

## ETHNOBOTANY, PROPAGATION AND CONSERVATION OF MEDICINAL PLANTS IN GHANA

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### ABSTRACT

Medicinal plants and plant-based medicines are widely used in traditional cultures all over Ghana and they are becoming increasingly popular in modern society as natural alternatives to synthetic chemicals. This paper studied the ethnobotany of medicinal plants through a socio-economic survey. Seed germination experiments were also carried out on selected medicinal plant species. It was found that the herbal medicine industry was a major source of income for 82% of the respondents. Almost 50% of the respondents were women with majority of them involved in marketing of the medicinal plant products. Out of 160 plant species marketed, 129 were collected in Ghana with Kumasi and Accra being the major marketing centres. Most of the species have multiple curative properties with over 46 diseases purported to be cured by herbal medicine. Over 100 species were reported to be in high demand, scarce or unavailable. Among the reported constraints to availability of medicinal plants were lack of cultivation, unsustainable harvesting, deforestation, wildfire and urbanization. Studies on seed germination showed that seven species out of the ten selected for conservation had good germination, ranging from 40-74% with an average of 63.3%. This suggests the possibility of cultivating medicinal plant species on commercial scale. Based on the results, it is suggested that linkages between all stakeholders should be strengthened in order to promote conservation and commercial production of medicinal plants. Furthermore, improving the knowledge-base of scientists, traditional herbal medical practitioners, policy makers and the public on the relevance and safety of traditional plant medicine could lead to the sustainability of the medicinal plants industry in Ghana.

**Keywords:** Herbal medicine, socio-economic survey, seed germination, phenology, health care

### INTRODUCTION

Medicinal plants have always been considered as healthy resources of life for people, however these plants have for a long time been neglected in terms of domestication and conservation, hereby threatening their sustainability. Nonetheless, these species on farms, in home gardens and rangelands contribute to improvement of farmers' livelihoods;

health, nutrition, income, and provision of environmental services (shade, microclimate, carbon sequestration, soil fertility improvement). Since these indigenous species are already adapted to the natural environment, they need to be treated as crops for the future in preparation for the anticipated climate change and its associated environmental instability and health problems.

Access to healthcare facilities in Africa is very poor as approximately 80% of the population relies on traditional medicine (WHO, 2008). In Ghana, the ratio of medical doctor to patient is 1:10,000, hence majority of the people rely on traditional health care delivery (WHO, 2012). However, over-reliance on wild collections results in rapid depletion of the resource. The current rate of forest degradation, uncontrolled exploitation and use of genetic resources of indigenous medicinal plant species without replacement is posing a threat to the continued existence of these species. Furthermore, the parts of the plants often harvested for use are sometimes the same parts used for anchorage, nutrient uptake, photosynthesis and regeneration (Daharani *et al.*, 2010; Ofori *et al.*, 2011a). This has posed serious constraints to the natural regeneration as well as vigorous stand development, hence continuous existence of the species in natural ecosystems are now greatly threatened (Adebisi, 1999). The silvicultural techniques of many of these species are also not adequately understood (Sofowora, 1993), hence the inability of the local communities to embark on their propagation and their inclusion in their farms, homestead gardens and conservation plots.

Currently, there is an increasing global interest in natural products because of the perceived side effects associated with synthetic drugs. Field observations however show that most traditional medical practitioners rely on wild collections from the natural forest which unfortunately are constantly dwindling at an alarming rate. Nonetheless, there have also not been adequate concerted efforts at addressing the large scale cultivation of the species, either in farming systems or pure culture at private or government levels. Furthermore, indigenous knowledge on these plants is not adequately documented for possible future development. Therefore a holistic study addressing the ethnobotany and propagation of selected medicinal plants will not only provide

basic information for sustainable management but will also help to create the required awareness for the integration of the species into the traditional farming systems and provide the needed silvicultural information for the cultivation of the species. Such a program if properly developed could serve as a foundation on which these important medicinal plants could be harnessed and developed for the sustained use of mankind. The objectives of the study therefore were: (i) to document indigenous information (formal and informal) on medicinal plants through ethnobotanical studies, (ii) document phenological information and develop appropriate methods for seed germination.

## METHODOLOGY

### Socioeconomic survey

The Socio-economic survey covered eight regions in Ghana (Western, Eastern, Ashanti, Brong Ahafo, Volta, Greater Accra, Central and Northern Regions) spanning across five ecological zones of Ghana, i.e. Wet Evergreen Forest, Moist Semi-deciduous Forest South east and North west, Savannah Transition, Coastal Savannah and Guinea Savannah (Figure 1). To facilitate information acquisition from respondents, local and national fora of the traditional herbal industry were attended to introduce the project and to establish a rapport with the groups. A list of members and their contacts was compiled during these meetings which assisted in locating respondents for interviews.

Three sets of structured questionnaires, each specifically designed for a category of respondents (i.e. medicinal plant suppliers, marketers and traditional medicine practitioners) were administered. The questionnaires were first tested on a nearby urban market (Kumasi Central Market) where all three categories of respondents

were encountered. A total of 301 male and female respondents were interviewed at markets, plant collection and distribution points, herbal clinics and homesteads. In each region surveyed, urban centres were first visited to interview plant marketers and herbal medical practitioners. This assisted in identifying supply sources and distribution points. Supply sources mainly in rural communities were then visited to interview plant collectors/suppliers, although some of them were interviewed at the distribution points on urban markets.

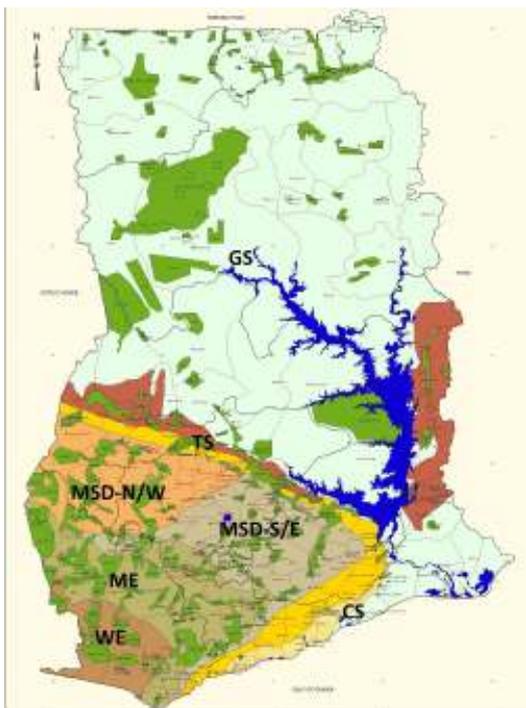


Figure 1: Map of Ghana showing the sample sites for the socioeconomic studies: WE = Wet Evergreen, ME = Moist Evergreen, MSD-N/W = Moist Semi-deciduous North West, MSD - S/E = Moist Semi-deciduous South East, CS = Coastal Savannah, TS = Forest-Savannah Transition Zone and GS = Guinea Savannah

Data were collected through one-on-one interviews and information gathered comprised local plant names, part(s) used and major uses, sources of collection and supply, availability and demand trends, threats to availability, indigenous cultivation techniques and measures to ensure continued availability of medicinal plants.

### Phenology and seed germination

Ten tree species were used for this study. Five of them (*Khaya senegalensis* (Desr.), *Rauvolfia vomitoria*, *Pycnanthus angolensis*, *Kigelia africana*, and *Zanthoxylum zanthoxyloides*) were selected based on their importance in Ghana (Table 1) and five others (*Securidaca longepedunculata*, *Tamarindus indica*, *Morinda lucida*, *Alstonia boonei* and *Vitellaria paradoxa*) also selected based on their importance in other West African countries, namely Benin and Nigeria (Jimoh, 2009). A survey was conducted within the distribution zones of the selected species and five trees of each species were labeled and monitored weekly. Records were taken on dates of first flowering and duration of flowering, fruit formation and fruit maturity from September 2007 to December 2009. Matured seeds were collected and seed germination experiment conducted. For each species, seeds were collected from all the five trees and bulked together. One hundred seeds were sampled from each seed lot and germinated in sand with four replicates and 25 seeds per replicate. Records on day of first germination, duration of seed germination and total number of seeds germinated were taken.

### Data analysis

Data generated from the socio-economic study were subjected to simple descriptive statistics of means, percentages or proportions, and summaries presented in tables. In order to assist collectors and those interested in seed propagation, the months in which flowering and fruiting occurred

were presented for each species. Data on seed germination were analyzed by computing the mean seed germination percentage as well as the length of seed germination period for each species using Microsoft Excel 2010.

## RESULTS

### Characteristics of respondents

A total of 301 people interviewed were made up of 151 herbal medicine practitioners, 90 marketers and 60 collectors. It was observed that the medicinal plant industry is a major source of livelihood and income for 82% of the respondents, particularly, the marketers and practitioners who engage in it as their major occupation (Figure 2). Three nationalities were found to be involved in the industry with 98% being Ghanaians and the minority from Nigeria and Benin. Approximately equal proportions of the respondents belonged to both gender with majority of the women in medicinal plants marketing. Thirty percent of the respondents had no formal education with the majority of the educated having the basic level of education.

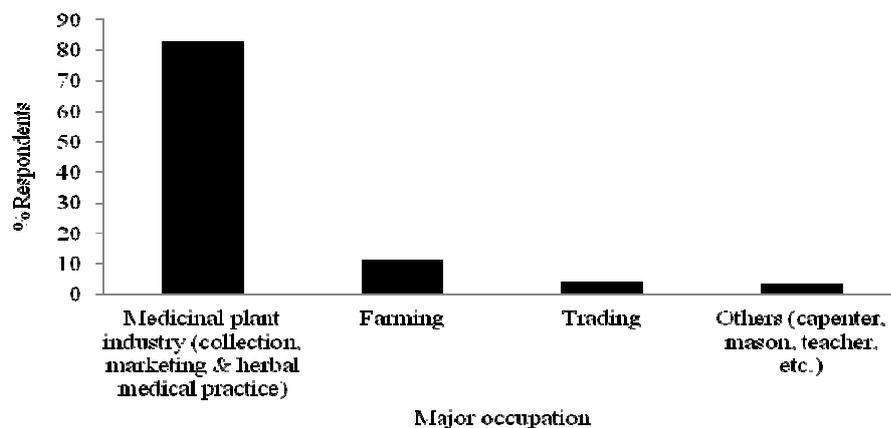


Figure 2: Major occupation of medicinal plant collectors, marketers and practitioners interviewed

The mean age of the respondents was 48 years. The productive age group, ranging from 31-60 years, constituted about 70% of the respondents.

### Collection and distribution of medicinal plants

Majority of the medicinal plants are gathered locally from the wild in forest reserves and on farms from all ecological zones in the country and often supplied to clients at their work places, market centres or to middlemen. Distances travelled to collect plant parts range from 1 to 26 km. Accra and Kumasi are the major markets or distribution centers where suppliers deliver products to marketers for wholesale or retail distribution to consumers. Out of the 160 medicinal plant species reported to be marketed and used, 129 were reported to be collected in Ghana. Most of the plant species have multiple curative properties, thus were applied in treating more than one disease condition.

Table 1: Major plants frequently collected and used by herbal medicine practitioners, parts collected and uses

Botanical name	Common/Local plant name	No. of practitioners (N=151)	Part used	Uses
<i>Khaya</i> sp.	Mahogany	78	Bark, root	Piles, blood tonic, fevers, infertility, stomach and menstrual disorders
<i>Pycnanthus angolensis</i>	Otie	38	Bark, leaves, seeds	Anaemia, stomach and menstrual disorders, toothache, blood tonic
<i>Ricinodendron heudelotii</i>	Wama (samandua)	31	Bark	Anaemia, rheumatism, infertility, stomach ulcer, loss of appetite
<i>Rauvolfia vomitoria</i>	Kakapenpen	30	Bark, roots, leaves, seeds	Sexual weakness, piles, hernia, madness, skin rashes
<i>Alstonia boonei</i>	Nyamedua	28	Bark, leaves	Measles, stomach disorders, blood tonic, malaria, waist and body pains, hernia
<i>Paullinia pinnata</i>	Tuoatini	27	Bark, root, leaves, stem	Waist pain, ulcer, sexual weakness, piles, rheumatism, bone fracture, impotency, fatigue
<i>Zanthoxylum zanthoxyloides</i>	Oyaa (kanton)	22	Root, bark	Rheumatism, waist and body pains, toothache, abdominal sores/pains, cough, hypertension, wounds, family planning, urine retention, diabetes, bone fracture
<i>Trichilia monadelpha</i>	Tannuro	22	Bark, root	Sores (wounds), blood tonic, rheumatism, hernia, cough, menstrual problems, diabetes
<i>Morinda lucida</i>	Konkroma	21	Bark, root, leaves	Fevers including malaria, typhoid, gonorrhoea, bone fracture, high blood pressure, rheumatism, candidiasis
<i>Ocimum gratissimum</i>	Nunum	21	Leaves	Stomach sores, skin rashes, fever, headaches, jaundice, bilharzia, whitlow, cough, infertility, ease child birth
<i>Spathodea campanulata</i>	Kuakuanesuo	19	Bark	Anaemia, fever, chest pain, piles, infertility, rheumatism, fibroid, gonorrhoea,
<i>Terminalia ivorensis</i>	Emire	18	Bark	Waist pain, piles, infertility, rheumatism, stroke, fibroid, family planning, stomach sore
<i>Zanthoxylum gillettii</i>	Okuo (kwakuobese)	18	Bark, root seed	Fever, cough, infertility, stomach disorders, diabetes, waist pains
<i>Anthocleista nobilis</i>	Wudifokete (bontodie)	17	Bark	Gonorrhoea, infertility, stomach and menstrual disorders, hernia, fever, constipation, piles

<i>Tetrapleura tetraptera</i>	Prekese	15	Bark, fruit, seed	Anaemia, fever/malaria, hypertension, high blood pressure, snake bite, loss of appetite
<i>Alchornea cordifolia</i>	Gyama	13	Bark, root, leaves	Fever, sexual weakness, anaemia, waist pain, gonorrhoea, skin rash, hernia, measles, stomach sore
<i>Mangifera indica</i>	Mango	12	Bark	Fevers including malaria and typhoid, blood tonic, urine retention, bilharzia, diarrhoea, hypertension
<i>Azadirachta indica</i>	Neem	12	Leaves	Fever, typhoid, rheumatism, skin rashes
<i>Bombax buonopozense</i>	Akonkodee (akata)	11	Bark, leaves	Skin rashes, blood tonic, fever, ulcer, bone fracture, loss of appetite
<i>Kigelia africana</i>	Nufuten	11	Bark, root, seed, fruit	Piles, rheumatism, infertility, sexual weakness, waist pain

Table 1 shows the most frequently collected plants and 46 disease conditions were reported to be treated by these plants including: fever, impotency, stomach disorders, ante- and post-natal disorders, hypertension, diabetes, skin disorders, sexually transmitted diseases and general aches and pains among many others.

### Demand and availability

Demand is increasing for most species due to increased recognition of natural plant cure. Over 100 species were reported to be in high demand,

scarce and rare or unavailable. The first 10 mentioned by the respondents are shown in Table 2. Deforestation, wild fire and urbanization were mentioned as the major sources of threats to the sustainability of the herbal plant industry. In addition, an increase in demand for natural medicines arising from popularization of traditional medicines which are known to be cheap and also believed to be very effective in treating common ailments such as malaria and other diseases (see Table 1) has also led to increased harvesting.

Table 2: High demanding and scarce medicinal plant species in Ghana

Botanical name	Local name	Frequency of mentioning the species
<i>Khaya spp.</i>	Mahogany	123
<i>Pycnathus angolensis</i>	Otie	57
<i>Rauvolfia vomitoria</i>	Kakapenpen	44
<i>Terminalia ivorensis</i>	Emire	39
<i>Alstonia boonei</i>	Nyamedua	38
<i>Trichilia monadelpha</i>	Tanuro	36
<i>Riciodendron heudelotii</i>	Wama	35
<i>Paullinia pinnata</i>	Toantini	32
<i>Guarea cedrata</i>	Kwabohoro	29
<i>Zanthoxylum zanthoxyloides</i>	Oyaa	24

### Sustainability of plant medicine industry

It was observed that improper harvesting methods were employed for the collection of plant parts. Particularly, severe removal of tree bark (Figure 3) and roots (Figure 4) can kill the tree. Furthermore, uncontrolled collection of fruits and seeds adversely affect regeneration of the species (see Table 1 for parts collected), usually without permits from the communities that own the resources and /or Forest Services Division. Sixty percent of the respondents suggested cultivation of endangered medicinal plant species to ensure sustainability of the medicinal plants industry. Thirty percent were of the view that medicinal plants could be protected for sustainable use through controlling illegal collection from the wild while 10% suggested improved harvesting methods to prevent destruction of medicinal plants. Even though, 98% of the respondents acknowledged medicinal plants cultivation would be a profitable venture, only 25% of the herbal practitioners were making efforts to cultivate or retain some species on farms and gardens for their own use. Some of the major factors constraining cultivation were lack of planting materials, information on silvicultural methods and land for cultivation.

### Phenology and propagation

With the exception of *Vitellaria paradoxa* whose fruit maturity period extends from March to September, flowering of the species generally began from October to April, while fruit maturity also occurred from December to July (Table 3). Seed germination ability ranged from as low as 7% for *V. paradoxa* to as high as 74% for *Khaya senegalensis*. The duration of seed germination also varied considerably, ranging from 8 to 28 days for *Tamarindus indica* to 70-120 days for *V. paradoxa* (Table 3).



Figure 3: Severe removal of tree bark (*Khaya ivorensis*) can kill the tree through blockage of translocation of water and minerals salts



Figure 4: Severe removal of roots and pruning of shoots of *Zanthoxylum zanthoxyloides*. This harvesting method interferes with tree survival, flowering and fruiting and hence regeneration of the species.

Table 3: Flowering, fruiting periods and seed germination of some selected high demanding medicinal plants

Species	Flowering	Fruit maturity	Seed germination	
			Duration	% Germination
<i>Khaya senegalensis</i>	February to March	December to January	7-42 days	74
<i>Morinda lucida</i>	January to April	April to July	9-90 days	65
<i>Rauvolfia vomitoria</i>	February to April	May to July	54-90 days	60
<i>Pycnanthus angolensis</i>	January to April	February to May	28-56 days	68
<i>Khaya africana</i>	January to March	March - June	9-28 days	40
<i>Alstonia boonei</i>	October-November	January - February	10-40 days	66
<i>Tamarindus indica</i>	January-April	March-July	8-28 days	70
<i>Vitellaria paradoxa</i>	October-February	March-September	70-120 days	7

## DISCUSSION AND CONCLUSION

Traditional plant medicine industry is widespread and is increasingly vital for affordable health care in Ghana. It is also a major source of livelihood and income for a large proportion of the respondents who engage in it as their major occupation. However sustained availability of the medicinal plants is becoming questionable because majority of the plant species traded in Ghana (126 out of 160) are obtained from wild collection and their demand also outstrips supply. As a result, a number of them are becoming rare and threatened. Even though demand for plant medicine is on the increase for most species, only few respondents were found to be engaged in cultivation of medicinal plants.

Major constraints to conservation of the species include unsustainable methods of harvesting, wildfires, deforestation and harvesting for timber

(e.g. *Khaya spp*, *Alstonia boonei*, *Pycnanthus angolensis* and *Morinda lucida*). Firewood extraction, charcoal production and overgrazing also constitute major threats in the Dry Semi-deciduous and Savannah forest ecozones. Invariably, potential exists to cultivate these valuable plant species in farmlands as a means of diversification of income through sale of the products (Monela *et al.*, 2005), since no seed germination difficulties were experienced in most of the species tested (Table 3).

Naturally, planting medicinal tree species by small holder farmers is subject to the normal constraints faced by farmers in developing new profitable business. More important factors constraining cultivation are lack of access to superior germplasm and absence of well-functioning markets for products. Other areas requiring attention are research and training on sustainable harvesting of plant parts and conservation since

the parts harvested are mostly leaves, seeds or fruits, bark and roots (Table 1, Figures 3 and 4) as has also been reported by other scientists (Dharani *et al.*, 2010; Ofori *et al.*, 2011a). These plant parts are nevertheless very essential for the regeneration and sustainability of the species and if collection is not regulated, their sustainability will continue to be at risk. Other areas for attention should include chemical composition, processing and packaging (Rukunga and Simons, 2006; Daharani *et al.*, 2010).

The sustainability of medicinal plants would benefit from creation of partnerships to influence the current rate of biodiversity loss while seeking innovative ways for improving the people's livelihoods. Through partnerships and involvement of the beneficiaries, stakeholders will collectively embark on the development of methods for sustainable harvesting, conservation, propagation, supply of quality germplasm for planting and market development. Typical successful examples are the adoption of participatory tree domestication in Cameroon (Tchoundjeu *et al.*, 2008) and the Novella partnership (Private-public partnership) to promote the domestication of *Allanblackia* species in East, West and Central Africa (Jamnadass *et al.*, 2010; Ofori *et al.*, 2011b). Furthermore, efforts should be made to strengthen linkages between all stakeholders to promote conservation and commercial production of medicinal plants, as well as improvement of knowledge base of scientists, traditional medical practitioners, policy makers and the public on the relevance and safety of traditional plant medicine.

The establishment of the Centre for Research into Plant Medicine at Akuapem Mampong, and the Department for Herbal Medicine under the Faculty of Pharmacy of the Kwame Nkrumah University of Science and Technology for research (collection, conservation and characterization of medicinal plants) and administration of plant

medicine has led to the emergence of many herbal clinics or centres in the country and contributing to making health care delivery accessible to many people as well as improvement of livelihoods.

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