Felefele	Tree	UCC-412	B	Fresh	Intestinal worms, Malaria	NT
	Dialioideae							
	Dialium guineense Willd.	Asena	Tree	UCC-99	R, B, Sh	Fresh	Jaundice, Bronchitis, Asthma, Cough, Painkiller	LC
	Papilionoideae							
	Amphimas pterocarpoides Harms.	Yaya	Tree	UCC-4322	R	Fresh	Blood tonic, Anaemia	LC
	Baphia nitida Lodd	Adwene	Tree	UCC-1055	L, B	Fresh	Yaws, Diarrhoea, Boil, Lumbar pain	LC
	Baphia pubescens Hook.f.	Odwenkobiri	Tree	UCC-1655	L	Fresh	Chest pain, Rheumatism	LC
	Pericopsis elata (Harms.) Meeuwen	Kokrodua	Tree	UCC-707	L, B	Dry	Malaria, Relieve pain	EN
Lamiaceae								
Hoslundia opposita Vahl.		Aberewaninsu	Shrub	UCC-510	L	Fresh	Increase bile production	NA
Lauraceae								
Beilschmiedia mannii (Meisn.) Benth. & Hook.f.		Tweanka	Tree	UCC-598	F, L	Fresh	Bronchitis, Migraine, Dysentery, Rheumatism	LC
Lecythidaceae								
Petersianthus macrocarpus (P. Beauv.) Liben		Esia	Tree	UCC-582	B, R	Dry	Bronchial difficulty, Cancer	LC
Loganiaceae								
Anthocleista adjalonensis A. Chev.		Bontodebere	Tree	UCC-514	B	Dry	Waist pain, Body weakness, Rheumatism,	NA
Malvaceae								
Nersogordonia papaverifera (A. Chev.) Capuron ex Halle		Danta	Tree	UCC-474	L, Sh	Dry	Cough	NA
Marantaceae								
Hypselodelphys poggeana (K. Schum.) Milne-Redh.		-	Liana	UCC-372	B	Dry	Aphrodisiac	NA
Meliaceae								
Carapa procera DC.		Kwakuobese	Tree	UCC-4576	B, R	Fresh	Sinusitis, Syphilis, Tuberculosis, Anaemia	LC
Cedrela odorata L.		Cedro	Tree	UCC-5301	B	Dry	Malaria	VU
Entandrophragma angolense (Welv.) C. DC.		Edinam	Tree	UCC-5100	B	Fresh	Stimulant against fatigue, Belly pain,	NT

Entandrophragma utile (Dawe ex Sprague) Sprague	Efobrodedwo	Tree	UCC-3894	B, R	Dry	Peptic ulcer, Rheumatism, Eye inflammation	VU
Khaya ivorensis A. Chev.	Dubini	Tree	UCC-3824	B	Fresh	Anaemia, Rheumatism, Piles	VU
Khaya senegalensis (Desr.) A. Juss.	Sereso-dubin	Tree	UCC-5302	L, B	Fresh	Anaemia, Malaria, Intestinal worms, Jaundice, Tonic	VU
Turraeanthus africana (Welw. ex C. D.C) Pellegr.	Apapaye	Tree	UCC-5300	B, R	Dry	Epilepsy, Migraine, Cough, Hernia	VU
Menispermaceae							
Pernianthus zenkeri (Engl.) Diels.	Kramankoti	Tree	UCC-5304	L, R	Dry	Aphrodisiac, Impotence,	NA
Moraceae							
Antiaris toxicaria Lesch.	Kyenkyen	Tree	UCC-5306	B, R	Dry	Cough, Asthma	LC
Ficus exasperata Vahl.	Nyankyerene	Tree	UCC-666	L, B	Fresh	Headache, Cough, Migraine	LC
Melicia excelsa (Welw.) C.C. Berg.	Odum	Tree	UCC-5305	B	Fresh	Dysentery, Malaria, Asthma	NA
Treculia africana Decne.	Brebretim	Tree	UCC-623	R	Fresh	Skin rashes, Skin irritation	LC
Myristicaceae							
Pycnanthus angolensis (Welw.) Warb.	Otie	Tree	UCC-1289	L, B	Dry	Chest pains, Ulcer, Headache, Anaemia, Digestive tonic	LC
Myrtaceae							
Eugenia calophylloides DC.	Pepera	Shrub	UCC-369	S	Dry	Intestinal worms	NA
Nephrolepidaceae							
Nephrolepis bisserata (SW.) Schott.	Abe nua	Herb	UCC-960	L	Fresh	Remove splinter, Menstrual disorder	NA
Ochnaceae							
Lophira alata Banks ex Gaertn. fil.	Kaku	Tree	UCC-918	B, L	Dry	Convulsion, Epilepsy, Hernia, Jaundice	VU
Olacaceae							
Oxalosus corpioides Oliv.	Ahohendedua	Shrub	UCC-1043	R, B, L	Dry	Malaria, Body weakness, Jaundice, Aphrodisiac	NA
Strombosia glaucescens Engl.	Afena	Tree	UCC-1273	B, S	Dry	Kidney/Bladder human condition, Bruises, Cough	LC
Passifloraceae							
Adenia cissampeliodes (Planch.ex Hook) Harms.	Hambri	Herb	UCC-1649	B	Dry	Hypertension, Numbness, Wound	NA
Phyllanthaceae							
Phyllanthus profusus N. E. Br.	-	Shrub	UCC-1672	L	Fresh	Belly pain, Sore eye	VU
Protomegabaria stapfiana (Beille) Hutch.	Agyahere	Tree	UCC-2077	L	Fresh	Belly pain	LC
Piperaceae							
Piper guineense Schumach & Thonn.	Nsesaa	Herb	UCC-1880	S	Fresh	Aphrodisiac, Rheumatism, Cough, Bronchitis	LC
Rhizophoraceae							
Anopyxis klaineana (Pierre) Pierre ex Engl.	Kokoti	Tree	UCC-1827	B, R	Dry	Bronchitis, Malaria, Cough	VU

Rubiaceae							
Coffea arabica L.	Coffee	Tree	UCC-5308	B, R	Dry	Anaemia, Aphrodisiac, Body weakness, Malaria	EN
Corynanthe pachyceras K. Schum.	Pampenama	Tree	UCC-5309	B,Sh	Dry	Male impotence, Urinary tract Infection/Human condition	LC
Hallea ledermannii (K. Krause) Verdc.	Baya	Tree	UCC-2061	B	Dry	Hypertension, Gonorrhoea, Sterility, Malaria	NT
Morinda lucida Benth.	Konkroma	Tree	UCC-2111	L, R	Fresh	Malaria, Typhoid, Aphrodisiac,	LC
Nauclea diderrichi (De Wild.) Merr.	Kusia	Tree	UCC-5307	L, B	Dry	Malaria, Belly pain, Stimulant against fatigue	NT
Nauclea latifolia Sm.	Sereso-kusia	Tree	UCC-2166	R	Fresh	Aphrodisiac, Sexual weakness, Malaria	LC
Pavetta corymbosa (DC.) F. N. Williams	Kronkoo	Tree	UCC-2204	L, B	Fresh	Bronchitis, Malaria, Cough, Anaemia, Jaundice, Rheumatism	LC
Rothmania longiflora Salisb.	Saman kube	Shrub	UCC-1962	L, B	Fresh	Body weakness/pain, Prevent miscarriage	NA
Zanthoxylum chevalieri P. G. Waterman	Oyaabere	Tree	UCC-5310	L, B	Fresh	Malaria, Body weakness, Dysentery, Rheumatism, Migraine	VU
Zanthoxylum zanthoxyloides (Lam.) Waterm.	Kanto	Tree	UCC-5311	B, R	Fresh	Impotence, Rheumatism, Intestinal worms, Paralysis,	LC
Santalaceae							
Okoubaka aubrevillei Pellegr. & Normand	Duyin/ Odii	Tree	UCC-2358	B, R	Fresh	Skin rashes, Skin swelling	EN
Sapindaceae							
Allophylus africanus P. Beauv.	Dua-ahabanum	Tree	UCC-2469	R	Fresh	Rheumatism, Body pain, Fracture, Headache, Anaesthetic	LC
Dienbollia pinnata (Poir.) Schum. & Thonn.	Woagye-akoa	Shrub	UCC-2460	L, R	Fresh	Bronchitis, Asthma, Cough, Malaria	NA
Eriocoelum pungens Radlk. ex De Wild.	Adwindwera	Tree	UCC-5312	B, R	Fresh	Cough, Enteritis, Gonorrhoea	NT
Sapotaceae							
Gluema ivorensis Aubrev. & Pellegr.	Nsudua	Tree	UCC-5315	B, R	Dry	Malaria, Cough	VU
Omphalocarpum elatum Miers	Esondokono	Tree	UCC-4802	B, R	Fresh	Breast milk production, Induce abortion,	LC
Synsepalum aubrevillei (Pellegr.) Aubrev. & Pellegri	Asaa	Tree	UCC-5313	R	Dry	Prolapse rectum, Waist pain, Skin rashes	VU
Tieghemella heckelii Pierre ex A. Chev.	Baku	Tree	UCC-5314	B, R	Fresh	Piles, Hernia, Toothache	EN
Vitellaria paradoxa Gaertn f.	Nkudua	Tree	UCC-4301	R, S	Fresh	Anaemia, Diabetes, Fracture, Waist pain, Chest pain	VU
Simaroubaceae							
Pierreodendron kerstingii (Engl.) Little	Kyama	Tree	UCC-5316	L, B	Dry	Waist pains, Anti-tumor	LC
Sterculiaceae							
Cola chlamydantha K. Schum.	Tananfre	Tree	UCC-5318	B, R	Fresh	Sore eye, Catarrh, Inflammation	LC
Cola gigantea L.	Watapuo	Tree	UCC-5320	B, R	Fresh	Belly pains, Piles, Waist pains, Malaria	LC
Cola nitida (Vent.) Schott & Engl.	Bese hene	Tree	UCC-5319	B, F	Fresh	Fracture, Herpes, Dystocia	LC

Heritiera utilis (Sprague) Sprague	Nyankom	Tree	UCC-5317	L	Dry	Leprosy, Kwashiorkor	LC
Octolobus spectabilis Welw.	Afinafi	Tree	UCC-2666	B, R	Dry	Aphrodisiac	LC
Pterygota macrocarpa K. Schum.	Watapuo	Tree	UCC-2588	B	Fresh	Skin infection, Sores	VU
Sterculia tragacantha Lindl.	Osofoa	Tree	UCC-2614	L, B, Sh	Dry	Dysentery, Whitlow, Syphilis, Malaria, Diarrhoea	LC
Ulmaceae							
Trema orientalis (L.) Blume	Sesea	Tree	UCC-5321	L, B, F	Fresh	Female sterility, Tonic, High blood pressure,	LC
Verbanaceae							
Vitex doniana Sweet	Abisaa	Tree	UCC-5322	B, R	Fresh	Chicken pox, Skin irritation, Catarrh, Sterility, Leprosy	LC
Zingiberaceae							
Aframomum latifolium (Afzel.) K. Schum.	Sensan	Herb	UCC-159	W	Dry	Fibroid, Cough	NA

L-leaf, Sh-shoot, W- whole plant, B-bark, R- root, F- fruit; LC-least concern, VU-vulnerable, NT-near threatened, EN-endangered, NA-not applicable

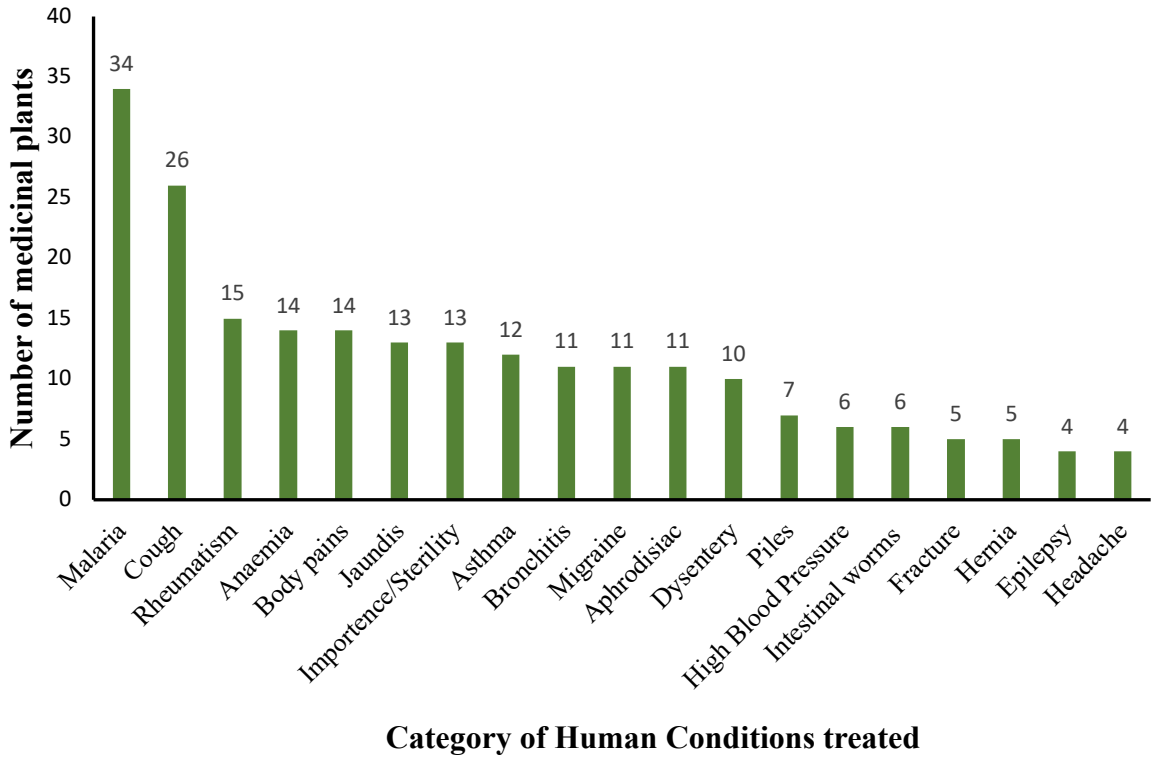

Figure 2:.Human conditions treated using the recorded medicinal plants of the study area.

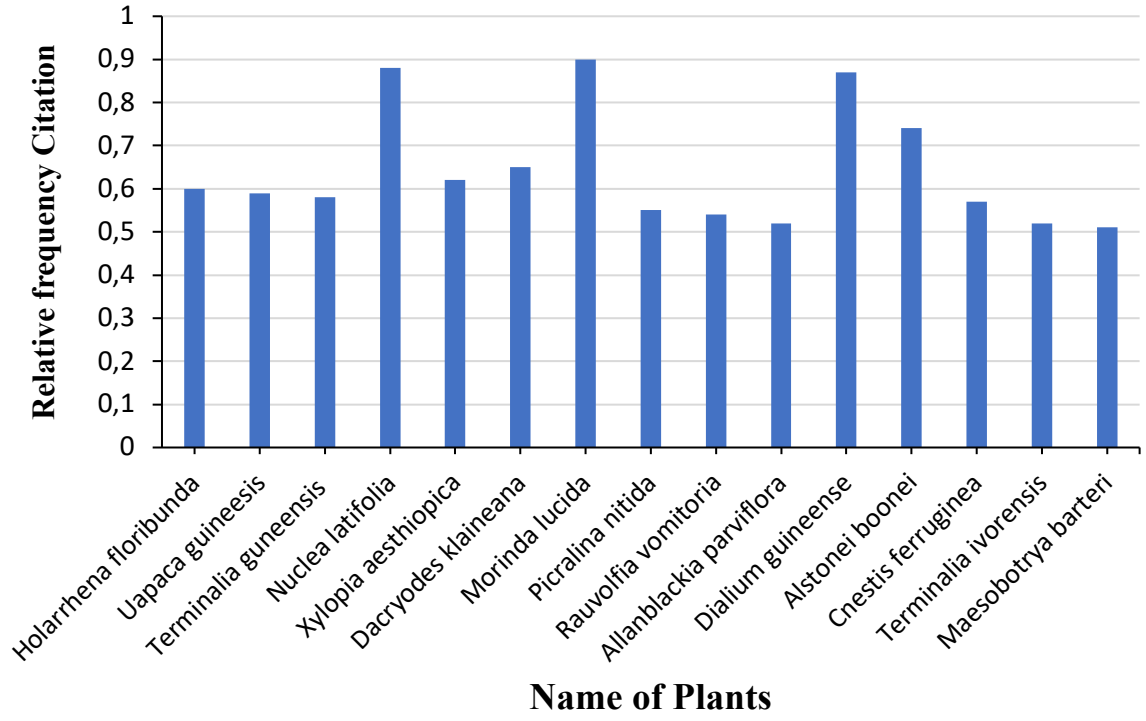

Figure 3. The most cited medicinal plants recorded in the study area.

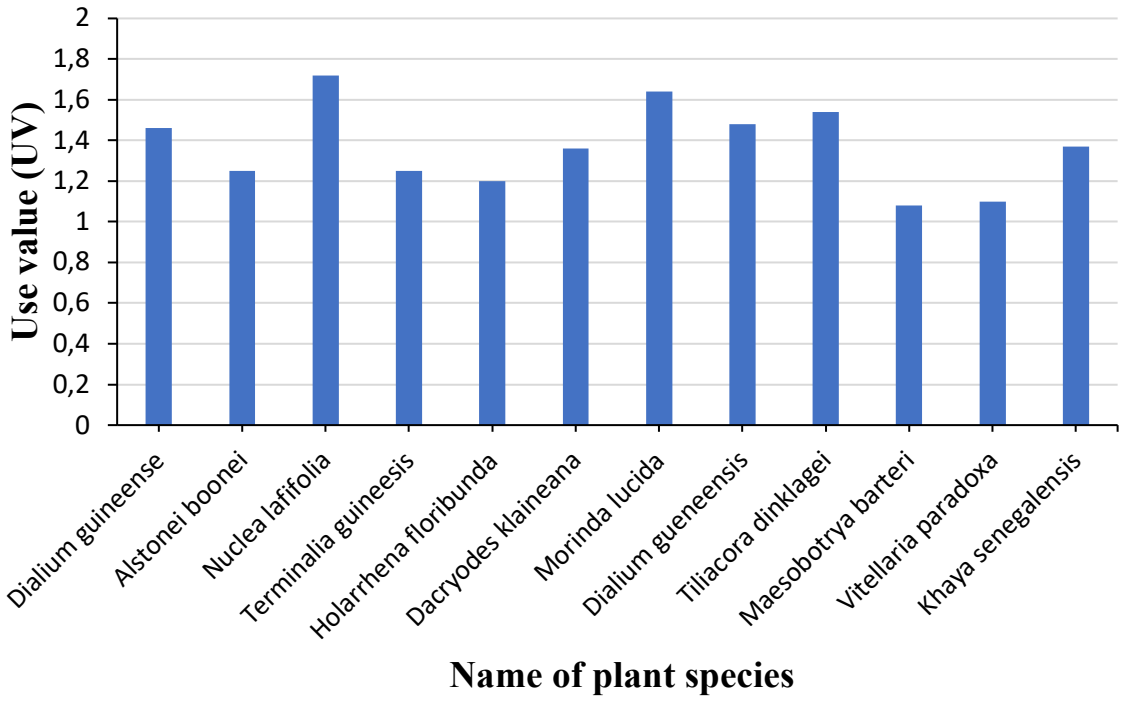

Figure 4. Medicinal plants with higher use values in the study area

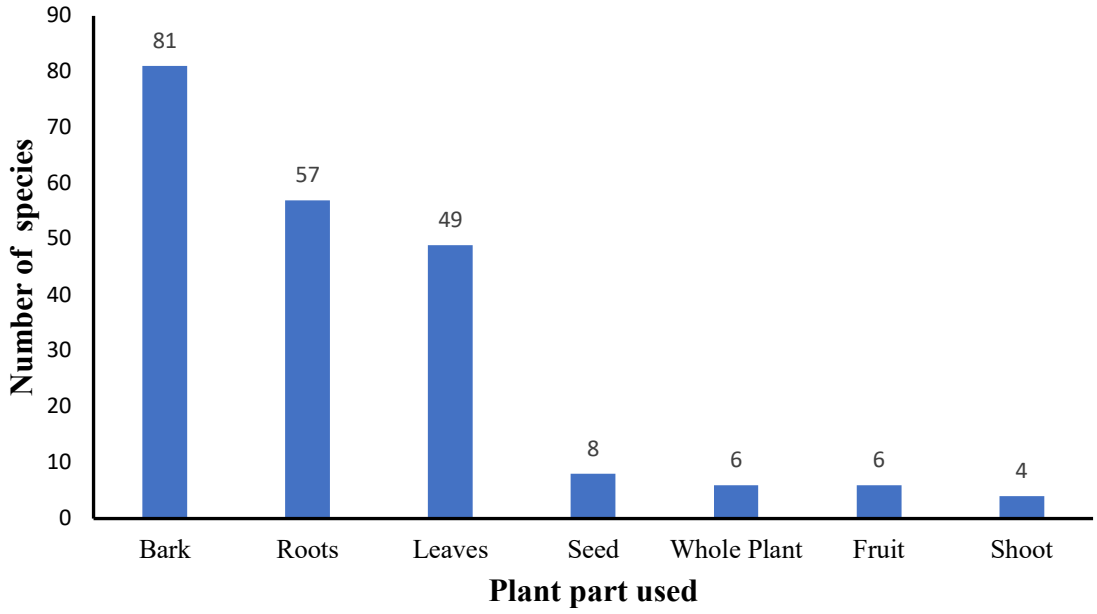

Figure 5.Plant parts used for the treatment of human ailments.

Table 3. Relationship 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	76	65	17	8	68	32
Herbs	14	56	30	14	56	44
Shrubs	8	60	25	15	70	30
Liana	2	82	18	-	82	18

Methods of preparation and modes of administration of medicinal plants

The dominant methods for the preparation of traditional medicines in the study area were decoction (46.1%), pounded (16.4%), powder (12.5%) and boiling (9.2%). Other medicines were once in a while prepared as infusion (4.6%), concoction (3.6%), mashed (2.6%), balm/ ointment (2.0%) and juice (1.3%). The preparation of medicines in the form of tea, tincture and poultice constituted less than 1% in each case (Table 4). Concerning the modes of administration of the medicines, 49% of the respondents indicated that the medications were taken orally (Table 4). The other forms of administration included rubbing (13%), bathing (9%) and inhaling vapour (8%). Relatively, fewer preparations were applied through vapour bath, sniffing, drop on eye, ear and nose, chewed/ swallowed, massage and sit-bath (1-6%) (Table 4). The experienced traditional medicine practitioners (11-20 years) generally preferred decoction (63 %) and drinking of medicine (50 %). Out of the 13 % who administered medicines through rubbing, and the 9 % who used bathing; 60 % (rubbing) and 52 % (bathing) were respondents with 1-10 years traditional healing practice and aged between 30-40 years.

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

Description	Frequency (%)
Method of Preparation	
Decoction	140(46.1)
Pounded	50(16.4)
Powder	38(12.5)
Boiling	28(9.2)
Infusion	14(4.6)
Concoction	11(3.6)
Mashed	8(2.6)
Balm/ointment	6(2.0)
Juice	4(1.3)
Tea	2(0.7)
Tincture	2(0.7)
Poultice	1.(0.3)
Mode of administration	
Drink	148(49)
Rub	38(13)
Bath	27(9)
Vapor	23(8)
Inhale	18(6)
Drop on eye, ear, nose	15(5)
Sniffed	13(4)
Massage	10(3)
Chewed/ swallowed	7(2)
Sitz- bath	5(1)

Conservation practices in relation to medicinal plant use

Most methods adopted for harvesting medicinal plants in the study area are destructive (82 %). The majority of the respondents (Table 5) collected plant parts (61 %) for preparation of the medicines instead of using the whole plant (12 %) or individual plants (27 %). A larger proportion of the respondents (66 %) indicated that the plants were difficult or challenging to find in the study area. Half of the practitioners (50 %) affirmed that the forest reserve was necessary, but only 36% agreed that it was feasible to conserve the medicinal plants. Some respondents (42%) did not agree with the feasibility of conserving the species whilst 22% of the people did not even appreciate the benefit associated with the conservation of the medicinal plant species (Table 5). On whether any conservation efforts had been put in place to save the reserve from degradation, 54 % of the respondents could not tell whether or not any conservation effort existed. However, 32 % acknowledged the existence of such an effort by either government or the community. Of the 32 %, majority were certified traditional healers (12 %) followed by practitioners in the 30-40 years bracket (10 %). The global conservation status of the medicinal plant species (Table 2) showed that 64 species (48.48 %) are of Least Concern, 35 (26.52 %) have not been evaluated, 8 species (6.06 %) are Near Threatened, 21 species (15.91 %) are Vulnerable, and 4 species (3.03 %) are Endangered. The endangered species are *Percopsis elata* (Harms.) Meeuwen, *Coffea arabica* L., *Okoubaka aubrevillei* Pellegr. & Normand, and *Tieghemella heckelii* Pierre ex A. Chev.; and the near threatened are *Pellegriniodendron diphyllum* (Harms.)

J. Leonard, *Eriocoelum pungens* Radlk. Ex De Willd., *Entandrophragma angolense* (Welv.) C. DC, *Albizia ferruginea* (Gull. & Perr.) Benth., *Hallea ledermannii* (K. Krause) Verde, *Nauclea diderrichi* (De Wild.) Merr., *Daniellia ogea* (Harms.) Rolfe ex Holland, and *Gilbertiodendron limba* (Scott-Elliot) J. Leonard. The vulnerable species include *Rhodognaphalon brevicuspe* (Sprague) Roberty, *Khaya ivorensis* A. Chev., *Pierreodendron kerstingii* (Engl.) Little, *Justicia flava* (Forsk) Vahl. and *Afzelia africana* Pers. (Table 2).

Table 5. Conservation practices in relation to medicinal plant use in the Ankasa forest reserve area

Description	**Frequency (%)**
Mode of plant collection	
Only part collected	186(61)
One/ few individuals collected	83(27)
Whole plant	35(12)
Plant harvesting methods	
Destructive	250(82)
Non destructive	54(18)
Plant Availability	
Easy to find	103(34)
Difficult to find	177(58)
Very difficult to find	24(8)
Is the reserve necessary	
Yes	152(50)
No	106(35)
I do not know	46(15)
Can these medicinal plants be conserved?	
Yes	110(36)
No	128(42)
I do not know	66(22)
Any conservation efforts made by Government/ Community?	
I do not know	164(54)
Yes	97(32)
No	43(14)

Integration of traditional healers into the health care system in the study area

From the data obtained in this study, some challenges affecting the integration of traditional healers into the health care system were identified. Biomedical health workers (midwives, nurses, nurse managers etc.) most often do not appreciate or have limited knowledge and understanding of the cultural beliefs and practices of the local community members. However, these cultural practices tend to influence the health choices made by the people, creating different levels of confrontations between the biomedical staff and the community members. In an interview with biomedical health staff, she complained that some pregnant women still use herbal medicine to induce contraction. In other cases, people bitten by snake resort to using herbal medicines. These practices often lead to fatalities despite active discouragement from biomedical health workers.

The insufficient appreciation of the cultural practices and beliefs of the local people, coupled with educational status differences between biomedical staff and traditional healers often lead to discrimination against traditional healers and their patients. It was observed that some biomedical health workers view traditional healing as being backward, unscientific and based on hidden beliefs and assumptions. A nurse retorted that "the efficacy of their medicines cannot be verified, and every ailment has a spiritual underpinning; it seems the people prefer their form of treatment". Patients identified as having sought earlier treatment from traditional healers are often insulted and discriminated against when they visited biomedical health centers. Such patients are reluctant to seek help from these health facilities, often leading to complications. One patient remarked:

"*I am fifty-two years old, educated and have used traditional medicines to treat almost all my ailments including spiritual ones. You cannot wish away our culture and beliefs*"

In one of the interviews with the biomedical health workers, a nurse stated her frustration:

"*You visit these traditional healers until your situation becomes complicated. You do not even accept your fault, deny ever visiting traditional healers. Why are you protecting these healers? You make the job so frustrating. I wish I get a transfer, I am tired*"

The study also identified the turn-over of biomedical staff as a limiting factor in building trust relationship between traditional healers and biomedical workers. Due to official transfers, movement from public to private health sectors and vice versa, and the quest to move to urban areas for perceived carrier opportunities; relations between biomedical staff and traditional healers are not fully established but remains superficial. This obstructs integration and collaboration, and often raises trust issues. Data from this study indicate that in few instances of collaboration, it was more of a person-to-person relationship.

The lack of trust between traditional healers and the biomedical staff was emphasized by a healer:

"*We need to keep the formula for preparation of our medicines a secret and would only disclose it to a trustworthy person. With this turn-over of biomedical workers, how can we trust any of them? I am a traditional birth attendant (TBA) and I was not invited when the patient I referred to the clinic was delivering. How do I gain further experience*?"

The problem of recruiting young people to become traditional healers exist in the study area. Increasing educational opportunities and professional alternatives have contributed to the decline of young people in the traditional healing practice. This is relatively severe in the TBA practice where the girls see no future in being TBAs. There is increasing advocacy of biomedical superiority over traditional healing practice; some identify people engaged in traditional healing practice as "unqualified and quack". This has led to loss of status and attractiveness of the traditional healing profession. Another disincentive for young people is the cultural belief that charging money for traditional healing is immoral and not permitted by ancestral spirits. It is believed that the efficacy of the medicine may reduce or even vanish when healers charge for their services. This notion pertains to some parts of the study area though, other areas realize the need to pay adequately and appropriately for the services of traditional healers. The traditional medicine practitioners identified acquiring medicinal plants and storing herbal medicines as a challenge. With the increasing patronage of their services, the healers have to travel longer distances to obtain medicinal plants. Obtaining appropriate storage materials (bottles, boxes etc.) is a problem. Data from this study showed the general lack of equipment for herbal medicine preparation at almost all the traditional healing centers visited.

Discussion

Demographic characteristics of the respondents

The majority of the respondents being males is in line with the African belief and practices elsewhere (Ssenku *et al*. 2022, Meke *et al*. 2017, Addo-Fordjour *et al*. 2013), especially concerning gender roles. Women are generally exempted from the rigorous nature of the collection and processing of medicinal plants but rather preferred in the vendorship role (Torres-Avilez *et al*. 2016, Addo-Fordjour *et al*. 2013). On the contrary, female traditional medicine practitioners were dominant in a similar study conducted in South Africa (Rahman *et al*. 2022). The generally held view that the elderly are more knowledgeable on the medicinal use of plants was confirmed in this study (Ssenku *et al*. 2022, Tugume *et al*. 2016, Addo-Fordjour *et al*. 2013). This could be attributed to most people in the study communities spending their early years schooling and only taking up traditional healing as a vocation when all other job avenues are closed. Moreover, traditional medicine practice is associated with the uneducated in the study area, thus depriving the younger generation the benefit of the vast medicinal resources available in their surroundings and pushing them towards market resources (Addo-Fordjour *et al*. 2013). The low educational status of the respondents influenced the level of conservation of medicinal plants (Tables 1 and 5). Usually, people with higher education are believed to have a potential knowledge on the conservation of medicinal plants (Addo-Fordjour *et al*. 2013). The average age of respondents in the study (49.9 years) is higher than the mean age (46.23 years) of traditional medicine practitioners in a study in Ethiopia (Limenh *et al*. 2023); but lower than the mean ages of 54.4 years (Baratti-Mayer et al. 2019) and 59.0 years (Kwame, 2021) obtained in Mali and Ghana respectively. The dominance of the aged with considerable number of years in practice, in the certified traditional healing and TBA categories could be due to their acquired experience attracting the trust of patients to treat them properly and also ensuring safe delivery (TBA) without complications.

Medicinal plant diversity and use in the study area

The study recorded 132 medicinal plant species in communities around the Ankasa Forest Reserve. This was lower than the 195 medicinal plant species around a traditional protected area in the Democratic Republic of Congo (Flavien *et al*. 2016) and the 167 species obtained from the Araripe National Forest in Brazil (da Silva *et al*. 2019). The 132 medicinal plant species

recorded in this study is within the range obtained by Rahman *et al*. (2022) in forest- dependent communities in Bangladish, 136 species in Mabira and Mpanga Central Forest Reserves in Uganda (Asiimwe *et al*. 2021), and 133 medicinal plant species in rural Eastern Uganda (Ssenku *et al*. 2022). Other studies recorded less medicinal species richness. Gumisiriza *et al*. (2019) recorded 111 species used by communities around Central Forest Reserve and Ihimbo Central Forest Reserve in Uganda. Mageresa *et al*. (2013) obtained 126 species in WayuTuka District, West Ethiopia; Ndegwa (2012) recorded 119 species used by the Ogiek people in East Mau Forest, and Yeboah *et al*. (2022) had 107 medicinal plant species in Guinea Savanah Zone in northern Ghana; whereas Addo-Fordjour *et al*. (2013) obtained 52 species in the Aparabi Forest Reserve also in Ghana. The generally high number of medicinal plant species (132 species) in this study suggests that the communities had good ethnobotanical knowledge about the medicinal plants to use for their daily healthcare needs.
The dominance of the Fabaceae, Euphorbiaceae and Rubiaceae as the most contributing families to medicinal plant species in the study area is in line with other studies (Aremu & Pendota 2021, Van Wyk 2020, Boadu & Asase 2017). Elswhere, the Malvaceae, Rutaceae and Lamiaceae were dominant (Rahman *et al*. 2022). From the inventory obtained in this study, the Fabaceae, Euphorbiaceae and Rubiaceae were abundant and widely distributed. This probably explains the local communities`familiarity and use of medicinal plants from these families. Trees were dominant (76%) for treating and managing diseases, followed by herbs (14%) and shrubs (8%) (Table 3), confirming earlier work done by Rahman et al. (2022).

The medicinal plant preparations were mostly used to treat malaria (34 species), cough (26 species), rheumatism (15 species), stomach pain (14 species) and anaemia (14 species) among others. (Figure 2).

Most of the respondents cited plant species like *Morinda lucida, Nauclea latifolia*, *Dialium guineense*, *Alstonei boonei* and *Dacryodes klaineana* for the treatment of malaria and cough which is consistent with a number of previous studies (Afolabi *et al*. 2020, Gnansounou *et al*. 2018, Addo-Fordjour *et al*. 2013).

The Relative Frequency of Citation (RFC) shows the local ethnobotanical importance of every medicinal plant species as provided by informants who cited these species (Chen *et al*.2022; Hani *et al*.2022). High RFC values (Figure 3) indicate that the medicinal plants are predominantly used and common to the local people. This could be attributed to the wide range of distribution of these medicinal plants which are usually readily available and accessible to the local TMPs for treating various diseases. Medicinal plants with low RFC values could mean the plants have restricted distribution in the study area, hence, are known by relatively fewer local people for medicinal purposes (Chismale *et al.* 2023, Hosseini *et al.* 2021). The plants with more use reports from the informants presumably also have high Used Value (UV), while medicinal plants with fewer reported use values tend to have low UVs. The UV of the plant species indicate ethnobotanically prominent plants in the area. The plants with relatively high UV values (Figure 4) show that they are relatively uniformly distributed, and their medicinal properties are well known to the local people, and in terms of use, they are very important to the practice of traditional healing in the study area. Thus, the over-harvesting of these medicinal plants poses serious threats to their population and even to the survival of traditional medicinal practice in the study area. Since most of medicinal plants are obtained from the wild, it is important to prioritize their conservation.

The use of traditional plant medicines to treat and manage common ailments (cough, stomach pain, malaria, rheumatism etc.) and specialized complications (diabetes, cancer, high blood pressure etc.) (Table 2) indicates the importance of traditional plant medicine to the communities in the study area. This may be a function of the availability, affordability and trust most studied communities attach to these medicines.

Most medicinal plants were obtained from the wild (Table 3), indicating that the practitioners mostly rely on the reserve for the plant species. This practice of collecting most of the medicinal plant species from the reserve poses a big threat to the survival of the reserve. WHO (2015) recommended cultivating medicinal plants to ensure continual supply and eventual reduction of pressure on wild plant species. China has responded positively and cultivate most of the medicinal plant species they use (He *et al*. 2022, Shen *et al*. 2021). However, the cultivation of medicinal plants has received little or no attention from most African countries including Ghana (Halilu 2022). The only country in Africa noted for medicinal plant cultivation is South Africa (Nwafor *et al*. 2021) where only about 1% is presently being cultivated.

The respondents indicated that different medicinal plants have different therapeutic effects, hence the variation in the use of plant parts to treat diseases. The study identified the use of plant barks (81 species), roots (57 species) and leaves (49 species) for the preparation of medicines in the study area (Figure 4). In other studies, the leaf was the most frequently used part followed by roots in Ethiopia (Moges & Moges 2020); and roots as most preferred plant part in Kenya (Nankaya *et al*. 2020). In this study, the respondents indicated that in some cases, different parts from the same plant were used to prepare

the medicines, and in other cases, similar or different parts of more than one plant were used, accounting for the high number (88) of ailments recorded as treatable or manageable by the medicinal plants (Table 2). The collection and use of plant barks and roots for medicinal preparations in the study area are not in line with international conservation standards (Chen *et al*. 2016). These practices adversely affect the survival of plants and may lead to loss of their gene pool from the population (Ssenku *et al*. 2022). There is a need to monitor the harvesting of medicinal plants to allow for regeneration of the plants. The traditional medical practitioners in the study area are not harvesting the plants in a sustainable way, probably due to their low level of education.

Method of preparation and mode of administration of the traditional medicines

The different preparation methods for the plant medicines and the modes of administration (externally and internally) to treat and manage ailments obtained in this study (Table 4) confirm that of similar studies done in communities around forested areas (Ssenku *et al*., 2022, Alebie *et al*. 2019). The *decoction* was done by boiling the plant parts in water until the required volume of the water needed is obtained. The *powder* was prepared by grinding or pounding the dried plant parts. *Rubbing* was done by crushing the plant parts and mixing with water or processed as ointment/ liniment and used to rub the body. *Inhalation* was done by burning plant parts and inhaling the smoke through the mouth and nose. The *poultice* preparation was done by crushing the plant parts, mixing with a little hot water and applied directly over the area of concern. The *Infusion* was achieved by steeping the plant parts in cold/ hot water overnight, and the mixture obtained is then strained. *Tincture* was obtained by placing the plant parts into alcohol and steeped for a few days in a sealed container. The modes of administration of the medicinal preparations commonly used in the study area which included drinking, bathing, vapour bathing, rubbing and inhalation (Table 4), corroborate that of earlier studies done in Ghana (Kpobi *et al*. 2019, Addo-Fordjour *et al*. 2013) and elsewhere (Ssenku *et al*. 2022, Nankaya *et al*. 2020, Dubost *et al*. 2019). The preference by experienced traditional healers for decoction (preparation) and drinking of ethnomedicine (administration) could be that these healers have accumulated rich experience in treating patients (Liu *et al*. 2023) which could influence their preference for decoction and drinking of medicines. However, the relatively younger traditional healers (30-40 years) preferred rubbing and bathing which probably could be from the influence of patients who generally do not like drinking of ethnomedicines citing the scent and bitterness of the medicines.

Medicinal plants and conservation practices

The mode of harvesting of medicinal plants in the study area is unsustainable (Table 5) and can cause a decline in biodiversity and genetic erosion from the population (Ssenku *et al*. 2022, Chen *et al*. 2016). The respondents indicated that deforestation, firewood collection and habitat loss threaten the survival of medicinal plants. Domestication and commercial cultivation of some of these medicinal plants could reduce the pressure on wild species in the area. The majority of the respondents (Table 5) upheld the need for the reserve. Forest reserves provide benefits such as protection of endangered plant species by serving as habitats, reservoir of medicinal plants, provision of food supply, maintenance of global and regional temperatures within appreciable range through sequestration of carbon, supply of oxygen and protect carbon for climate adaptation and mitigation (Ngwembe *et al*. 2022, Akomaning *et al*. 2021, Law *et al*. 2021, Amoah & Korle 2020). The respondents who had a negative view of the reserve (Table 5) cited the restriction imposed on them from collecting medicinal plants from the reserve as their main concern since traditional healing is their primary source of livelihood. According to the respondents, this may also lead to the loss of traditional medicinal knowledge. The relatively younger traditional practitioners (30-40 years) generally acknowledged the existence of conservation of medicinal plants by government and local authorities. The younger practitioners are relatively more educated and abreast with current issues and can easily collaborate with management of the reserve on conservation issues. Moreover, they need to protect their profession. The global conservation status of the medicinal plants (Table 2) shows that about 76 % of the species are of least concern or not evaluated; and 18.2 % are under serious threat. Presently, the 18.2 % species (Tress) may not be under threat locally however, there is need for the management of the reserve to ensure sustainable utilization or outright ban on the harvesting of these globally threatened plant species. In this regard, sustainable harvesting and commercial cultivation of medicinal plants should be encouraged and facilitated by the government. The bye-laws of the Ghana Wildlife Division and the local Municipal Assembly should be strengthened and fully operationalized to regulate the collection of medicinal plants, especially, from the reserve. Rare and endemic species in the Ankasa Forest Researve including *Pavetta ankasensis* W. D. Hawth., *Pavetta abujuamii* W. D. Hawth. and *Pavetta sonjae* W. D. Hawth. (Hawthrone, 2013) were not recorded as medicinal plants in the study area.

Integration of traditional medicine practice into the health delivery system

Findings from this study showed that contrary to earlier studies (Subedi 2023, Ampomah *et al*. 2022), traditional medicine practitioners (TMP) and biomedical health workers are generally willing to cooperate in the delivery of health care to the local community members (Solera-Deucher *et al*. 2020, Krah *et al*. 2018). There existed a certain level of formalization and

standardization as some members of the Federation of Traditional Medicine Practitioners Association (GHAFTRAM) had identification cards and even referral cards in some few instances allowing them to transfer patients to the biomedical health centers. Thus, there is the need for the Ghana Health Service to set up appropriate and efficient channels to allow for communication, education and trust building between the TMPs and biomedical workers. For effective collaboration, the TMPs and biomedical health workers proposed ideas that could foster cordial relations. These included encouraging individual TMP`s to join the local associations which are affiliated to GHAFTRAM; only credible healers from GHAFTRAM should be introduced formally to the biomedical health facilities; traditional medicine and healing services should be covered by the National Health Insurance; and the point of contact at the biomedical health centers should have appropriate personnel who appreciate the culture and beliefs of the local people and can keep their personal secrets. To demonstrate their willingness to collaborate, two TMPs showed referrals and collaborations between them and biomedical facilities concerning bone-setting and diabetes treatment. This relationship, though personal, has enabled the two TMPs to interpret X-rays so as to provide appropriate medication. Similarly, the traditional healers refer cases such as deep open wounds to the biomedical health facilities for the needed attention. These opportunities for integration should be strengthened. In this regard, those TMPs who distinguish themselves can be recognized as competent professionals to assist with primary health care in the study area. These selected TMPs should be registered with GHAFTRAM, dependable, regularly attend to their patients and willing to refer patients promptly to the biomedical health centers. To encourage them, a special day should be set up to recognize and support the work of committed TMPs who show effective and fruitful collaborations with biomedical facilities. There should be a targeted investment in the inter-personal relationships between TMPs and biomedical staff to remove or reduce discrimination and build trust. This will facilitate bonding and cross-referrals. The bureaucracy at all levels of this collaboration should as much as possible be minimized to allow for direct and efficient collaboration marked by mutual respect and exchange of information. The credible and recognized TMPs should be supported with basic supplies and equipment (gloves, boxes, bottles, soap etc.) and where practicable, the health facilities of the TMPs could be renovated for patients` comfort and efficiency in the treatment delivery.

In sum, the TMPs indicated that integration of traditional medicine into the health care system could be enhanced when members are facilitated to join GHAFTRAM, policies and regulations on traditional medicine practice are disseminated to the local member associations, the Ghana health service through their local representatives provide continues training for the TMPs to improve their relationships with biomedical health workers and above all, support them both financially and equipment wise.

Access and Benefit Sharing of Genetic Resources (Medicinal plants)

Ghana has about 3600 plant species and the study area recorded 132 medicinal plants which calls for protection of this genetic resource. The country signed and ratified the Convention on Biological Diversity in 1992 and the Nagoya Protocol in 2018. Presently, the Access and Sharing of Benefits (ABS) Clearing-House supervised by the Council of Scientific and Industrial Research has established Competent Authorities to grant users access to their genetic resource; and represent providers on a local or national level. The Competent Authorities grant prior informed consent, establish mutually agreed terms, and issue national permit to the user for specific genetic resource. The parties (users and providers) send information on their permits to the ABS Clearing-House in order to obtain Internationally Recognized Certificates of Compliance. All these elaborate processes are to protect the interest of Ghana, especially indigenous people and local communities, for them to benefit from their traditional knowledge related to use of genetic resource (Medicinal plants). Ghana is in the process of developing laws and policies to facilitate implementation of Community Protocols in relation to ABS of genetic resources including medicinal plants in the study area.

Conclusion

The findings from the study showed that the area has a high diversity of medicinal plant species used to treat a variety of ailments by the communities around the Ankasa Forest Reserve. Most medicinal plant species used belong to the Fabaceae, Euphorbiaceae, and Rubiaceae families. This is evident from the floristic inventory which recorded most of the tree species from these families. The component species of these families should be managed sustainably as they were most frequently used in managing some of the world`s killer ailments such as malaria and anaemia. Most medicinal plants were collected from the reserve, which calls for commercial cultivation of medicinal plants to reduce pressure on the wild species stock. Traditional medicine practitioners have limited knowledge on conservation issues and there is a need to engage them on resource utilization and sustainable management of the reserve. Accordingly, the Ghana Forestry Division and GHAFTRAM should colllaborate to educate traditional medicine practitioners on appropriate conservation measures for medicinal plant exploitation. The local people in the study area have trust in traditional healing for their primary health care needs, and there should be concerted efforts to integrate TMP into the health care delivery system. Findings from this study showed that

biomedical workers` lack of knowledge on local traditional beliefs and practices, the high turn-over of biomedical workers, poor recruitment of young people as traditional healers, and the lower status attached to traditional healers are some of the challenges affecting integration. However, the study showed the willingness of both parties to cooperate based on mutual respect and recognition. In this regard, investment into the relationship between TMPs and biomedical staff, appreciating TMPs who collaborate, and providing equipment to aid the effective functioning of TMPs among others listed earlier, would enhance the integration of TMPs into the health care delivery system. The level of integration is generally not appreciable at the study area.

Declarations

Abbreviations: WHO: World Health Organization; **TCIM:** Traditional Complementary and Integrative Medicine Practice; **GHAFTRAM:** Federation of Traditional Medicine Practitioners Association; **TMP:** Traditional Medicine Practitioners; **TBA:** Traditional Birth Attendants; **RFC:** Relative Frequency of Citation; **UV:** Used Value

Ethic statement: Prior verbal consent was taken from all the participants.

Data availability: The original data has been presented in the article. There is no supplementary data.

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