UNIVERSITY OF CAPE COAST

ETHNOBOTANY AND ECOLOGY OF PLANTS OF IMPORTANCE IN REPRODUCTIVE HEALTH: A CASE STUDY OF SUBRI RIVER FOREST RESERVE IN THE WESTERN REGION OF GHANA.

BY

GERTRUDE LUCKY AKU DIAME

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SEPTEMBER 2007

DECLARATION

CANDIDATE'S DECLARATION

I hereby declare that this thesis is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature:............................Date. 23-09-2008

Gertrude Lucky Aku Diame

SUPERVISORS' DECLARATION

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Signature............ Date. 01-10-2008

Prof. H. K. Akotoye

Co-Supervisor's Signature.................... Date 09-10-2008

Mr. A. N. M. Pappoe

ABSTRACT

Ethnobotanical and ecological studies were carried out to take inventory of the species used by the inhabitants surrounding the Subri River Forest Reserve for reproductive health care and to assess the ecological status of woody plant species of this reserve. The study was carried out between November 2005 and December 2006.

Medical ethnobotanical knowledge was gathered from 80 inhabitants in 25 communities using questionnaires. Reproductive health conditions were categorized into 19 major conditions, some of which included abortion, breast cancer, miscarriage and sexual impotence; and 7 corporeal or body systems. A total of 185 medicinal plants species, distributed in 60 families and 155 genera were cited. The most cited species was *Gouania longipetala* (4.23%). Of these 185 species, 72.97% were woody, while 27.03% were herbaceous. The most frequently employed plant part was barks (32.49 %), followed by roots (29.95%) and leaves (21.32%).

Phytosociological studies on woody species with girth of at least 10 cm were undertaken in 50 circular plots of 0.1ha, making a total of 5ha study area. A total of 128 species belonging to 104 genera and 45 families were encountered. The importance value indices of these species were generally low (0.28 to 20.09). Their distribution into Raunkiaer's frequency classes showed that 92.19% of the species were rare and none was common. There were high species diversity indices of Simpson (0.96) and Shannon-Weaver (4.00). Species evenness was also high (0.82).

Only 57 (44.53%) of the woody species were cited for reproductive health conditions. The Relative Importance (RI), calculated from an ethnobotanical perspective, showed that approximately 28% of the 57 plant species were versatile. *Alchornea cordifolia* was the most versatile species for the reproductive health conditions. However, there was no significant ($p>0.05$) association between the RI and the phytosociological parameter values of the 57 woody medicinal species. Provisions of sustainable harvesting methods, adequate knowledge about forest management and cultivation among others, will ensure the conservation and sustainable use of these medicinal plants.

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To Mr. Nicholas Adorsu, the Acting Manager of Subri Industrial Plantation Limited (S. I. P. L.), Daboase, and his entire family.

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INTRODUCTION AND LITERATURE REVIEW

General Introduction

Life on the planet Earth has existed without humans but humanity could not sustain itself without the life of other organisms (Kim and Weaver, 1994). Biodiversity is the nested composite of plants, animals and microbes. It is also the basis for ecosystem processes and the fountain of mankind's life-support system. Biodiversity provides potential sources of food, shelter, fuel, ornamentals, antibiotics, pharmaceuticals and other products that satisfy human needs (Kim and Knutson, 1986; Weaver, 1990). The ability of man to exploit these natural resources including plants around him to his advantage has indeed made humans the most successful/powerful organism on planet Earth.

A discussion of human life on this planet would not be complete without a look at the role of plants, because plants have been an integral part of human society since the start of civilization. The main uses of plants include sources of food (cereals, vegetables, fruits, beverages, drinks, spices, condiments, seasoning, etc.); edibles (for colouring) or as dye-colours; ethno-medicine and ethno-veterinary medicine; pesticides and insecticides to protect the crops; wood for making implements, utensils, tools, musical instruments, boats, oars and other household goods; cordage; commercial plants; crude drugs, packaging material, wild fruits and vegetables and fuel (Shah, 2005).

Since the beginning of civilization, people have used plants as medicine. Also, plants continue to be a major source of medicines, as they have been throughout human history. It has been said that between 35 000 and 70 000 species of plants have been used at one time or another for medicinal purposes (Farnsworth *et al.*, 1991). By far the greater number of species is employed in herbal medicine. Medicinal plants thus play a vital role in the maintenance of human health throughout the world and notably in the tropics. They are of critical importance in poor communities where even relatively cheap western medicines remain prohibitively expensive. Medicinal plants also play important cultural and economical roles. Knowledge of their use is widespread and their efficacy is trusted, based on a long history of use. Interestingly, many of today's drugs have been derived from plant sources. It is estimated that, plant materials are present in or have provided the models for 50% western drugs (Robbers *et al.*, 1996). Right now, 80% of the world's population relies on plant-derived medicines for their healthcare. In the US for instance, between the years 1959 to 1980, 25% of prescriptions given contained some sort of plant extract (Gurib-Fakeem, 2006).

Traditional healers or shamans use plants in treatment of diseases like bleeding, boils, bronchitis, cold, cough, colic, debility, dropsy, asthma, dysentery, ear complications, headache, leucoderma, pneumonia, renal complications, piles, scorpion bite, snake bite and skin diseases. Plants are also used for other health conditions notably reproductive health conditions including infertility, abortion, delivery complications, menstrual disorders, miscarriages, family planning and many gynaecological disorders. For instance, *Alternanthera pungens* (Family Amaranthaceae) is used for treatment of abdominal pains, gonorrhoea and haemorrhage, to promote flow of milk, and to cause abortion (Dokosi, 1998).

The tropical forests are believed to be the source of a large proportion of the world's recognized medicinal plants although the fallow areas and the village periphery are also important sources. The tropical rainforest is earth's most complex biome in terms of both structure and species diversity. More than half of the world's estimated 10 million species of plants, animals, and insects live in the tropical rainforests. Currently, 121 prescription drugs sold worldwide derive from several plant species of the rainforests (Shanley, 2003). There are many more over-the-counter drugs and herbs sold that come from plant sources as well. In fact, today's 20 best-selling drugs, which are worth about $6 billion a year, are derived from tropical plants (Balunas, 2005). It is believed there are still undiscovered species of plants in the rainforests, and it is unimaginable the amount of undiscovered species in the rainforests that have the possibility of doing even more than these discovered species have been proven to do.

Only 1% has been thoroughly studied for their chemical composition and medicinal value thus far. Specifically, in the tropical forests of the Amazon basin, approximately 1% of the plants have been studied chemically and an astonishing 90% have not yet been subjected to even a superficial chemical analysis (Schultes, 1988). Therefore, the need to study medicinal plants, cannot be overemphasized for a vista of reasons including, widespread use of plants in folk medicine, rescuing traditional medicinal plants and knowledge about them from imminent loss as well as the need for health for all (WHO, 1978). Since the first earth summit in Rio de Janeiro in 1992, there has been a sustained global awareness of the importance of the plethora of biodiversity and natural resources from tropical forests for several purposes. This stems not only from the ecotourism potentials, the forest products derivable there from, but also from the ethnobotanical and ethno medicinal-uses attached to the plant genetic resources obtained from these forests.

However because native plant habitats are destroyed almost daily, many medicinally valuable plants will be gone before scientists can even investigate them. As the world's population increases, the threat to biodiversity becomes greater (WRI, 2000). Technologically, through both the magnitude of its population and its actions, humanity has caused increasingly devastating effect on the stability of this ecosystem, causing extinction of valuable species. The threat is more pronounced in developing countries like Ghana, mainly due to human activities such as urban development and construction, deforestation, expansion in agriculture, over exploitation and indiscriminate exploitation of natural resources. Thus, every aspect and component of biodiversity, including the rainforest is under threat of extinction and therefore, needs to be conserved to meet the demands of the current and future generations. Harvesting of tropical plants by scientists and biologists to be used or experimented for medical purposes also contributes little to rainforest loss.

It has been postulated that the present rate of global species extinction is 400 times faster than the rate in the geologic past, and that this rate is rapidly accelerating (Plotkin, 1995). The unpleasant conclusion is that the human race is causing one of the first major reductions of global, vascular plant diversity since the origin of life (Plotkin, 1995). With the disappearance of the flora, we are losing a vast genetic base of variation in botanical and zoological species that has evolved over thousands of years. This is because rain forest plants may carry important genetic information that sophisticated plant breeders can use to modify and improve important crops (Forsyth and Miyata, 1984).

By necessity, a multidisciplinary approach is needed to help us to understand the frightening implications which loss of the rainforests would bring in terms of consequent loss of knowledge about tropical plants, and loss of native cultures in their entirety, as well as the damage to the earth's ecological health. This is where Ethnobotany comes into play.

Ethnobotany and Traditional Medicine

The term Ethnobotany refers to all studies that are related to the reciprocal relationship between plants and traditional peoples (Martin, 1995; Cotton, 1996). Ethnobotany, in general, thus refers to the study about the utilization of plants for a wide variety of humans needs such as medicine, food, fodder, fibre, and goods required for their material culture and amenities. The primary aims of Ethnobotany are twofold: (1) to document facts about plant use and plant management; and (2) to elucidate the ethnobotanical text by defining, describing, and investigating ethnobotanical roles and processes (Alcorn, 1995). Ethnobotany is a multidisciplinary science encompassing botany, anthropology, chemistry, economics and linguistics among others.

The importance of ethnobotany includes economic growth and development, conservation of biodiversity, and most especially provision of medicine and healthcare. The start of the 'Peoples and plants' cooperation between World Wildlife Fund (WWF) international, (United Nations Educational, Scientific and Cultural Organisation) UNESCO and the Kew Royal Botanic Gardens, the creation of the 'Foundation for Ethnobiology' and the publication of the first number of Indigenous Knowledge and Development Monitor (Hamilton, 1994) are important steps forward in the development and diversification of the ethnobotany-related sciences. The importance of medical ethnobotanic research has been increasing, since potential sources for drugs could disappear in the future as a result of the rapid loss of biodiversity (Balick and Cox, 1998). Furthermore, Berlin and Brent (1996) have argued that ethnobotanical research can contribute in developing countries by documenting traditional forms of healthcare, the discovery of crude plant extracts and the elaboration of cheap drugs.

Ethnobotany plays a crucial role in the study of traditional medicine (Pei, 2005). Traditional medicine is the sum total of all knowledge and practical application, whether explicable or not used in diagnosis, prevention, and elimination of physical, mental or social imbalance; and relying exclusively on practice and experience, and observations handed down from generation to generation, whether verbally or in writing (Ampofo and Johnson-Romauld, 1978).

Traditional medicine also refers to health practices, approaches, knowledge and beliefs incorporating plant, animal and mineral-based medicines, spiritual therapies, manual techniques and exercises, applied singularly or in combination to treat, diagnose and prevent illnesses or maintain well-being. A traditional healer is therefore, defined as a person with competence to practice traditional medicine (Togola *et al.*, 2005). Traditional healers have various specializations, which include herbalists, diviners, spiritualists, traditional surgeons and birth attendants among other categories (Mbiti, 1969; Ampofo and Johnson-Romauld, 1978; IDRC, 1980). Although traditional medicine involves the use of herbal, animal parts and minerals, herbal medicines are the most widely used of the three (Orwa, 2002).

Traditional medicine is a significant element in the cultural patrimony and is an important part of the rural people. It is of critical importance in poor communities, where even relatively cheap western medicines remain prohibitively expensive. Its use has increased with the increase in price of conventional medicine in the local currency. The World Health Organisation (WHO) estimates that up to 80% of the world's people rely on plants for their primary health care, since western pharmaceuticals are often expensive, inaccessible or unsuitable. In Africa, up to 80% of the population uses traditional medicine for primary health care and in industrialised countries adaptations of traditional medicine are termed *complementary* or *alternative* medicine.

In many tropical and sub-tropical countries, as in Africa and South and East Asia, the majority of people resort to herbal medicine for the majority of their primary health care needs. There are also strong traditions of herbal medicine in parts of Europe, such as Germany, France and Eastern Europe generally. Diallo and Paulsen (2000) confirmed that approximately 80% of the population in Mali use traditional medicine as their only type of medicine. Officially, traditional medicine is acknowledged in Kenya as an important part of the life of the people in the rural areas (Nyamwaya, 1995). In the early 1950s up to 84% Pakistani population was dependent on traditional medicines for all or most of their medicinal uses (Hocking, 1958). In Himalayan, 70-80% population depends on these traditional medicines for health care (Pei and Manandhar, 1987). The herbal sector is growing fast, increasing by 12-15% by value per year in the UK, USA and Italy (Abrahams, 1992). Reports by McAlpine-Thorpe (1992) indicate that there are more than 2000 herbal medical companies in Europe and more than 220 in the USA, with Germany the largest market in the world for herbal medicines, with annual sales of $1.2 billion representing nearly 25% of the national pharmaceutical market. Boye (1985) pointed out that over 90% of the drugs in hospitals today have been introduced the last 50-60 years and one can understand the important role that traditional medicine has played in the past. Traditional medicine still remains the main recourse for a large majority of people for treating health problems.

Outstanding Issues in Traditional Medicine.

Until about the 1970s, most studies concerned with traditional medicine in Africa linked it with belief and ritual (Yoder, 1982). Negative approach to African traditional medicine emanated from colonial times and this includes the view that all healers are witch hunters practising "black magic" (Thairu, 1975).

However, realizing the crucial roles traditional medicine plays, Naranjo (1995) advocated an urgent need to study these medicinal plants with the note that there was an abject neglect of this highly endangered but cheap alternative health care resource. Traditional medicine is advocated for a number of reasons. It is an integral part of every culture developed over many years; it is socially acceptable; has little or no side effects; it is readily available and has the widest spatial coverage; it is wholesome, so that, besides controlling or curing a disease condition, it provides the body with nutrients such as proteins and vitamins; it is efficacious; and affordable (WHO, 1978; Pillsbury, 1979; Philips, 1985). Although economic inaccessibility of modern medicines is the major reason as to why most people resort to the use of traditional medicines, Kenyans, just like people in other African countries, may not seek western medicine even when this is available owing to social, psychological or cultural reasons (Pillsbury, 1979; Katz and Kimani, 1982; Mayer, 1982).

While traditional healing methods continue to be well used, younger people's knowledge of them is diminishing fast, as certain plants disappear from the environment and the older practitioners die, taking their specialist knowledge with them. Often the traditional knowledge about the plants can bc obtained only by specialists within an indigenous community, for example, the shamans, beekeepers, and master fishermen. These people claim that they derive their knowledge directly form the plants as well as from their human teachers (Plotkin, 1995), and in dreams. Since the traditional knowledge about the plants can be obtained only verbally, with every specialist that dies without an apprentice, the great medical knowledge base of his/her culture dies with him/her. Naranjo (1995) lamented that due to modernisation, such precious knowledge systems have been eroding and corroding fast and at times totally disappearing in the recent past. Subsequently, with this loss, several steps are also taken back in the prospect for progress in the development of new pharmaceuticals (Forsyth and Miyata, 1984). Furthermore, knowledge of how these species might prove themselves useful for human welfare is also disappearing even faster than the tropical trees, as the natives change their aboriginal lifestyles (Plotkin, 1995).

Herbal Medicine in Ghana

Practice of traditional medicine has existed in Africa and other cultures for centuries since man came into being. Until recently, it has been neglected or even outlawed in some cases due to undue pressure from practitioners of modern medicine and the unscientific background of its method of operation. As in many developing countries, however, traditional and "western" medical practices exist side by side in Ghana. The WHO (1976) estimated that traditional medicine caters for the health care needs of over 80% of the rural population in most African countries. For instance, in Ghana, Mali, Nigeria and Zambia, the first line of treatment for 60% of children with high fever resulting from malaria is the use of herbal medicines at home. At present, the WHO is supporting clinical studies on antimalarials in three African countries, which are revealing good potential for herbal antimalarials, while other collaboration is taking place with other countries including Ghana in the research and evaluation of herbal treatments for HIV/ AIDS, malaria, sickle cell anaemia and diabetes mellitus.

Although most of Ghana's population lives in rural areas, the vast majority of pharmacists (as well as other health professionals) lives and works in the cities. Ghana has a particularly strong tradition in using medicinal plants and they play an important cultural and economic role in poverty alleviation, particularly through the involvement of fetish priests; people of significant status in villages throughout the country. According to Dokosi (1969), more than 3,000 different plant species occur in Ghana and almost all are used in traditional medicine. Other workers also have worked intensively on useful plants in Ghana. Notably among them are Irvine (1961) and Mshana *et al.* (2000). Irvine has recorded a lot of medicinal plants, for example a decoction of whole plant of *Hoslundia opposita* is used for gonorrhoea, while the seeds of *Sterculia foetida* is used for abortion. Mshana and others have prepared a list of medicinal plants and their uses- for example a stem bark of *Ricinodendron heudelotii* is used to treat female infertility, while the bark of *Lannea welwitschii* is used to treat lower abdominal pain. Available figures show that between 60 and 70% of Ghanaians rely on traditional medical systems for their health needs (Sarpong, 2000).

According to Ampofo (1983), even though there is considerable opposition from some western-trained doctors, some scientific investigations into traditional medicine have begun in Ghana, and appreciation of the importance of medicinal plants at government level is increasing nowadays, as government policy now promotes the integration of traditional and conventional health systems. An indication of the importance ascribed to medicinal plants is given by the existence within the Ministry of Health of a Director for Traditional Medicine. In addition, a Centre for Scientific Research into Plant Medicine has been established. Tsey (1997) describes the initiative as "an attempt to modernise and incorporate traditional herbal knowledge and treatment into the formal health sector".

Incorporation of Traditional Medicine and Orthodox Medicine

The history of the use of traditional medicine with WHO goes back to 1977 when the World Health Assembly (WHA) drew attention to the potential of traditional medicine, especially its human power reserve in national health care systems, urging all member countries to utilize traditional medicines (Akerele, 1987). Then in 1978, it highlighted the crucial role of medicinal herbs in the health care systems of developing countries. This was reinforced by the Alma Ata Conference, which recommended that governments give priority to utilizing traditional medicines in national drug policies and regulations (Akerele, 1987).

Africans frequently utilise both traditional and modern medicine simultaneously for the same episode of illness or at different times for different illness (Alexander, 1985), even though there is little coordination between them. Traditional knowledge can be regarded as the product of a natural screening process and medicinal plants used both for herbal medicine and for the manufacture of pharmaceutical drugs. The use of plants in traditional medicine has led to the discovery of the majority of major drugs used in western medicine with an origin in plants (Hollman, 1991), with an estimate of annual worldwide sales of plant-derived pharmaceuticals currently total over $20 billion (Davis, 1995). These have led to growing interest in obtaining samples of plant material or traditional knowledge about plant uses to explore for new commercial medical products.

In Ghana, the traditional health care sector, which includes herbalists and spiritual healers, remains an important source of health care. The WHO encourages the incorporation of useful elements of traditional medicine into national health care systems (Akerele, 1987). In Ghana, the quest for integration of plant medicine and orthodox medicine has been expressed by Twumasi (1975).

The present health status in Ghana would not have been attained without the involvement of traditional medicine in our health delivery system. Health was declared as a universal human right at the 1978 Alma Ata International Conference. Therefore, in order to provide affordable, accessible and socially relevant health care to all individuals, an incorporation of traditional and orthodox medical practices is urgently needed. In order to achieve this, the tropical forests, which serve as the reservouir of the world's recognized medicinal plants, need to be conserved.

Forests and Forest Ecosystems

No species is endowed with genetic and phenotypic attributes needed to fit into every ecological niche, and no single species can survive alone without interaction with other species (Noss, 1990). Conversely, no healthy ecosystem can function without interaction with its primary component species (Odum, 1989). Biodiversity involves all biological and environmental levels from gene through populations and species to ecosystems and landscapes. The natural environment is characterised by a myriad of ecosystems such as the tropical rainforest.

A forest is a natural ecosystem in which trees are a significant component. Tropical rainforests are the most diverse ecosystems found in the world today. They are home to thousands of species of plants and animals; many of these species are not found anywhere else. That is, forest products are derived not only from trees, but also from all plants, fungi and animals for which the forest ecosystem provides habitat. The preponderance of species notwithstanding, it has been noted that so many of the trees found in the tropical rainforests are rare (Hubbell and Forster, 1986). Despite the rarity in species, humans continue to enjoy the forests' resources directly or indirectly. Both timber and Non-Timber Forest Products (NTFPs) are derived from forests. NTFPs encompass all non-timber biological materials, which are extracted from forests for human use.

Forests have an important role to play in human development. Throughout West Africa, forests form an integral part of the rural economy, providing subsistence goods and services as well as items of trade (Falconer, 1992). It is FAO's view that forests can do much more than provide energy for subsistence, and that their role in providing energy for development will ultimately be just as important. Vegetation, such as forests, has had a great significance both to the economy and ecology of Ghana. In the economic sense, forests have been a major export product before the advent of cocoa, contributing almost 80% of the Gross Domestic Product (GDP). Even, with the advent of cash crops such as cocoa, coffee and mineral resources, forest products still contribute substantially to GDP of Ghana. In fact, it is recorded that timber trade contributed a whooping amount of US$100 million to the 1988 GDP of Ghana. In the ecological sense, forests play a vital role in the balance of the ecological process as that helps to maintain nature and recycling of natural resources. This has been confirmed by Keita (1994), when he reported that forests play a role in the genesis and maintenance of the production potential of soils, water reservoirs and provides protective cover against erosion. Furthermore, multiplicity in form, quality and structure allows the tropical rainforest to act as a gene resource (Maydell, 1991).

Unfortunately, with the ever-growing population of humans the rainforests are being cut down at a shocking rate to provide humans with lumber, pasture land, and farmland, thus destroying the forests. Tragically, the Amazon basin, which has been estimated to have the greatest overall biodiversity in the world, now faces certain destruction as logging companies and local farmers exploit the natural habitats in the acquisition of natural resources. Deforestation normally results in desertification and in Ghana the major cause of desertification is indiscriminate felling of trees.

The causes of deforestation are mainly related to a competitive global economy, which forces poorer countries to exchange their natural resources for money. This happens both locally and nationally. Locally, people use land for farming to make money, due to poverty. Nationally, governments sell logging concessions to cover debts and to develop industries. By selling their prized woods, such as mahogany, they can pay back their debts and develop their own industries to generate wealth for the country (Moran and Ostrom, 2005).

As population pressure increases on forest resources, a picture of their products and services, exploitation, users and uses are needed for policy making and forest management planning (Myers, 1989), in order to avoid total loss and the consequences of deforestation.

Effects of Deforestation

Deforestation is one of the major environmental problems now facing the tropics. Available literature on effects of deforestation is immense, emphasisng the ecological consequences of deforestation (Gbadegesin, 1996). Shanley (2003) reported that rainforests once covered 14% of the earth's land surface; now they cover only 6%. Over 200,000 acres of rain forest are burned every day in the world to make room for farming and housing. That is over 150 acres lost every minute of every day. Experts estimate that at the current rate of destruction, the last remaining rainforests could be consumed in less than 40 years and 130 species of plants, animals and insects are lost every single day as they become extinct from the loss of rainforest land and habitats Cubie (2003). Myers (1989) also estimated that the world's tropical rainforests are disappearing at the rate of about 7.3 million hectares a year.

Obviously, deforestation has not only led to serious degeneration of forests, but also destruction of microhabitat for both fauna and flora. This life is slowly diminishing as the natural habitats are vanishing. In countries with poor economies, people turn to agriculture to meet their everyday needs. They either burn the stumps to release the nutrients into the soil needed to grow crops or use the land for large plantations using pesticides and irrigation systems that are very damaging to the land. However, with no trees, the nutrients are soon washed away by rain. The land is left to re-grow, but as the soil is left infertile, the forest will take a long time to grow back (Rudel, 2005). The rain washes these chemicals into the water system leading to destruction of marine life.

Commercial loggers also cut forests to sell as timber or pulp. This is done either selectively, taking only certain types of trees, or through clear cutting, where all trees in a certain area are removed. Selective deforestation is more damaging than expected, with studies showing that felling a small amount of trees in a forest can affect a great deal of trees in the surrounding area. This is because these trees are just taken away, not burnt, so their nutrients are not released into the soil (Jordan, 2006).

The plants and soil of tropical forests hold 460-575 billion metric tons of carbon worldwide with each acre of tropical forest storing about 180 metric tons of carbon. Trees are made of about 50% carbon, so when trees are burnt, carbon is released into the atmosphere ((Jordan, 2006). This joins with oxygen to make carbon dioxide (CO_2), which enhances the greenhouse effect, resulting in global warming and climate change. For instance, it has been estimated that clearing of forests, especially in the tropics, is responsible for 15% to 25% increase in atmospheric carbon dioxide (Kriebitzsch, 1992). As trees and plants are cleared away, the moist canopy of the tropical rain forest quickly diminishes. Evaporation and evapotranspiration processes from the trees and plants return large quantities of water to the local atmosphere, promoting the formation of clouds and precipitation. Less evaporation means that more of the sun's energy is able to warm the surface and the air above, leading to a rise in temperatures and the drying of land (Jordan, 2006).

Also greatly affected are the plants and animals that live in the rainforests. Many of these plants and animals could hold cures for cancer or AIDs that may never be discovered because of deforestation. Animals are also being threatened, as their habitats are destroyed and they themselves are killed too (Palloni, 2006).

There are also social consequences of deforestation, as forest destruction threatens the unique lifestyle of indigenous people (Cansari, 2001). For indigenous communities, the arrival of civilization usually means the destruction of their traditional life-style and the breakdown of their social foundations. Individual and collective rights to the forest resources have been frequently ignored. The intrusion of outsiders destroys traditional lifestyles, customs, and religious beliefs (Moran and Ostrom, 2005).

The solutions to problems, such as deforestation, lie in addressing the root cause. In this case, finding a solution means considering the economic problems that lie at the heart of the situation. Many propositions have been put forward, for example sustainable wood sources. If deforestation continues at its current rate, in just 100 years there will be no more rainforests left at all (Jordan, 2006). Rainforests are magnificent, unique, and diverse areas on our precious Earth. If something is not done to stop the effects of deforestation, several species of plants and animals as well as cures for diseases will be lost.

The problems facing governments and world leaders are pressures on them to help preserve the remaining rainforest. Attempts are being made to protect and conserve forests and such attempts can be seen through forest reserves, biosphere reserves and natural reserves (Keita, 1994). The Costa Rican government has recently begun taking action to preserve the rainforest. In 1969, thirty-two national parks and reserves were established (Munasinghe, 1996). In Ghana too, a number of forest reserves have been established early in the first half of the century.

Forest Reserves in Ghana

Only a third of Ghana's total area is naturally covered by high forest. Much of its 23.4 million hectares of land area is savannah. The high forest areas, confined only to the western third of the country, however contain over 70% of floral diversity of the country (Abu-Juam, 2004). Unfortunately, most of these forests have gone. Protecting the forest ecosystem is thus critical to any biodiversity conservation effort.

The bulk of the remaining forests are in forest reserves and very little closed forest remains outside the forest reserves. These reserves hold virtually all that is left of the forest in Ghana. Most of today's forest reserves were established in hilly or swampy areas and in watersheds, to protect the climate, soils and water supply and to prevent the savannah from spreading (Abu-Juam, 2004). A secondary aim of the reserves was to circumscribe and protect stocks of timber trees for careful management by authorities and to protect supplies of non-timber forest product for the villages surrounding the forests (Foggie and Piasecki, 1962).

However, the looming destruction of Ghana's forest reserves by mining companies put them under great threat. Such forest reserves include Subri River, Supuma Shelterbelt, Opon Mansi, Tano Suraw, and Cape Three Points forest reserves, all in the Western region; and the Ajenjua Bebo and Atewa Range forest reserves, both in the Eastern region. Unfortunately, forests are being reduced at an alarming rate. For instance, Ghana's forest estate used to be about 8.3 million hectares but now, only 1.6 million hectares are left as a result of deforestation (EPA, 2000). The country's current forest reserve, which stands at 1.6 million hectares, is less than the initial 1.76 million hectares reserved as permanent forest estates, while only two per cent of the present forest reserve is said to be in excellent condition; with less than two percent of its native tree cover remaining (Senaya, 2003).

Currently, very little closed forest remains outside the forest reserve network with much of it in small-scattered patches in swamps and sacred groves.

Every year two million acres of Ghana's forested land is lost to mining, and in Wassa West District alone, 60 % of rainforests have already been destroyed by mining operations. Senaya (2003) also stressed that mining in forest reserves contravenes the principles underlying the establishment of forest reserves in the first place, and it violates several international conventions such as the Convention on Biological Diversity, to which Ghana is a signatory.

Pulling down the forest reserves could result in multiple ecological and social consequences such as soil erosion due to the removal of tree cover, the loss of valuable top soil, extensive flooding in rural areas and urban areas caused by excessive silting of river systems, and climate change due to increased carbon dioxide in the atmosphere as a result of the loss of trees. Hence, prioritising commercial development over ecological concerns is dangerous. This portend has been aptly expressed as Indian proverb thus: "only after the last tree has been cut down; only after the last river has been poisoned; only after the last fish has been caught; only then you will find that money cannot be eaten" (www.sleddogcentral. com/forum/topic.asp?, 15/07/07). Action is therefore urgently required to implement measures to ensure continued availability of the forest reserves. Such action requires that the species composition and structure of the forest stands be investigated.

Species Composition and Stand Structure

Vegetation is the plant cover of the Earth, and comprises all plant species growing in a very great diversity of assemblage and whose phytosociology deals with floristic structure, development, distribution and definition of plant communities. Plant communities differ in their structure and the structure of any vegetation can be considered from many perspectives.

Mueller-Dombois and Ellenberg (1974) identified five levels of vegetation structure, which are hierarchically integrated. These levels include vegetation physiognomy, biomass structure, life form structure, floristic structure and stand structure. Vegetation physiognomy is defined as the external appearance of vegetation (Fosberg, 1961). Biomass structure is a more concise concept that relates specifically to the spacing and height of plants forming the matrix of a vegetation cover. Life form structure relates to the composition of growth forms or life forms of plants in a vegetation. Growth forms include trees, shrubs and herbs. However, a plant may be woody or herbaceous (non-woody). Woody plants are vascular plants that have their stems lignified to a high degree and are normally trees, shrubs, and vines (or lianas). Floristic structure relates to the floristic composition. Stand structure or community structure involves population structure analysis, where population curves of different species are compared. However, a sample stand is delimited as a definite area of ground containing stand vegetation. The floristic composition, simply expressed as the list of species, life form composition and structure of the vegetation is necessary of all ecological work.

Vegetation structure is the organisation in space of the individuals that form a stand (and by extension a vegetation type or a plant association) while the primary elements of structure are growth form, stratification and coverage (Dansereau, 1957). Kershaw and Looney (1985), defined the structure of vegetation by three components: (1) the vertical arrangement of species, (stratification of the vegetation); (2) the horizontal arrangement of the species (spatial distribution of the individuals) and, (3) the abundance of each species.

In the tropical rainforest ecosystem, the vegetation is generally, stratified into three vertical layers of trees, referred to as A, B, and C layers. Taylor (1960) has described the composition of the various strata in the Ghanaian high forests.

The A layer consists of the emergents, widely spaced trees 30 to 40 m tall and with umbrella-shaped canopies that extend above the general canopy of the forest. Since they must contend with drying winds, they tend to have small leaves and some species are deciduous during the brief dry season. The crowns of the trees in this layer do not close together to form a canopy but are scattered (Taylor, 1960). The emergents normally include timber species such as *Terminalia superba, Ceiba pentandra, Anopyxis klaineana, Khaya spp., Milicia excelsa* and *Triplochiton spp.*

The B layer is the upper layer, a closed canopy of 25 m tall trees. The trees present in this layer form a canopy with their crowns. Light is readily available at the top of this layer, but greatly reduced below it. The species found in this layer include *Hannoa klaineana, Mansonia altissima, Albizia ferruginea* and *Calpocalyx revibracteatus.*

The C layer is the lower storey, a closed canopy of 20 feet tall trees. The trees here are heavily crowned and branched. There is little air movement in this zone and consequently humidity is constantly high. Some of the species commonly found in this storey include *Capara procera, Microdesmis zenkeri (puberula), Trichilia spp.* and *Monodora myristica.*

The undergrowth comprises mainly two layers; the shrub/sapling layer and ground layer. In the shrub/sapling stratum, arrested growth is characteristic of young trees capable of a rapid surge of growth when a gap in canopy above them opens. Also, less than 3% of the light intercepted at the top of the forest canopy passes to this layer. The ground or herbaceous layer is characterised with sparse plant growth. Less than 1% of the light that strikes the top of the forest penetrates to the forest floor. In such darkness plants grow. The canopy above also reduces moisture and a third of the precipitation is intercepted before it reaches the ground.

Besides the trees, shrubs and herbs, the high forest is composed of epiphytes, lianas, climbers and stranglers. Epiphytes are so-called air plants growing on branches high in the trees, bromeliads (pineapple family) and members of the orchid family are examples. Lianas are woody vines that grow rapidly up the tree trunks when there is a temporary gap in the canopy, such as *Combretum comosum* and *Griffonia simplicifolia.* Climbers are green-stemmed plants that remain in the understorey, and include the domesticated yams and sweet potatoes. Stranglers comprise those plants that begin life as epiphytes in the canopy and send their roots downward to the forest floor, an example being the fig family. Also found in the forest are heterotrophs, non-photosynthetic plants that live on the forest floor, including parasites (for example, *Rafflesia arnoldi*) and saprophytes (for example, some orchids).

Distribution of individuals in a population may be random, uniform or clumped. Random distribution is very rare in nature, occurring where the environment is very uniform and there is no tendency to aggregate. Uniform distribution occurs where competition is so severe or where there is positive antagonism, which promotes spacing. Clumping is the commonest pattern, almost the rule, when individuals are considered.

The quantitative structure of the vegetation which relates to the abundance of each species in a community can be expressed in several ways, ranging from a direct count of the number of individuals in an area (density) to the dry weight of the vegetable material produced in a given area (yield). However, Mueller-Dombois and Ellenberg (1974) have pointed out that the more important measurable quantities in community sampling are density, frequency and cover. Density is the number of individuals in a given area, frequency is the number of times a species is present or absent in a given number quadrats, while cover is defined as the proportion of the ground occupied by perpendicular projection on to it of the aerial parts of the individuals of the species under consideration (Greig-Smith, 1983).

The tropical rainforest is very heterogeneous with many species. Plant communities in tropical rainforests are generally characterised in terms of production and species diversity. By virtue of the high species richness of the tropical rainforest, there is lack of dominance of trees species. Additionally, there are tree species with different degrees of shade tolerance and the trees themselves are the framework of a wide series of habitats for other species such as climbers and epiphytes (Gradwohl and Greenberg, 1988). Generally, the vegetation of the tropical rainforest is influenced by the prevailing environmental factors.

Environmental Factors Prevailing in the Forest

Kimmins (1987) has observed that the development of vegetation of any habitat relies on at least the physical nature of the soil particularly on the moisture regime, pH and the levels of available mineral elements. Whitmore (1990) pointed out that humus contributes to soil physical structure and water retaining capacity, both of which are important for the development of root systems and hence plant growth.

In many areas of tropical forest, the soils themselves are relatively low in nutrients, although on younger substrates, especially of volcanic origin, tropical soils may be quite fertile. With an exception, however, the nutrients in a tropical forest ecosystem are mostly in the plants themselves and these nutrients are normally made available to the plants through decomposition of dead plants and litter fall. Litter fall gives an indication of above-ground forest production (Proctor, 1983).

The typical mature tropical high forest experiences high rainfall and high relative humidity. Thus, it occurs under optimal growth conditions: abundant precipitation and year round warmth. Mean monthly temperatures are above

18°C; precipitation is often in excess of 3.94 mm a year. However, there is usually a brief season of reduced precipitation.

Wind is virtually absent inside the forest due to the formation of a windbreak by the trees (Lawson, 1985). Sunlight is a major limiting factor. A variety of strategies have been successful in the struggle to reach light or to adapt to the low intensity of light beneath the canopy. There is no annual rhythm to the forest; rather each species has evolved its own flowering and fruiting seasons.

Reproductive Health

Concern with health is a basic element of the human condition. Within the framework of WHO's definition of health as a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity, reproductive health addresses the reproductive processes, functions and system at all stages of life.

Reproductive health, implies that people are able to have a responsible, satisfying and safe sex life and that they have the capability to reproduce and the freedom to decide if, when and how often to do so (WHO, 1994). Implicit in this are the rights of men and women to be informed of and to have access to safe, effective, affordable and acceptable methods of fertility regulation of their choice, and the right of access to appropriate health care services that will enable women to go safely through pregnancy and childbirth, and provide couples with the best chance of having a healthy infant.

Sexual and reproductive health concerns everyone everywhere, and at every stage of life. It is fundamental to the social and economic development of communities, economies and nations. Kamatenesi-Mugisha and Oryem-Origa (2007) have argued that reproductive health care is the second most prevalent health care problem in Africa.

Infertility afflicts millions of couples the world over. In general, one in ten couples experiences primary or secondary infertility, but most of those who suffer from infertility live in developing countries. Although it is often stated that the population growth of Africa is 2.6% for the whole continent, this rate is not uniformly evidenced as a whole (Ampofo, 1993). For instance, in Northern Cameroon, the population growth rate has been estimated as a low 1.7% and for the Central African Republic 1.9%, while as high as 36% of Central African Republican women between the ages of 25 and 34 years, were childless. In both male and female, the common cause of infertility is indeed infection, mainly caused by sexually transmitted diseases (STDs). In females septic abortion and other pelvic inflammatory diseases can be an additional cause. Surveys have shown that between 50% and 80% of married women in developing countries want to limit or space births (Ampofo, 1993). Through innovative family planning options, some countries have made rapid progress in the reduction of Total Fertility Rate (TFR) of women. For instance, in the US, it took 58 years to reduce TFR from 6 to 3.5 live births per woman (Potts, 1991). However, the contraceptive prevalence rate in Ghana is only about 13% as compared to 39% in Zimbabwe, in spite of Ghana's high awareness and knowledge of family planning methods. In Ghana the contraceptive awareness among married women is 80%, but only 13% use effective contraceptive methods (Ampofo, 1993). In enabling women to exercise their reproductive rights, family planning programmes can also improve the social and economic circumstances of women and their families.

Abortion is one issue in human reproduction of great concern. An estimated 38% of all pregnancies occurring around the world every year are unintended, and around 6 out of 10 such unplanned pregnancies result in an induced abortion. Unsafe abortion claims the lives of tens of thousands of women in the world each year, disproportionately affecting women in Africa (Brookman-Amissah *et al.*, 1999).

In 2000, it was estimated that 529 000 women died from complications related to pregnancy or delivery (WHO *et al.*, 2004). The majority of maternal deaths occur in developing countries. Causes of maternal deaths are similar in these countries, however, the distribution of causes differs somewhat from region to region (AbouZahr and Royston, 1991). Causes of maternal deaths normally, include complications of abortion, obstetric complications such as haemorrhage, dystocia and infections such as tuberculosis and HIV-1 (Khan *et al.*, 2001). Maine (1994) had argued that the inability to get adequate care in time is the overwhelming reason why women die in developing countries.

From studies conducted in the 1960s at the Korle-Bu Teaching Hospital, the average maternal mortality rate was 77 per 1000 live birth (Ampofo, 1993). Figures for maternal mortality rates for Ghana have always been estimation and never accurately obtained. For example, in the 1968 report on Health Needs of

Ghana, it was recorded that maternal mortality rates were 45.5 per 1000 live births in Accra and Kumasi, 22.2 for the urban areas and 35.6 for the rural areas (Ampofo, 1993). The health profile extract from the 1984 census gave the range of maternal mortality rates as 5-15 per 1000 births. Maternal mortality is the vital indicator with the greatest disparity between developed and developing countries (WHO *et al.*, 2004).

Attendance at antenatal clinics and receipt of professional delivery care has been associated with a reduction in maternal deaths (Magadi *et al.*, 2001; UNICEF, 2003). Majority of births occur without the help of a skilled assistant (a midwife, nurse trained as midwife, or a doctor) at home or in other non-hospital settings in many developing countries. Home deliveries in the absence of skilled professional attendants have been associated with adverse infant and maternal outcome (De Brouwere *et al.*, 1998; Koblinsky *et al.*, 1999).

Home deliveries without a skilled attendant, are chosen or occur for a variety of reasons, including long distances or difficult access to a birth facility, high costs of services and perceived lack of quality of care in a health facility (Hodgkin, 1996; Adamu and Salihu, 2002; Mwaniki *et al.*, 2002). Other contributing factors for a home delivery included the fast progression of labour, distance, difficulty of (night) travel, and given the urgent nature of deliveries, there may be less time to cover the distance.

It has been suggested that training of Traditional Birth Attendants (TBAs) could reduce maternal and prenatal mortality, but recent data have not supported this strategy (Weil and Fernandez, 1999; Smith *et al.*, 2000; Gloyd *et al.*, 2001).

In an attempt to improve care during home deliveries and reduce maternal mortality, TBAs have been trained in modern delivery care, with varying reports of success (Smith *et al.*, 2000; Ray and Salihu, 2004; Sibley *et al.*, 2004). De Brouwere *et al.* (1998) and Koblinsky *et al.* (1999) also emphasised that the presence of a professional attendant at each birth can lead to a marked reduction in maternal mortality and morbidity. Professional health care, during childbirth, is one of the process indicators to assess progress towards the Millennium Development Goal of improving maternal health (UN, 2006).

TBAs frequently form the backbone of maternity services in rural areas. The WHO estimates that in several African countries TBAs assist in the majority of births. Women in these countries often resort to home delivery assisted by a TBA or a relative as their first option. In Ghana, the TBAs are widely distributed and have intimate contact with the pregnant women in their communities. Although the amount of services rendered by TBAs is difficult to quantify, it has been estimated that TBAs were responsible for 75.2% of all deliveries nationwide in 1968 (Ampofo, 1993). There have been training programmes for TBAs since 1968 and by 1985, 26% of all deliveries in Ghana were conducted by trained staff, comprising health workers and TBAs. Some women prefer TBAs attending to them because of the greater flexibility in payment.

Medicinal plants are used for reproductive health in various ways. Many believe that there are species of plants in the rainforests that can treat or even fully cure HIV/AIDS. Currently, there are a few identified plants that are known to be used to slow the progression of the HIV viral infection. Some of the most hopeful anti-HIV/AIDS compounds are found in the Madagascan Periwinkle (*Lochnera rosea*) and the Malaysian tree (Gurib-Fakeem, 2006). The woody vine, *Ancistrocladus*, a tropical plant has been found to have anti-HIV compounds (Balunas, 2005). Other STDs can be cured with plants, for instance, Irvine (1961) recorded a number of plants including *Afzelia africana, Cassia alata,* and *Citrus aurantiifolia*, among others, that can be used to treat gonorrhoea.

Conservation and Sustainable Use of Medicinal Plants

A frequently quoted estimate indicates that 75% to 80% of the population of the world depends on medicinal plants for their health (Villamil, 2004). Apart from treating disease, medicinal plants are now being increasingly used in cosmetics, foods and teas. The growing interest in herbs is based on the belief that the plants have a vast potential for use as curative medicine.

Plant conservation has long been overshadowed by conservation efforts towards animals, and has also been much divided among efforts focused on different production sectors that rely on plant resources namely, agriculture, forestry, non-wood forest products and efforts targeting different ecosystems. Direct and coherent efforts to conserve plant species have received relatively little policy attention and research support (Leaman, 2004). For instance, Khan (1985; 1991) noted that although the Pakistan Forest Institute focuses on cultivation of medicinal plants, little analysis of the conservation status of medicinal plant species at source areas has been conducted.

Although relatively few of these species are cultivated, the great majority is still provided by collection from the wild (Xiao, 1991; Lange and Schippman, 1997). Overexploitation of wild populations and lack of conservation programmes are two interlocking problems facing sustainable management of these plant resources, especially in African countries.

According to local sources, the harvesting has also been indirectly responsible for triggering total forest loss, associated with the sudden injection of a heavy dose of materialistic values, undermining local traditions, which afforded some protection to the forests. Other workers urgue that despite being widely known and used, the harvesting of medicinal plants by local populations might have a low impact on native vegetation depending on the demand and the kind of product extracted (Figueiredo *et al*., 1997; Albuquerque and Andrade, 2002), barring excessive commercialization of plants and plant products.

Realizing the importance of medicinal plants, a three-year capacity building project to support the conservation and sustainable use of medicinal plants in Ghana was undertaken from 1999 to 2002 to relieve the pressure from the over-harvesting of medicinal plants from the wild, raise awareness of biodiversity conservation. Ghana is a signatory to the Convention on Biological Diversity and as such has a responsibility to identify and monitor the state of medicinal plants within the country, including *in situ* and *ex situ* conservation actions, to identify processes having an adverse impact on these plants, and to maintain and organise relevant data. Under the National Biodiversity Data Management Strategy, the Ghana Biodiversity Data Management System

(GBDMS) has been set up. The project has helped to build capacity to facilitate management of data on medicinal plants, including details relating to value, usage, occurrence, threat and conservation status.

Conservation and sustainable use of medicinal plants can be achieved through the establishment of forest reserves, national parks and botanic gardens, among others. Botanic gardens have a long history of involvement with medicinal plants and with movements of plants around the globe, but not with conservation. These gardens were established principally for economic evaluation of plants for the benefit of the colonial powers, while medicinal plants were given little emphasis (Heywood, 1991). Nonetheless botanic gardens and the other reserves can also have a role to play in the conservation of genetic diversity within species of medicinal plants through networks of *in situ* and *ex situ* conservation of populations. They can often play useful roles in helping to select and develop varieties for cultivation, and in undertaking research on techniques for propagation and cultivation.

Modern problems such as drug abuse, environmental disasters such as global warming, deforestation in the tropics and the loss of biodiversity are all, in some way connected to the use of plants. Balick and Cox (1998) believe that ethnobotany could play an important role in dealing with several of these contemporary world problems. The application of ethnobotanic data for non-direct economic purposes increased enormously during the last decades. For example, ethnobotanic studies have been used for prospecting biodiversity and for vegetation management (Cotton, 1996).

An important branch in the contemporary ethnobotany is the incorporation of indigenous protection methods in the management of natural areas. This branch is also called ethno-conservation-ecology (Balick and Cox, 1998) and it can contribute enormously to the protection of natural areas. When a certain type of nature protection policy is forced upon indigenous populations it could possibly cause disastrous impacts.

Objectives of the Study

Ghana faces difficulties in promoting the sexual and reproductive health of its citizens. The growing shortfall in the availability of the supplies needed for HIV/AIDS prevention, contraception and other vital sexual and reproductive health care services threatens the well-being of men and women.

Habitat destruction and over-collection means sources of medicinal plants are becoming increasingly scarce and threaten. For areas largely reliant on oral rather than written tradition, loss of medicinal plants means not only an immediate loss of effective remedies but also rapid erosion on knowledge of their use. This is a process that is particularly difficult to halt. There is therefore the need to implement measures to ensure the continued availability and use of medicinal plants through documentation and promotion of medicinal plant use.

Studies on the knowledge and use of natural resources by local populations may contribute to finding economic alternatives for these populations, especially in terms of the use of natural resources for treating health problems. In this research, the ethnobotany and ecology of the medicinal plants of the Subri

River Forest ecosystem was studied, in order to identify the plant species used for reproductive healthcare and provide baseline information for future pharmacological and photochemical studies.

This research aimed at promoting the conservation of medicinal plants as well as the traditional knowledge associated with them, so that long-term biodiversity values would not be lost. So it is important to study how local people have been using forest plants, for control of family size and as cure for many reproductive-related diseases by their traditional knowledge. This research therefore, specifically

- determined the ethnobotany of plants for reproductive health conditions;
- took an inventory of these plants;
- determined the plant part mostly used in medicine;
- undertook ecological studies of woody plants used for reproductive health;
- classified the plant species into their respective families;
- determined Relative Importance (IR) of woody medicinal plants; and
- assessed the correlation between the phytosociological data and ethnobotanical usage of the woody medicinal plants.

CHAPTER TWO

MATERIALS AND METHODS

Study Area

Historical background

Subri River Forest Reserve, which derives its name from the river Subri, the main river flowing through the reserve, was demarcated in 1936 and constituted under the Wassa-Fiase Native Authority (Subri River Forest Reserve) Rules of 1949 (Forestry Commission, 2002). These rules revoked the Wassa-Fiase Native Authority bye-laws of 1937.

The Tintinso-Bukroso Felling series (CV727), which covered approximately 300 km of the reserve, was carved out and invested in the Provisional National Defence Council by Executive Instrument 7 (E.I.7) of 27 February 1990.

Management of this area was placed under the authority of Subri Industrial Plantations Limited (SIPL) to salvage-fell the area and plant suitable species, particularly *Gmelina arborea* for pulping to feed the proposed Pulp and Paper Mill that was to be established in the country (Forestry Commission, 2002). However, the salvage-felling rights were abrogated in 1996.

Geographical location and extent

Subri River Forest Reserve lies between latitudes 5 ° 30' and 5° 05' north and longitudes 1° 35' and 1° 55' west in the Mpohor-Wassa East Administrative District of the Western Region, Ghana (Fig.2), with its headquarters at Daboase. The reserve lies close to Bonsa River Forest Reserve in the southern and western extremity and only about 3 km to the Pra-Suhien Reserve (GH018) in the south-east. It is about 16 km south of the railway line linking the towns of Huni Valley–Twifo Praso and 21 km north-west of Daboase.

This forest covers an area of about 58,793 ha. A total of 824 ha is unproductive, comprising admitted farms and village lands. This leaves a net forest reserve area of 57,969 ha. It is the largest Forest Reserve in the country (BirdLife International, 2005). Out of the 57,969.0 ha, 4,062.0 ha have been used for plantation by SIPL, leaving a natural forest area of about 53, 907.0 ha.

Topography of the the area

The topography of Subri River Forest Reserve is fairly undulating, with altitudes in the range 60 to125 m above sea level. The northern, south-eastern and central parts have steep-sided hills that reach 300 m above sea level. The reserve forms part of the watershed between the Bonsa and Pra rivers and is traversed by tributaries of each, resulting in extensive areas of swampy vegetation which make access difficult even in the dry season (Forestry Commission, 2002).

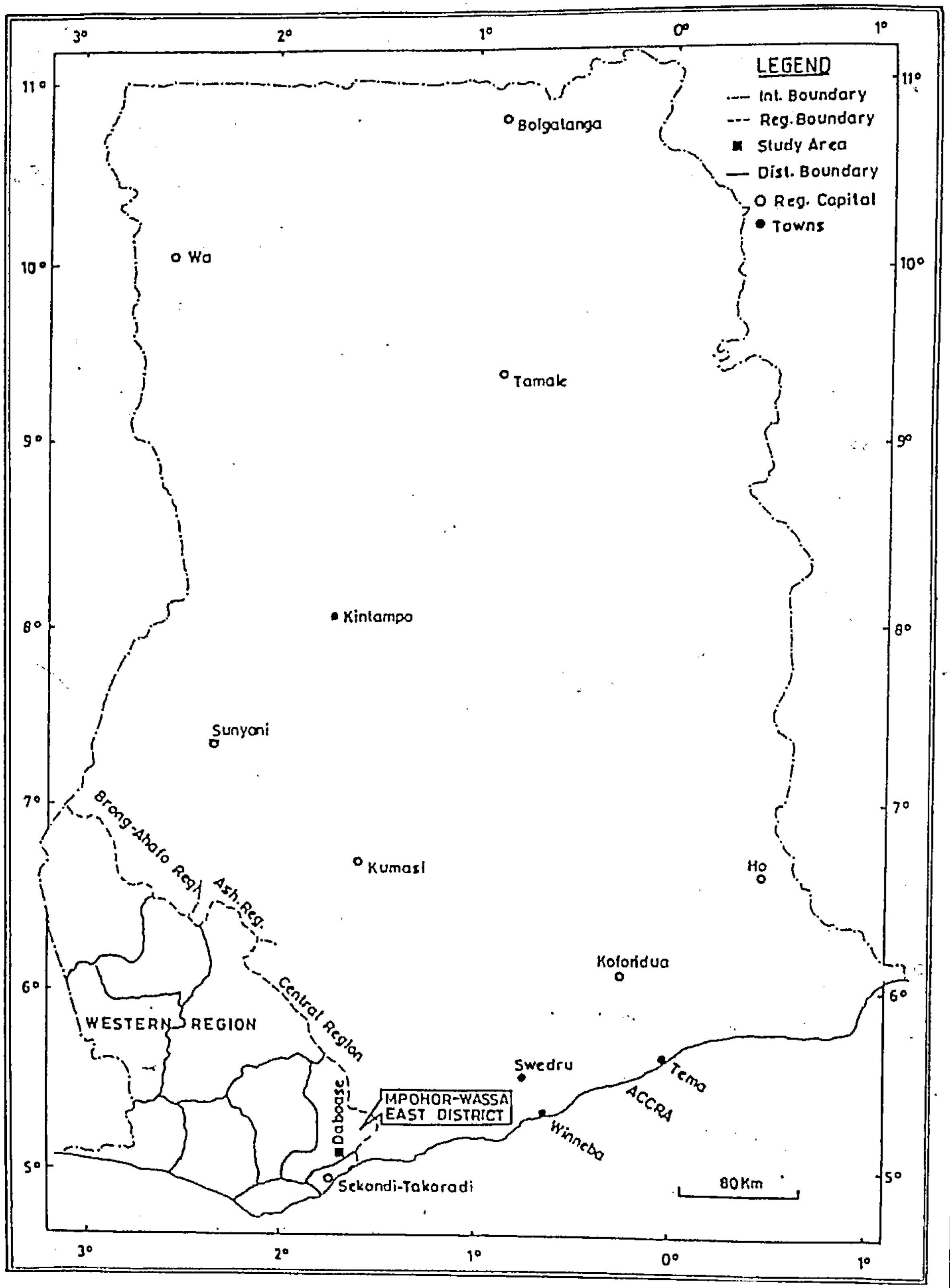

Fig. 1: Map of Ghana showing Mpohor Wassa East District and study site

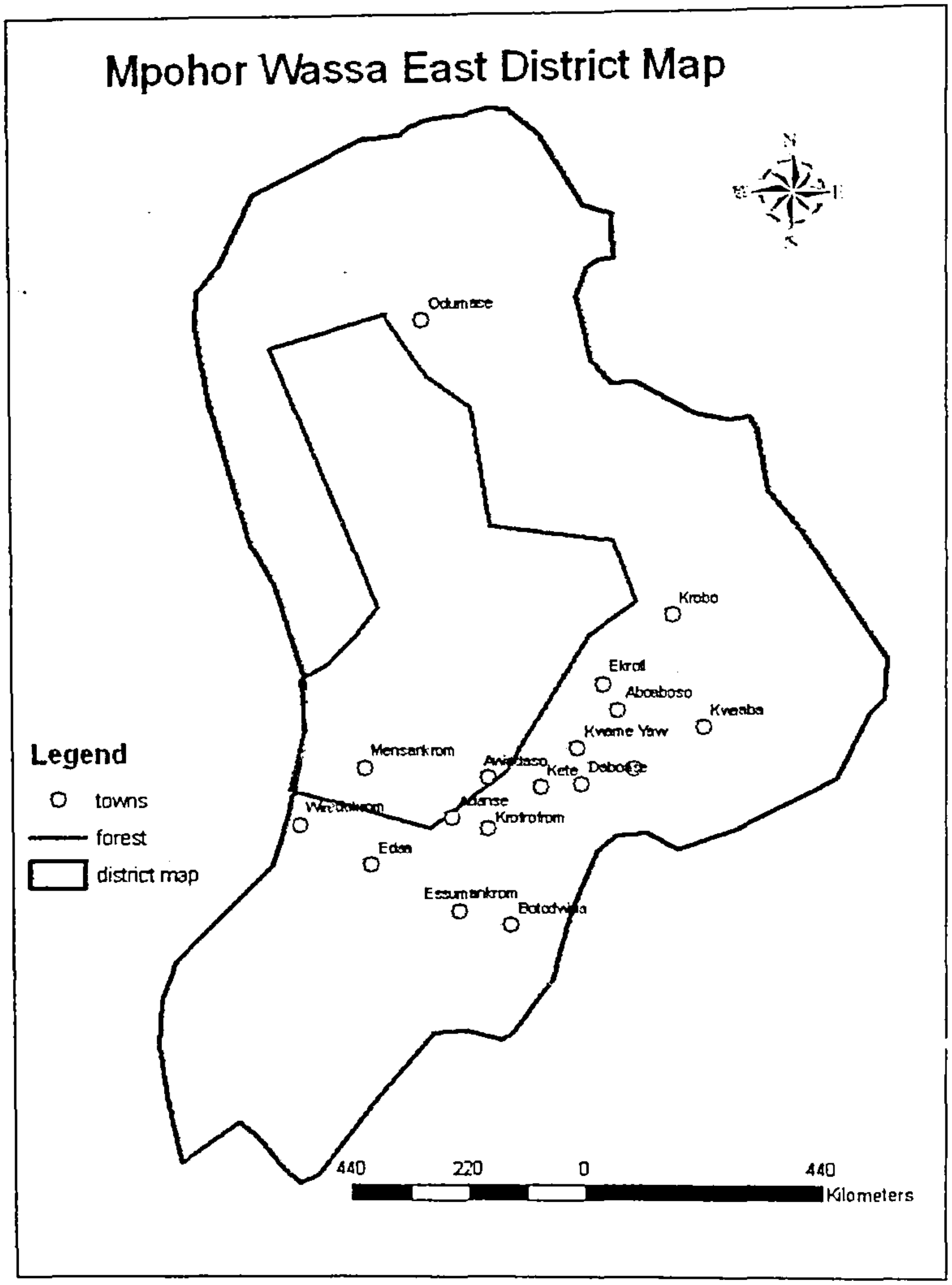

Fig. 2: Map of Mpohor Wassa East District showing the Subri River Forest Reserve and some communities involved in the ethnobotanical study

Climate of the study area

The Subri River Forest Reserve is situated within the high forest zone in the southwest of Ghana. The reserve lies in the tropical humid climate zone with very high relative humidity of about 85% over the year.

The rainy seasons follow the bimodal pattern comprising a major (mid-March-July) and a minor (August-October), with two peak wet seasons occurring in May/June and September/October. The annual rainfall ranges from 1500 mm to 3000 mm, with an average about 1500mm (Forestry Commission, 2002).

The temperature regime is moderate, having lows of 15°C and highs seldom above 35°C, with mean annual temperature ranging between 23°C and 29°C.

Prevailing calm winds are interspersed during storms with winds blowing at 10 m/s from South to East. Such wind speeds are rather infrequent.

Forest type and species composition

The vegetation is moist evergreen forest type, with *Celtis-Triplochiton* association in the north and east and *Lophira -Triplochiton* association in the south. The forest varies from wetter south-west patches with *Cynometra*, *Lophira* and *Heretiera* to drier areas with *Celtis* and *Triplochiton*.

The high forest zone is numerically rich in species. An enumeration survey of the Subri River Forest Reserve by Taylor (1960) on an area of 120 hectares recorded 3,970 trees of 10 cm DBH or more, representing 90 species. Typically, the rainforest trees included those of the upper and emergent storeys, such as *Lophira alata, Piptadeniastrum africana, Parkia bicolor* and *Tarrietia utilis*. The lower storey trees included species such *Diospyros sanza-minka Funtumia africana, Allanblackia parviflora,* and *Cola* spp. The shrub layer is often sparse but typical species included *Randa hispida, Heisteria parviflora, Bertiera racemosa* and *Mussaenda chippii*. Herbaceous plants are rare, but *Scleria barteri* (Cyperaceae), may form tangles within the tree canopy.

The Subri ''A'' contributes to the 57 rare plant species identified by a botanical group (Taylor, 1960). As a repository, there are many species of timber in the ''scarlet star'' plant species such as *Piptadeniastrum africana, Lophira alata, Ricinodendron heudolotii* and *Terminalia ivorensis,* which are near economic extinction; and ''red star'' species that include *Ceiba pentandra, Nesogordonia papaverifera, Daniella ogea,* and *Bombax brevicuspe,* which are also heavily utilised species. The forest also contains the promotable ''pink star'' species, namely *Parkia bicolor, Uapaca guineensis, Albizia ferruginea* and *Afzelia bella*. The rare or endangered ''black and gold star'' species include *Cola umbratilis* and *Okoubaka aubrevillei,* respectively. A vegetation profile shows several layers of non-generating *Lophira alata* in the uppermost canopy; *Dacryodes klaineana* occupies a mid-canopy level position. Several climber species fill out any spaces left in the ecosystem.

Geology and soils

The soil types range in ascending order of age from forest oxysols to lithosols; the northern portions are mainly ochrosols. The final products of the physico-chemical weathering are lateritic soils (Latosols) or Acrisol-Ferrasols Interphases, which spread across an undulating landscape 67% of which constitutes the mid-slopes. The general profile of the mid-slope is a sedentary soil developed *in situ*, without drift, colluvial or alluvial deposit. The topsoil is characterised by a silty or gritty loam texture, under which clay subsoil with abundant ironstone concretions are found. Ferruginised rock fragments and quart gravels dot the subprofile while a mottled weathered substratum, rather loamy or sandy is found towards the C-horizon (Taylor, 1960).

Erosion takes place but moderately due to the near 95% plant cover and the stability of the slope, which is averagely not higher than 30°. Only about 7% to 10% of the soil is described as upland and well drained. Flooding is seldom and sedimentation practically nil. The valleys and the lowlands remain yellow and acquire grey sandy or silty alluvial clayey character. This allows the formation of a network of freshwater streams or rivers that meander the entire forest, while the interphase of the water bodies with soils provides an excellent ecological interplay.

Conservation issues

The Forest Reserve is rated a Condition 3 forest (though some areas are reported to be in good condition), with GHI of 107–207, while an area of 5,120 ha of the total area has been designated as a Globally Significant Biodiversity Area by the Forest Department (BirdLife International, 2005). This area is strictly protected and access is not allowed.

Communal rights to collect deadwood, spices and raffia-leaves for domestic use as well as access to roads and paths are subject to free Forestry Service Division permits. The main NTFPs harvested on permit are snails, rattan, sponge (e.g. *Acacia pennata*), canes, pestles (e.g.*Celtis mildbraedii*), chewing stick *(Garcinia* sp.) and recently firewood. Bush meat is also obtained by hunting a variety of game notably antelopes, duikers, monkeys, grasscutters and rats.

Some areas of the reserve were subjected to salvage-felling between 1966 and 1976, followed by selective logging since 1978. Timber harvesting rights are given to concession holders including the SIPL (Forestry Commission, 2002).

Five compartments of Pra Felling Series were designated as swampy or wet areas and subsequently put under protection. A block of uncompartmented area of 21 km^2 in the north-western portion of the reserve and some compartments of Mampongso/Abetumasu and Anyinabrim/Chichewere Felling Series were also protected as Hill Sanctuaries.

Methodology

Ethnobotanical Studies

Ethnobotanical studies were carried out in 25 communities in the Mporhor Wassa East District in the Western Region of Ghana. The medium of communication was Akan (Fante and Twi). The Subri River Forest Reserve was demarcated into southern and northern zones. Visits were made to various traditional healing homes, popular herbalists and traditional birth attendants, and local people, who have knowledge on plant medicine in the southern zone.

Prior to any contact with the local people, the study and its objectives were introduced to the town chairman/officer or the opinion leaders of all the communities. Interviews were conducted with the local inhabitants and questionnaires (Appendix I) detailing their backgrounds, reproductive health conditions, healing traditions, plants and their parts mostly used and therapeutic techniques were administered. Some of the respondents (informants) who were not forthcoming with information about their local ethnomedicine were motivated with cash reward and provisions for the services rendered. In some communities, however, the people totally refused to give the information, while in other communities too, the inhabitants claimed they knew nobody with herbal knowledge. In all 80 respondents were interviewed.

Identification and classification of species

The scientific names of the various plants were then obtained using various literature by Irvine (1961), Hawthorne (1990), Dokosi (1998), and Mshana *et al.* (2000).

With the help of some respondents and field assistants, plant voucher specimens were collected for plants whose local names were not found in literature and these specimens were brought to the University of Cape Coast Herbarium for identification. The plants species were then classified into their various taxonomic families. Literature on medicinal plants was also searched to corroborate the claims by the respondents.

Ecological Studies

Selection of sites

Ecological survey was also done in the southern zone of Subri River Forest reserve. Factors taken into consideration for selecting the site included accessibility, convenience, ecological sensitivity and avoidance of obviously disturbed areas (in case of sampling). Two sites were demarcated for random sampling. A total of fifty temporary plots were randomly established. Site 1 was located in the Subri natural forest and site 2 in the Subri Industrial Plantation.

Sampling of woody plants

Sampling with quadrats (plots of a standard size) can be used for most plant communities (Cox, 1990). A quadrat delimits an area in which vegetation cover can be estimated, plants counted, or species listed. Round quadrats can be most accurate because they have the smallest perimeter for a given area. Round quadrats are also simple to define in the field, requiring only a centre stake and a tape measure (Cox, 1990).

A representative of 0.1ha (radius of 5.64m) circular or round plots were delimited within each site. The quadrats were chosen randomly to give unbiased estimate of the vegetation of the area, although accessibility was importantly considered. The quadrats were established at least 30m away from forest roads and routes to remove border effects (Alder and Synnot, 1992). Ten quadrats were established at site 1 while 40 plots were established at site 2, taking the sizes of the two sites into consideration. The number of plots in each site was chosen, considering the size of each site- this was to give proportionate sampling.

In each 0.1 ha circular plot, a surveyor's tape was used to measure the girth (gbh) of all woody plants with a central stem ≥ 10 cm at 1.4 m (at breast height) above the forest floor. The tape was levelly wound around the trunk and pulled tight (Plate 1).

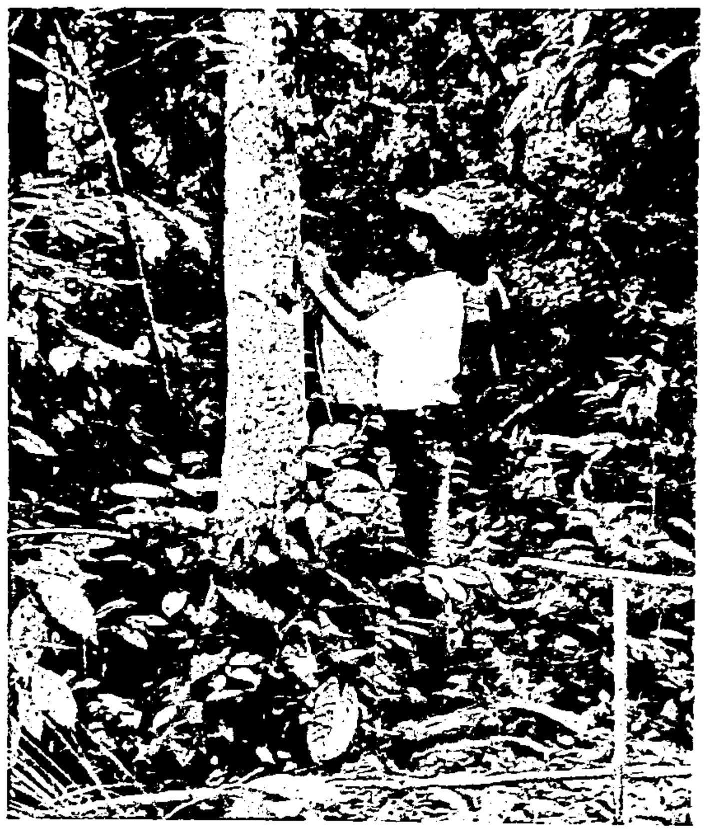

Plate 1: Measurement of tree girth at breast height

Plate 2: Measurement of tree height directly with measuring pole

The measurement of plants with large buttresses was done with the help of more than two people. Mosses, lichens, climbers and loose bark were removed prior to measurement (Kohl, 1992). Trees that are forked or have more than a single stem were measured as separate individuals. This is because if two or more plant species overlap, the cover of each should be tallied independently (Barbour *et al.*, 1987).

Total tree height refers to the vertical height from ground level to the tip of the tree. The total height of the woody plants was also measured within each circular plot. The height of shrubs and young trees (up to 7 metres) was easily and directly measured using a height-measuring pole at 0.1 metre intervals (Plate 2). The Suunto Clinometer was used to measure height of all the woody plants greater than 7 m indirectly. The Suunto Clinometer has a peep-hole at the rear but none at the front. A weighted wheel within the Suunto rotates. When looking through the peephole, a circular field of view of the scales and a horizontal line are seen. Scale readings are taken from the line. The horizontal distance from the base of a vertical tree to a location where the required point on the tree (i.e. tree tip) can be seen was measured. Using both eyes, the required point on the tree was sighted. With one eye looking at the Suunto scale and the other looking at the tree, the images were allowed to appear to be superimposed on each other and where the horizontal line on the Suunto scale crosses the tree was read. The left-hand scale gives the slope angle (θ) in degrees from the horizontal plane at eye level, while the right-hand scale gives the height (in metres) of the point sighted at the eye level (the datum) from the same horizontal plane. The height of the woody plant was then calculated using the formula below:

Total Height = (Tan θ x horizontal distance) + Datum,

where θ is the angle measured and datum is the height measured at eye level.

Most of the woody plants in each circular plot were identified in the field by slashing of the bark for diagnostic features like smell, colour and exudates among others. Specimens of the leaves, bark, and flowers of species that could not be readily identified were collected for later identification. These species were later identified, in consultation of the local people and hunters, and with the aid of botanical keys and diagrams (Hutchinson and Dalziel, 1958; Irvine, 1961; Hawthorne, 1990; Mshana *et al.*, 2000), where necessary. The various species were later classified into the taxonomic families.

Basal area, relative dominance, relative density, relative frequency, species diversity, species evenness and important value index were calculated, using the formulae given below (Greig-Smith, 1983).

Basal Area (m^2) = Area occupied by tree at breast height

$$= (C^2/4\pi)/10000 \text{ or } (C^2/4\pi) \times 10^{-4} \quad (1)$$

where C is circumference in metres

Relative Dominance (RDo) = $(Bs / B_T) \times 100$ (2)

where Bs = basal area of a single species

B_T = total basal area of all species

Relative Density (RDe) = $(n_i / N) \times 100$ (3)

where n_i = number of individuals of i^{th} species

N = total number of individuals

Relative Frequency (RFr) = $(f_i / F) \times 100$ (4)

where f_i = frequency of a species

F= sum or total frequency of all species

Species Diversity

i. **Simpson's Diversity Index (D),** (1949)

$$D = \frac{1 - \Sigma ni(ni - 1)}{N(N - 1)} \quad (5)$$

where ni = number of individuals of the i^{th} species

N= total number of individuals

ii **Shannon-Weaver diversity index (H^1),** (1949)

$$H^1 = -\Sigma \rho i \ln \rho i \quad (6)$$

where pi = ni / N

iii. **Species Evenness (E)** = $H^1 / \ln S$ (7)

where S = number of species.

Important Value Index (IVI) = $\Sigma(RDe + RDo + RFr)$ (8)

The IVI was used to determine the ecological status of the species. The Raunkaier's (1934) Law of Frequency or valence analysis (Table 1) was used to assess the rarity or commonness of the species.

Table 1: Raunkaier's classification of species within a community

Frequency class	Percentage frequency	Remarks /Comments
A	0-20	rare
B	20-40	low
C	40-60	intermediate frequency
D	60-80	moderately high frequency
E	80-100	high frequency (common)

The expected distribution of the species amongst the frequency classes is expressed as: A >B>C>< D<E

Soil sampling and analysis

Using an auger, soil samples (20 - 40 cm deep) were collected at the centre of each of the 50 circular plots. The soil samples from each plot were put into polythene bags and tightly tied and brought to the laboratory for analyses.

In the laboratory, the samples were air-dried by spreading them thinly on polythene sheet for two weeks. The air-dried soil was sieved through a 2 .0 mm mesh, leaving out the gravels and rocks. The resultant fine earth was used for the physico-chemical analyses.

The soil texture was determined, using USDA guide for classifying texture (Anderson and Ingram, 1989). A mixture of 20.0 g of fine earth and 50.0 ml of distilled water in a beaker was used. The mixture was allowed to stand for 30 minutes and was occasionally stirred using a glass rod. A Jenway 3071 pH-meter was then used to the pH of the soil. The average pH for each plot was then calculated and recorded.

Relative importance of woody medicinal plants

For each woody medicinal species (that is, woody plants in the forest reserve used for reproductive health), the Relative Importance was calculated according to the formula described by Bennett and Prance (2000).

$$RI = NCS + NP \qquad (9)$$

$$NCS = NCSS/NCSVS \qquad (10)$$

$$NP = NPS/NPVS \qquad (11)$$

where:

RI = relative importance;

NCS = number of corporeal systems. It is given by the number of corporeal systems treated by a species (NCSS) over the total number of corporeal systems treated by the most versatile species (NCSVS);

NP = number of properties attributed to a specific species (NPS) over the total number of properties attributed to the most versatile species (NPVS).

In this calculation, "2" is the greatest or highest possible value, indicating the most versatile species, that is, those that have the greatest number of medicinal properties.

Therapeutic indications attributed to the species for the 19 reproductive health conditions (19 properties) were classified under 7 Body or Corporeal systems:

1. Termination and prevention of pregnancy (abortion, contraceptives and miscarriage);
2. Complications during pregnancy (protrusion retention, bleeding and abdominal pains);
3. Infectious diseases (white and STDs);
4. Infertility and impotence (infertility in males and females, and impotence);
5. Menstrual disorders;
6. Delivery (prepartum, placenta retention, bleeding and pains, and lactation failure); and
7. Diseases affecting organs and cells (breast cancer, hernia and piles).

Linear correlation analysis was performed to assess the relationship between Relative Importance and phytosociological data, using the software Minitab. This was to verify associations between ethnobotanical analysis and phytosociological analysis (Silva and Albuquerque, 2005).

CHAPTER THREE

RESULTS

Ethnobotanical Studies

A total of 80 people were interviewed; the addresses, ages and other detailed personal information on the respondents or informants are provided in Appendix 2, while appendix 2 (b) shows the descriptive statistics on the respondents.

Of the 80 respondents, 61.30% were men and 38.80% were women; 6.30% were aged 20-30 years, 10.00% were between 31-40 years, 26.30% were in the age range 41-50 years, 57.50% were above 50 years. In terms of the formal education, 1.30% of respondents had attained tertiary education and 30.00% were still in school or had completed elementary (basic) school. Most (68.80%) of the respondents did not attend any school.

In relation to how knowledge in herbal medicine was acquired, 2.50% of the informants acquired knowledge from their husbands and from formal training (mainly workshop), 15% acquired their knowledge either by themselves and from dreams and from grandparents, while 65% of the respondents acquired the training from their parents. Over 90% (97.50%) had the training verbally whilst only 2.50% had a formal training. In terms of occupation, 82.50% of the respondents were farmers, 2.50% were herbalists and pensioners, while 12.25% were engaged in other forms of occupation.

A total of 185 medicinal plant species distributed in 60 families and 155 genera were documented (Appendix 3). The family that had the most cited number of species was Euphorbiaceae (13), followed by Papilionaceae (10). Of the genera recorded, *Cassia*, *Celtis*, *Citrus*, *Grewia*, *Momordica*, *Vernonia* and *Vitex* recorded 3 species each, 13 genera recorded 2 species each, and while 135 genera recorded only one species each. The local names (mainly in Akan) and the habit or growth form of each species are also presented in Appendix 3.

Medical applications of the plants

The ethnobotanical results for the various major categories of reproductive health conditions including the names of plant, the frequency of usage and plant parts used are provided in Table 2.

Out of the 12 species used for abortion (Table 2i), *Carica papaya* and *Momordica balsamina* had the highest frequency usage of 16.67% in each case.

Table 2ii shows that 28 species were recorded for breast cancer: *Spathodea campanulata* had the highest frequency usage of 8.16%; followed by *Afrostyrax lepidophyllus*, *Citrus medica* var. *limonum*, *Kigelia africana*, *Milicia excelsa*, *Monodora myristica* and *Musa paradisiaca* each of which had frequency usage of 6.12%.

Alchornea cordifolia was cited as the most frequently (10.75%) used species for candidiasis or white, followed by *Justicia flava* and *Terminalia ivorensis* both with frequency usage of 4.30% each, among the 52 species recorded for candidiasis in Table 2iii.

Table 2iv shows frequency usage of a total of 80 species used for complications during pregnancy: 23 species were used for abdominal pains during pregnancy, with *Spathodea campanulata* being the most (10.71%) used (Table 2 IV a); *Spathodea campanulata* again had the highest frequency usage of 9.09% among 30 species used for protrusion retention (Table 2iv b); while *Synedrella nodiflora* had the highest frequency usage of 9.67%, out of the 27 species used for bleeding during pregnancy in (Table 2iv c).

All the 8 species used as contraceptives recorded the same frequency usage of 12.50% each (Table 2v).

A total of 87 species was used during labour or delivery (Table 2vi). Out of these, 35 species were used for prepartum in order to facilitate delivery (Table 2vi a) with *Carica papaya* being the frequently used (14.04%). Table 2vi b shows 52 species used for postpartum: 28 species were recorded for placenta retention. Again, *Carica papaya* was the frequently used (29.43%) as shown in Table 2vi bI; 8 species were recorded for lactation failure. Of these, *Ficus capensis* and *Euphorbia hirta* were the frequently used with 25.00% (Table 2vi bII). For bleeding and pains after birth, 16 species were recorded, with *Musa paradisiaca* as the most frequently used with 22.73% (Table 2vi bIII).

Gouania longipetala recorded the highest frequency usage of 42.71% among 40 species recorded for haemorrhoids or piles, as shown in Table 2 vii. Forty-three (43) species were recorded for hernia of which *Guarea cedreta* recorded the highest frequency usage of 8.64% Table 2viii.

A total of 91 species was recorded for infertility in both males (39 species) and females (52 species), as shown in Table 2ix. *Cyperus esculentus* was the most used species for infertility in males and had a frequency usage of 6.90%, (Table 2ix a). *Alchornea cordifolia* and *Kigelia africana* both recorded the highest frequency usage of 8% each, among the 52 species used for infertility in females (Table 2ix b).

Table 2x presents enumeration of 56 species used for menstrual disorders, and *Alstonia boonei* registered the highest frequency usage of 6.06%. A total of 51 species were used for miscarriage, and the frequently used species (5.05% each) were *Alchornea cordifolia*, *Khaya anthotheca*, *Khaya ivorensis*, *Picralima nitida* and *Spathodea campanulata* (Table 2xi).

Cyperus esculentus and *Sphenocentrum jollyanum* both recorded the highest frequency usage of 8.15% each, among the 53 species used for sexual impotence or aphrodisiac (Table 2xii).

Among the 27 species cited for Sexually Transmitted Diseases (STDs), mainly gonorrhoea, *Momordica charantia* dominated with frequency usage of 20.00%, as shown in Table 2xiii.

Table 2: Frequency of usage and parts of plants used for the various reproductive health conditions.

Plants	Frequency (%)	Plant part(s) used
i. Abortion		
Aspilia africana	5.56	leaf
Carica papaya	16.67	root; leaf
Cassia alata	5.56	leaf
Citrus medica var. *limonum*	5.56	fruit
Funtumia elastica	5.56	leaf
Gossypium arboreum	11.11	leaf
Manihot esculenta	11.11	leaf; tuber peels
Mareya micrantha	5.56	leaf
Momordica balsamina	16.67	seed
Pentaclethra macrophylla	5.56	seed
Pycnanthus angolensis	5.56	bark
Solanum torvum	5.56	leaf
ii. Breast Cancer		
Aframomum melegueta	4.08	fruit; root
Afrormosia laxiflora	2.04	bark
Afrostyrax lepidophyllus	6.12	bark
Ageratum conyzoides	2.04	leaf
Alchornea cordifolia	2.04	leaf

Table 2ii *continued*

Plants	Frequency (%)	Plant part(s) used
Alternanthera pungens	2.04	leaf
Anopyxis klaineana	2.04	bark
Baphia nitida	2.04	leaf
Blighia sapida	4.08	bark
Chrysophyllum albidum	2.04	seed
Citrus medica var. *limonum*	6.12	fruit
Cnestis ferruginea	2.04	root
Elaeis guineensis	4.08	leaf; fruit (tip)
Garcinia mannii	2.04	bark; root
Justicia flava	2.04	leaf
Khaya ivorensis	4.08	bark
Kigelia africana	6.12	seed; bark
Mallotus oppositifolius	4.08	fruit
Manihot esculenta	2.04	tuber
Milicia excelsa	6.12	stem
Momordica charantia	2.04	leaf
Monodora myristica	6.12	seed
Musa paradisiaca	6.12	stem
Picralima nitida	2.04	fruit
Piptadeniastrum africanum	4.08	bark
Spathodea campanulata	8.16	bark; leaf

Table 2iii *continued*

Plants	**Frequency (%)**	**Plant part(s) used**
Entandrophragma angolense	1.08	bark
Ficus exasperata	2.15	leaf
Gossypium arboreum	1.08	leaf
Grewia mollis	2.15	bark
Hoslundia opposita	2.15	root
Justicia flava	4.30	leaf; whole plant
Khaya anthotheca	2.15	bark
Khaya ivorensis	2.15	bark
Kigelia africana	2.15	bark; leaf; root
Lannea welwitschii	2.15	bark
Maesobotrya barteri	1.08	bark
Mallotus oppositifolius	1.08	leaf; root
Mangifera indica	2.15	leaf; root
Momordica charantia	2.15	leaf
Musa paradisiaca	3.22	fruit (peels)
Musanga cecropioides	1.08	bark
Myrianthus arboreus	1.08	root
Ocimum conium	1.08	leaf
Ocimum viride	2.15	leaf
Palisota hirsuta	1.08	root
Petersianthus macrocarpus	2.15	bark

Table 2iii *continued*

Plants	Frequency (%)	Plant part(s) used
Phyllanthus fraternus	1.08	leaf
Picralima nitida	1.08	seed
Piper guinnense	2.15	fruit
Rauwolfia vomitoria	2.15	root
Ricinodendron heudelotii	2.15	bark
Sansevieria liberica	1.08	leaf; root
Spathodea campanulata	2.15	bark
Struchium sparganophora	2.15	leaf; root
Terminalia ivorensis	4.30	bark
Thalia geniculata	1.08	root
Theobroma cacao	1.08	leaf
Trichilia monadelpha	3.22	bark
Vernonia amygdalina	2.15	root; leaf
Vernonia conferta	1.08	leaf; root
iv. Complications during pregnancy		
a. *Abdominal pains*		
Alchornea cordifolia	7.14	root
Alstonia boonei	3.57	bark
Cochlospermum tinctorium	3.57	root
Cola nitida	3.57	bark

Table 2iv a *continued*

Plants	Frequency (%)	Plant part(s) used
Desmodium adscendens	3.57	root
Elaeis guinnensis	7.14	fruit; leaf
Entandrophragma angolense	3.57	bark
Heliotropium indicum	3.57	leaf
Hunteria elliotii	3.57	bark
Justicia flava	3.57	leaf
Khaya ivorensis	7.14	bark
Kigelia africana	3.57	bark
Lannea welwitschii	3.57	bark
Milletia thonningii	3.57	root
Millettia zechiana	3.57	root
Phyllanthus fraternus	3.57	seed
Physalis angulata	3.57	leaf
Picralima nitida	3.57	bark
Piper umbellatum	3.57	whole plant
Spathodea campanulata	10.71	bark; leaf
Struchium sparganophora	3.57	root
Terminalia ivorensis	3.57	bark
Vitex simplicifolia	3.57	bark

Plants	Frequency (%)	Plant part(s) used
b. *Protrusion retention*		
Abelmoschus esculentus	2.27	stem
Anopyxis klaineana	2.27	bark
Anthocleista nobilis	6.82	bark; leaf
Argemone mexicana	2.27	leaf
Baphia nitida	2.27	leaf
Carica papaya	2.27	leaf
Elaeis guineensis	4.55	root
Ficus capensis	2.27	bark
Ficus exasperata	2.27	leaf
Grewia pubescens	4.55	bark
Heliotropium indicum	2.27	whole plant
Khaya ivorensis	6.82	bark
Kigelia africana	4.55	bark
Manihot esculenta	2.27	leaf
Millettia zechiana	2.27	root
Monodora myristica	2.27	fruit
Morinda lucida	4.55	bark; root
Musa paradisiaca	2.27	root
Picralima nitida	2.27	bark
Piper umbellatum	2.27	leaf
Pycnanthus angolensis	4.55	bark

Table 2iv b *continued*

Plants	Frequency (%)	Plant part(s) used
Spathodea campanulata	9.09	leaf; bark
Stachytarpheta cayennensis	2.27	leaf
Synedrella nodiflora	4.55	leaf
Talinum triangulare	2.27	leaf
Terminalia ivorensis	4.55	bark
Theobroma cacao	2.27	leaf
Trichilia monadelpha	2.27	bark
Turraea heterophylla	2.27	leaf; root
Vernonia amygdalina	2.27	root
c. *Bleeding*		
Alchornea cordifolia	9.09	leaf; root
Baphia nitida	3.03	leaf
Canthium glabriflorum	3.03	bark
Cassia occidentalis	3.03	leaf; bark
Ceiba pentandra	3.03	leaf; bark
Desmodium adscendens	3.03	leaf
Elaeis guineensis	3.03	frond
Hannoa klaineana	3.03	leaf
Hoslundia opposita	3.03	root
Justicia flava	3.03	leaf

Table 2iv c *continued*

Plants	Frequency (%)	Plant part(s) used
Khaya anthotheca	3.03	bark
Mallotus oppositifolius	3.03	root
Monodora myristica	3.03	fruit
Musa sapientum	3.03	stem
Phyllanthus fraternus	3.03	leaf
Picralima nitida	3.03	bark
Piper umbellatum	3.03	leaf
Rauwolfia vomitoria	6.06	root
Spathodea campanulata	6.06	leaf; root
Synedrella nodiflora	9.09	leaf
Tabernaemontana africanus	3.03	root
Thalia geniculata	3.03	root
Turraea heterophylla	3.03	leaf; root
Vernonia amygdalina	3.03	root
Vitex simplicifolia	3.03	bark
Xylopia aethiopica	3.03	leaf
Zingiber officinale	3.03	leaf

Plants	Frequency (%)	Plant part(s) used
v. Contraceptive		
Alstonia boonei	12.50	bark
Artocarpus communis	12.50	bark
Azadirachta indica	12.50	seed
Carica papaya	12.50	leaf
Chaetacme aristata	12.50	leaf
Citrus medica var. *limonum*	12.50	fruit
Discoglypremna caloneura	12.50	bark
Synedrella nodiflora	12.50	leaf
vi. Delivery/ Labour		
a. *Prepartum-To facilitate delivery*		
Abelmoschus esculentus	3.51	seed
Acacia pennata	1.75	leaf
Aframomum melegueta	3.51	leaf; root
Alchornea cordifolia	1.75	leaf
Allium ascalonicum	3.51	bulb
Allium cepa	1.75	bulb
Baphia nitida	1.75	root
Bussea occidentalis	1.75	bark
Carica papaya	14.04	root; seed; stem
Cassia occidentalis	1.75	root

Table 2vi a *continued*

Plants	**Frequency (%)**	**Plant part(s) used**
Celtis zenkeri	1.75	root
Citrus aurantiifolia	1.75	leaf
Citrus medica var. *limonum*	1.75	root
Cola nitida	1.75	bark
Costus dubius	1.75	rhizome
Crotalaria retusa	3.51	root
Elaeis guineensis	3.51	root
Ficus exasperata	1.75	bark
Gossypium arboreum	1.75	bark
Indigofera macrophylla	1.75	leaf
Jatropha curcas	7.02	bark; root
Mallotus oppositifolius	1.75	flower
Musa paradisiaca	3.51	leaf; root
Musa sapientum	1.75	stem
Nicotiana tabacum	1.75	leaf
Physalis angulata	1.75	leaf
Piper umbellatum	1.75	leaf
Premna quadrifolia	1.75	root
Sansevieria liberica	1.75	root
Sida acuta	8.77	leaf; whole plant
Spondias monbin	5.26	twig; leaf

Table 2vi a *continued*

Plants	Frequency (%)	Plant part(s) used
Stachytarpheta angustifolia	1.75	leaf
Synedrella nodiflora	1.75	leaf
Tetrapleura tetraptera	1.75	fruit
Turraea heterophylla	1.75	root
b. ***Postpartum***		
bI. ***Placenta retention***		
Abelmoschus esculentus	2.38	seed
Anthocleista nobilis	2.38	bark
Baphia nitida	2.38	bark
Carica papaya	21.43	root; leaf
Citrus sineensis	2.38	bark
Cochlospermum tinctorium	2.38	bark; root
Cola gigantea	2.38	leaf
Corynanthe pachyceras	2.38	bark
Elaeis guineensis	2.38	stem
Ficus exasperata	2.38	leaf
Heliotropium indicum	4.76	flower; seed
Indigofera macrophylla	2.38	leaf
Jatropha curcas	11.90	root; stem; seed
Justicia flava	2.38	leaf

Table 2vi bI *continued*

Plants	Frequency (%)	Plant part(s) used
Marantochloa ramosissima	2.38	root
Mitragyna stipulosa	2.38	bark
Momordica charantia	2.38	leaf
Morinda lucida	2.38	root
Musa paradisiaca	2.38	stem
Musa sapientum	2.38	stem
Nicotiana tabacum	2.38	leaf
Sansevieria liberica	2.38	root
Sida acuta	4.76	whole plant; leaf
Terminalia ivorensis	2.38	bark
Tetrapleura tetraptera	2.38	fruit
Theobroma cacao	2.38	leaf; root
Trichilia monadelpha	2.38	bark; root
Xylopia aethiopica	2.38	fruit
bII. *Lactation failure*		
Bombax buonopozense	6.25	bark
Carica papaya	12.50	fruit; flower
Euphorbia hirta	25.00	leaf; whole plant
Ficus capensis	25.00	fruit; leaf; bark
Ficus exasperata	6.25	leaf

Table 2vi bII *continued*

Plants	Frequency (%)	Plant part(s) used
Kigelia africana	6.25	bark
Phyllanthus fraternus	6.25	leaf
Solanum torvum	12.50	fruit
bIII. ***Bleeding and pains***		
Abelmoschus esculentus	4.55	seed
Carica papaya	4.55	flower
Ceiba pentandra	4.55	bark
Desmodium adscendens	4.55	leaf
Dioscorea cayenensis	4.55	tuber
Fagara xanthoxyloides	4.55	root
Jatropha curcas	4.55	leaf
Manihot esculentus	9.09	leaf; tuber peels
Musa paradisiaca	22.73	stem
Musa sapientum	4.55	fruit; stem
Paullinia pinnata	4.55	leaf
Scoparia dulcis	4.55	leaf
Synedrella nodiflora	9.09	leaf
Terminalia superba	4.55	bark
Vernonia cinerea	4.55	whole plant
Zingiber officinale	4.55	tuber

Plants	Frequency (%)	Plant part(s) used
vii. Haemorrhoids/piles		
Adenia cissampeloides	1.05	bark
Aframomum melegueta	2.11	fruit
Alafia multiflora	1.05	bark
Albizia zygia	1.05	bark
Alchornea cordifolia	2.11	leaf; root
Amaranthus spinosus	2.11	leaf
Amphimas pterocarpoides	1.05	bark
Anacardium occidentale	1.05	bark
Anopyxis klaineana	1.05	bark
Anthocleista nobilis	4.21	bark; root
Blighia sapida	1.05	bark
Capsicum annum	1.05	leaf
Cochlospermum tinctorium	1.05	root
Cola gigantea	1.05	bark
Datura suaveolens	1.05	leaf
Eclipta alba	1.05	leaf; whole plant
Entandrophragma angolense	2.11	bark
Gouania longipetala	43.16	bark; leaf; root; sap; whole plant or any part
Grewia mollis	1.05	bark
Grewia pubescens	1.05	root

Table 2vii *continued*

Plants	Frequency (%)	Plant part(s) used
Khaya anthotheca	3.16	bark
Khaya ivorensis	4.21	bark
Lannea welwitschii	1.05	bark
Lecaniodiscus cupanioides	1.05	root
Lophira alata	1.05	bark
Maesobotrya barteri	1.05	bark
Mangifera indica	1.05	bark
Millettia zechiana	2.11	bark
Nauclea latifolia	1.05	bark
Palisota hirsuta	1.05	leaf; root
Paullinia pinnata	1.05	root
Pupalia lappacea	1.05	whole plant
Ricinodendron heudelotii	1.05	bark
Salacia debilis	1.05	whole plant
Sansevieria liberica	1.05	leaf
Spondias monbin	1.05	leaf
Tabernaemontana africanus	2.11	root
Terminalia ivorensis	1.05	bark
Trichilia monadelpha	3.16	bark; root

Plants	Frequency	(%)Plant part(s) used
viii. Hernia		
Adenia lobata	1.23	whole plant
Aframomum melegueta	1.23	whole plant
Afrormosia laxiflora	1.23	bark
Afzelia africana	3.70	bark
Alchornea cordifolia	2.47	leaf
Anogeissus leiocarpus	1.23	bark
Anopyxis klaineana	1.23	bark
Anthocleista nobilis	3.70	bark; root
Caesalpinia bonduc	2.47	seed
Calliandra partoricensis	1.23	root
Cassia occidentalis	1.23	root
Celtis mildbraedii	1.23	bark
Citrus aurantiifolia	3.70	fruit; root
Conopharyngia chippii	1.23	root
Discoglypremna caloneura	1.23	bark
Ficus exasperata	1.23	leaf
Gouania longipetala	1.23	bark
Guarea cedreta	8.64	bark
Justicia flava	1.23	whole plant
Lecaniodiscus cupanioides	1.23	root
Khaya anthotheca	1.23	bark

Table 2viii *continued*

Plants	Frequency (%)	Plant part(s) used
Khaya ivorensis	2.47	bark
Milicia excelsa	2.47	bark; stem
Momordica angustisepala	1.23	root
Momordica charantia	2.47	leaf
Monodora myristica	2.47	root; seed
Morinda lucida	7.41	bark; leaf; root
Nauclea latifolia	2.47	root
Paullinia pinnata	1.23	root
Petersianthus macrocarpus	3.70	bark; fruit; root
Physalis angulata	1.23	bark; root
Picralima nitida	6.17	seed; fruit
Piper guinnense	2.47	root
Pleiocarpa mutica	1.23	leaf; root
Rauwolfia vomitoria	7.41	root; bark
Ricinodendron heudelotii	1.23	bark
Solanum indicum	1.23	bark; root
Spathodea campanulata	1.23	bark
Tabernaemontana africanus	3.70	root
Terminalia ivorensis	1.23	bark
Treculia africana	1.23	bark; seed
Vernonia amygdalina	1.23	root

Table 2viii *continued*

Plants	Frequency (%)	Plant part(s) used
Vitex doniana	1.23	root
ix. Infertility		
a. *In Males*		
Adenia lobata	3.45	whole plant; root
Alchornea cordifolia	3.45	leaf; bark
Alstonia boonei	1.72	bark
Anthocleista nobilis	1.72	bark
Bridelia grandis	1.72	bark
Caesalpinia bonduc	1.72	root; stem
Cochlospermum tinctorium	1.72	root
Cocos nucifera	3.45	bark; fruit
Cyperus esculentus	6.90	root
Dioclea reflexa	1.72	bark
Discoglypremna caloneura	1.72	root
Elaeis guineensis	1.72	root
Gossypium arboreum	1.72	bark; root
Gouania longipetala	1.72	bark; root
Griffonia simplicifolia	1.72	bark; root
Guarea cedreta	1.72	stem
Khaya anthotheca	3.45	bark
Khaya ivorensis	3.45	bark

Table 2ix a *continued*

Plants	Frequency (%)	Plant part(s) used
Mallotus oppositifolius	1.72	leaf
Mezoneuron benthamianum	1.72	root
Milicia excelsa	3.45	bark
Millettia zechiana	3.45	root
Monodora myristica	3.45	seed
Morinda lucida	1.72	bark
Paullinia pinnata	5.17	root
Penianthus zenkeri	5.17	root
Physalis angulata	1.72	root
Picralima nitida	3.45	root; fruit; seed
Piper guinnense	1.72	fruit
Piptadeniastrum africanum	1.72	bark
Pseudagrostistachys africana	1.72	bark
Rauwolfia vomitoria	3.45	root
Ricinodendron heudelotii	1.72	bark
Sphenocentrum jollyanum	1.72	root
Spondias monbin	1.72	leaf
Tabernaemontana africanus	1.72	root
Trichilia monadelpha	1.72	bark
Turraea heterophylla	5.17	root
Vitex doniana	1.72	root

Plants	Frequency (%)	Plant part(s) used
b. *In Females*		
Ageratum conyzoides	1.00	leaf
Alchornea cordifolia	8.00	root; leaf
Alstonia boonei	2.00	bark
Ananas comosus	1.00	root
Anthocleista nobilis	1.00	bark; root
Argemone mexicana	1.00	root
Baphia nitida	1.00	root
Caesalpinia bonduc	1.00	root; stem
Calliandra partoricensis	1.00	root
Carica papaya	1.00	root
Ceiba pentandra	1.00	bark
Cleistopholis patens	1.00	bark
Cochlospermum tinctorium	1.00	root
Cocos nucifera	1.00	fruit
Cola gigantea	2.00	bark
Costus dubius	1.00	rhizome
Desmodium adscendens	2.00	root
Discoglypremna caloneura	2.00	bark
Entandrophragma angolense	1.00	bark
Gouania longipetala	1.00	bark
Grewia pubescens	1.00	root

Table 2ix b *continued*

Plants	Frequency (%)	Plant part(s) used
Griffonia simplicifolia	1.00	bark; root
Hoslundia opposita	1.00	root
Khaya anthotheca	4.00	bark
Khaya ivorensis	3.00	bark
Kigelia africana	8.00	bark; leaf; fruit; seed
Lannea welwitschii	1.00	bark
Lecaniodiscus cupanioides	1.00	root
Lophira alata	1.00	bark
Maesobotrya barteri	1.00	bark
Milicia excelsa	2.00	bark
Millettia zechiana	2.00	root; stem
Monodora myristica	2.00	seed
Morinda lucida	4.00	bark; leaf
Nauclea latifolia	2.00	bark
Palisota hirsuta	2.00	leaf; root
Paullinia pinnata	3.00	leaf; root
Picralima nitida	6.00	bark; seed; root
Piper umbellatum	1.00	leaf
Ricinodendron heudelotii	1.00	bark
Schwenckia americana	2.00	leaf; whole plant
Spathodea campanulata	7.00	bark; leaf

Table 2ix b *continued*

Plants	Frequency (%)	Plant part(s) used
Stachytarpheta cayennensis	1.00	leaf
Struchium sparganophora	1.00	root
Tabernaemontana africanus	3.00	root
Terminalia ivorensis	1.00	bark
Theobroma cacao	1.00	leaf
Tieghemella heckelii	1.00	bark
Trichilia monadelpha	3.00	bark
Turraea heterophylla	1.00	leaf
Xylopia aethiopica	1.00	seed
x. Menstrual disorders		
Alchornea cordifolia	4	root; leaf
Allium cepa	1	bulb
Alstonia boonei	6	bark
Alternanthera pungens	1	whole plant
Amaranthus spinosus	2	whole plant; leaf
Anopyxis klaineana	1	bark
Azadirachta indica	1	leaf
Blighia sapida	1	bark
Bombax buonopozense	1	flower
Canthium glabriflorum	1	bark

Table 2x *continued*

Plants	Frequency (%)	Plant part(s) used
Carica papaya	1	root
Cassia occidentalis	1	leaf
Cassia podocarpa	1	leaf
Citrus aurantiifolia	1	fruit
Cnestis ferruginea	1	root
Cochlospermum tinctorium	2	root
Cola nitida	1	bark
Desmodium adscendens	2	root
Discoglypremna caloneura	3	bark
Elaeis guinnensis	1	fruit
Entandrophragma angolense	1	bark
Ficus exasperata	1	leaf; root
Gouania longipetala	1	bark
Grewia carpinifolia	1	stem
Heliotropium indicum	2	leaf
Hoslundia opposita	1	root
Khaya anthotheca	3	bark
Khaya ivorensis	5	bark
Kigelia africana	3	bark; leaf; seed
Lannea welwitschii	1	bark
Maesobotrya barteri	1	bark

Table 2x *continued*

Plants	Frequency (%)	Plant part(s) used
Millettia zechiana	2	root
Momordica charantia	2	whole plant
Monodora myristica	2	bark; seed
Morinda lucida	1	bark
Musa sapientum	1	bark
Omphalocarpum ahia	1	bark
Paullinia pinnata	1	root
Phyllanthus fraternus	1	leaf
Picralima nitida	3	seed; bark
Piper umbellatum	1	leaf
Pleiocarpa mutica	1	seed
Rauwolfia vomitoria	3	root; bark; any part
Ricinodendron heudelotii	3	bark
Solanum torvum	1	leaf
Spathodea campanulata	5	bark; leaf
Spondias monbin	1	leaf
Struchium sparganophora	1	root
Synedrella nodiflora	4	leaf; whole plant
Tarrietia utilis	1	leaf
Terminalia ivorensis	3	bark
Tetrapleura tetraptera	1	fruit

Table 2x *continued*

Plants	Frequency (%)	Plant part(s) used
Treculia africana	1	bark
Trichilia monadelpha	1	bark
Vernonia amygdalina	2	leaf
Xylopia aethiopica	3	fruit; leaf; seed
Zea mays	1	leaf
xi. Miscarriage		
Alchornea cordifolia	5.05	root; leaf; bark
Alstonia boonei	3.03	bark
Amaranthus spinosus	1.01	whole plant
Anacardium occidentale	2.02	bark
Anopyxis klaineana	2.02	bark
Anthocleista nobilis	1.01	bark
Aspilia africana	1.01	leaf
Blighia sapida	1.01	bark
Boerhavia diffusa	1.01	root
Celtis mildbraedii	2.02	bark
Cnestis ferruginea	2.02	root
Cola gigantea	1.01	bark
Costus dubius	1.01	stem
Datura suaveolens	1.01	leaf

Table 2xi *continued*

Plants	Frequency (%)	Plant part(s) used
Desmodium adscendens	2.02	root; twig
Elaeis guineensis	1.01	bark; fruit
Entandrophragma angolense	1.01	bark
Euphorbia hirta	2.02	whole plant
Gouania longipetala	1.01	stem
Hannoa klaineana	1.01	leaf
Heliotropium indicum	1.01	leaf
Khaya anthotheca	5.05	bark
Khaya ivorensis	5.05	bark
Kigelia africana	2.02	bark; fruit
Lannea welwitschii	1.01	bark
Mallotus oppositifolius	1.01	root
Mannihot esculenta	1.01	leaf
Milletia thonningii	1.01	root
Millettia zechiana	2.02	root
Monodora myristica	1.01	fruit
Morinda lucida	2.02	leaf
Newbouldia laevis	1.01	leaf
Palisota hirsuta	1.01	leaf; root
Petersianthus macrocarpus	1.01	leaf
Phyllanthus fraternus	2.02	leaf; root

Table 2xi *continued*

Plants	Frequency (%)	Plant part(s) used
Physalis angulata	1.01	leaf
Picralima nitida	5.05	bark; root; seed
Piper umbellatum	3.03	leaf
Psidium guajava	2.02	leaf
Rauwolfia vomitoria	2.02	root
Spathodea campanulata	5.05	bark; leaf
Stachytarpheta cayennensis	1.01	leaf
Struchium sparganophora	1.01	root
Synedrella nodiflora	4.04	leaf; whole plant
Tabernaemontana africanus	3.03	root
Terminalia ivorensis	3.03	bark
Trichilia monadelpha	3.03	bark
Turraea heterophylla	2.02	bark; root
Vernonia amygdalina	2.02	root
Vernonia cinerea	2.02	whole plant
Vitex simplicifolia	1.01	bark
xii. Sexual impotence/aphrodisiac		
Adenia lobata	4.44	root; whole plant; leaf; stem
Aframomum melegueta	0.74	fruit
Alchornea cordifolia	0.74	bark

Table 2xii *continued*

Plants	Frequency (%)	Plant part(s) used
Alstonia boonei	0.74	bark
Ananas comosus	0.74	root
Boerhavia diffusa	1.48	root
Caesalpinia bonduc	2.22	root; seed; stem
Canthium glabriflorum	0.74	root
Cassia occidentalis	0.74	root
Celtis adolphi-friderici	1.48	root
Citrus sinensis	0.74	root
Cnestis ferruginea	0.74	root
Cochlospermum tinctorium	0.74	bark; root
Cocos nucifera	1.48	bark
Cola nitida	0.74	stem
Combretum smeathmannii	0.74	root
Cyperus esculentus	8.15	root
Elaeis guineensis	2.96	root; twig
Fagara xanthoxyloides	2.22	root; bark
Ficus exasperata	0.74	leaf
Garcinia mannii	3.70	root
Gouania longipetala	0.74	bark
Guarea cedreta	0.74	bark
Khaya anthotheca	0.74	bark

Table 2xii *continued*

Plants	Frequency (%)	Plant part(s) used
Khaya ivorensis	3.70	bark
Millettia zechiana	3.70	bark; root; stem
Momordica angustisepala	0.74	root
Monodora myristica	0.74	root
Nicotiana tabacum	0.74	leaf
Omphalocarpum ahia	0.74	bark
Parinari excelsa	0.74	root
Paullinia pinnata	5.93	root
Penianthus zenkeri	6.67	root; whole plant
Physalis angulata	0.74	root
Piper guinnense	1.48	fruit
Piptadeniastrum africanum	1.48	bark
Pycnanthus angolensis	0.74	root
Raphia hookeri	0.74	twig
Rauwolfia vomitoria	5.93	root
Ricinodendron heudelotii	0.74	bark
Salacia debilis	0.74	root
Sida acuta	2.96	root; whole plant
Spathodea campanulata	1.48	bark
Sphenocentrum jollyanum	8.15	root
Tabernaemontana africana	2.96	root

Table 2xii *continued*

Plants	Frequency (%)	Plant part(s) used
Tetrapleura tetraptera	1.48	bark; fruit
Tetrorchidium didymostemon	0.74	root
Trichilia monadelpha	1.48	bark
Trichilia prieuriana	0.74	bark
Turraea heterophylla	0.74	root
Uraria picta	0.74	root
Vitex grandifolia	0.74	root
Xylopia aethiopica	1.48	bark; root
xiii. Sexually Transmitted Diseases- Gonorrhoea		
Afzelia africana	2.22	root
Alchornea cordifolia	2.22	root
Amaranthus spinosus	4.44	whole plant
Aspilia africana	2.22	leaf
Baphia nitida	2.22	leaf
Bombax buonopozense	4.44	bark
Caesalpinia bonduc	2.22	root
Citrus aurantiifolia	2.22	fruit
Cnestis ferruginea	4.44	root
Combretum smeathmannii	6.67	root
Ficus capensis	2.22	bark; leaf
Ficus exasperata	6.67	leaf

Table 2xiii *continued*

Plants	Frequency (%)	Plant part(s) used
Hoslundia opposita	2.22	stem
Khaya anthotheca	2.22	bark
Millettia zechiana	2.22	root
Momordica angustisepala	2.22	root
Momordica charantia	20.00	leaf; whole plant
Monodora myristica	2.22	seed
Morinda lucida	2.22	bark
Musa paradisiaca	2.22	root
Myrianthus arboreus	2.22	bark
Piper guinnense	2.22	bark
Psidium guajava	4.44	leaf; root
Rauwolfia vomitoria	4.44	root
Sida acuta	4.44	root
Sida alba	2.22	leaf
Talbotiella gentii	2.22	leaf

The frequency of usage of all the 185 species recorded for reproductive health conditions are presented in Table 3. *Gouania longipetala* had the highest frequency usage of 4.23%, followed by *Alchornea cordifolia* with frequency usage of 3.73%. A total of 51 species had frequency usage of 0.09% each which was the least. Some of these species included *Acacia pennata, Adenia cissampeloides, Cassia alata, Amphimas pterocarpoides, Cassia podocarpa, Celtis zenkeri,* and *Funtumia elastica*.

Table 3: Frequency of the species used for reproductive health conditions

Species	Frequency (%)	Species	Frequency (%)
Abelmoschus esculentus	0.5	*Khaya anthotheca*	2.05
Acacia pennata	0.09	*Kigelia africana*	1.96
Adenia cissampeloides	0.09	*Lannea welwitschii*	0.62
Adenia lobata	0.80	*Lecaniodiscus cupanioides*	0.27
Aframomum melegueta	0.71	*Lophira alata*	0.18
Afrormosia laxiflora	0.18	*Maesobotrya barteri*	0.36
Afrostyrax lepidophyllus	0.27	*Mallotus oppositifolius*	0.62
Afzelia africana	0.36	*Mangifera indica*	0.27
Ageratum conyzoides	0.18	*Manihot esculenta*	0.62
Alafia multiflora	0.18	*Marantochloa ramosissima*	0.09
Albizia zygia	0.18	*Mareya micrantha*	0.09
Alchornea cordifolia	3.74	*Mezoneuron benthamianum*	0.09
Allium ascalonicum	0.18	*Milicia excelsa*	0.80

Table 3 *continued*

Species	Frequency (%)	Species	Frequency (%)
Allium cepa	0.18	*Milletia thonningii*	0.18
Alstonia boonei	1.43	*Millettia zechiana*	1.60
Alternanthera pungens	0.45	*Mitragyna stipulosa*	0.09
Amaranthus spinosus	0.62	*Momordica angustisepala*	0.27
Amphimas pterocarpoides	0.09	*Momordica balsamina*	0.27
Anacardium occidentale	0.36	*Momordica charantia*	1.51
Ananas comosus	0.18	*Monodora myristica*	1.43
Anogeissus leiocarpus	0.09	*Morinda lucida*	1.60
Anopyxis klaineana	0.62	*Musa paradisiacal*	1.43
Anthocleista nobilis	1.25	*Musa sapientum*	0.45
Argemone mexicana	0.18	*Musanga cecropioides*	0.09
Artocarpus communis	0.09	*Myrianthus arboreus*	0.18
Aspilia africana	0.53	*Nauclea latifolia*	0.45
Azadirachta indica	0.27	*Newbouldia laevis*	0.09
Baphia nitida	0.62	*Nicotiana tabacum*	0.27
Blighia sapida	0.45	*Ocimum canum*	0.09
Boerhavia diffusa	0.27	*Ocimum viride*	0.18
Bombax buonopozense	0.36	*Omphalocarpum ahia*	0.18
Bridelia grandis	0.09	*Palisota hirsuta*	0.45
Bussea occidentalis	0.09	*Parinari excelsa*	0.09
Caesalpinia bonduc	0.71	*Paullinia pinnata*	1.60

Table 3 *continued*

Species	Frequency (%)	Species	Frequency (%)
Calliandra partoricensis	0.18	*Penianthus zenkeri*	1.07
Canthium glabriflorum	0.36	*Pentaclethra macrophylla*	0.09
Capsicum annum	0.09	*Petersianthus macrocarpus*	0.53
Carica papaya	2.58	*Phyllanthus fraternus*	0.62
Cassia alata	0.09	*Physalis angulata*	0.53
Cassia occidentalis	0.45	*Picralima nitida*	2.32
Cassia podocarpa	0.09	*Piper guinnense*	0.71
Ceiba pentandra	0.27	*Piper umbellatum*	0.80
Celtis adolphi-friderici	0.18	*Piptadeniastrum africanum*	0.45
Celtis mildbraedii	0.27	*Pleiocarpa mutica*	0.18
Celtis zenkeri	0.09	*Premna quadrifolia*	0.09
Chaetacme aristata	0.09	*Pseudagrostistachys africana*	0.09
Chrysophyllum albidum	0.09	*Psidium guajava*	0.36
Citrus aurantiifolia	0.62	*Pupalia lappacea*	0.09
Citrus medica var. *limonum*	0.53	*Pycnanthus angolensis*	0.36
Citrus sineensis	0.18	*Raphia hookeri*	0.09
Cleistopholis patens	0.09	*Rauwolfia vomitoria*	2.41
Cnestis ferruginea	0.62	*Ricinodendron heudelotii*	0.89
Cochlospermum tinctorium	0.71	*Salacia debilis*	0.18
Cocos nucifera	0.53	*Sansevieria liberica*	0.36
Cola gigantea	0.53	*Schwenckia Americana*	0.18

Table 3 *continued*

Species	Frequency (%)	Species	Frequency (%)
Cola nitida	0.36	*Scoparia dulcis*	0.09
Combretum smeathmannii	0.36	*Sida acuta*	1.16
Conopharyngia chippii	0.18	*Sida alba*	0.09
Corynanthe pachyceras	0.09	*Solanum indicum*	0.09
Costus dubius	0.27	*Solanum torvum*	0.36
Crotalaria retusa	0.18	*Spathodea campanulata*	3.12
Cyperus esculentus	1.34	*Sphenocentrum jollyanum*	1.07
Datura suaveolens	0.18	*Spondias monbin*	0.62
Desmodium adscendens	0.89	*Stachytarpheta angustifolia*	0.09
Dioclea reflexa	0.09	*Stachytarpheta cayennensis*	0.27
Dioscorea cayenensis	0.09	*Struchium sparganophora*	0.53
Dioscorea dumetorum	0.09	*Synedrella nodiflora*	1.51
Discoglypremna caloneura	0.71	*Tabernaemontana africana*	1.51
Eclipta alba	0.09	*Talbotiella gentii*	0.09
Elaeis guineensis	1.51	*Talinum triangulare*	0.09
Entandrophragma angolense	0.62	*Tarrietia utilis*	0.09
Euphorbia hirta	0.53	*Terminalia ivorensis*	1.51
Fagara xanthoxyloides	0.36	*Terminalia superba*	0.09
Ficus capensis	0.53	*Tetrapleura tetraptera*	0.45
Ficus exasperata	1.07	*Tetrorchidium didymostemon*	0.09
Funtumia elastica	0.09	*Thalia geniculata*	0.18

Table 3 *continued*

Species	Frequency (%)	Species	Frequency (%)
Garcinia mannii	0.53	*Theobroma cacao*	0.36
Gossypium arboreum	0.45	*Tieghemella heckelii*	0.09
Gouania longipetala	4.19	*Treculia africana*	0.18
Grewia carpinifolia	0.09	*Trichilia monadelpha*	1.60
Grewia mollis	0.18	*Trichilia prieuriana*	0.09
Grewia pubescens	0.36	*Turraea heterophylla*	0.89
Griffonia simplicifolia	0.18	*Uraria picta*	0.09
Guarea cedreta	0.80	*Vernonia amygdalina*	0.80
Hannoa klaineana	0.18	*Vernonia cinerea*	0.27
Heliotropium indicum	0.62	*Vernonia conferta*	0.09
Hoslundia opposita	0.53	*Vitex doniana*	0.18
Hunteria elliotii	0.09	*Vitex grandifolia*	0.18
Indigofera macrophylla	0.18	*Vitex simplicifolia*	0.27
Jatropha curcas	0.89	*Xylopia aethiopica*	0.71
Justicia flava	0.80	*Xylopia quintassi*	0.09
Khaya ivorensis	3.12	*Zea mays*	0.09
		Zingiber officinale	0.18

Mode of preparation and administration

Most of the traditional healers prepared remedies for the reproductive health conditions using more than one plant species.

The preparation of remedies was generally in the form of infusions or decoctions (by boiling or soaking in hot water); extracts or juice (by crushing the fresh plant parts with or without water; or powder (by grinding the dried plant parts). Some applications were also prepared with a mixture of plants and ingredients, such as milk, salt, ginger and pepper. In a few medications, plant materials were ground, moulded and either used for vaginal insertion (mainly for abortion) or anal insertion (example for piles). Preparation for breast cancer mainly involved grinding of plant materials and applying it on the breast. Still, few preparations included chewing plant parts and using plant parts for bitters, especially for aphrodisiac. The preparations were mainly taken orally or by enema and the dosage varied from practitioner to practitioner.

Plant parts used in medicine

The most frequently employed plant parts were barks (32.49 %), followed by roots (29.95%) and leaves (21.32%), is shown in Table 4. The least medicinally cited plant part was the sap (0.17%).

Table 4: Percentages of plant parts used in medicine

Plant part used	Percentage
Any part	0.51
Bark	32.49
Flowers	0.34
Fruit	4.48
Leaf (including bulb)	21.32
Root (including tuber)	29.95
Sap	0.17
Seed	4.15
Stem (including rhizome)	2.88
Twig	0.42
Whole plant	3.30

Growth form/habit of the medicinal plants

Table 5 shows the dominant growth forms among the reported medicinal plant species cited for reproductive health conditions. They were mainly trees (47.57%), followed by herbs (27.03%). Of these plants, 72.97% were woody, while 27.03% were herbaceous.

Table 5: Growth Form/Habit of the Medicinal Plants Species

Habit	Number of species	Percentag e (%)
Trees	88	47.57
Herbs	50	27.03
Small trees/shrubs	35	18.92
Woody herbs	2	1.08
Lianas	10	5.41
*Woody plants	135	72.97
*Non-woody plants	50	27.03

Ecological Studies

Floristic composition and forest stand structure

The species composition of the woody plants with gbh of 10cm or higher is presented in Appendix 4. A total of 128 species (including 11 lianas) belonging to 104 genera and 45 families (Appendix 5) were encountered. Most of the species (14) belonged to the Euphorbiaceae family. The commonest genera were *Cola* and *Diospyros,* each represented by 4 species.

The species with the most occurrences was *Microdesmis zenkeri* with density of 26 per 5 ha and *Tabernaemontana africana* with density of 15.4 per 5 ha (Appendix 6). The number of species that recorded the least density of 0.2 per 5 ha was quite high. Some of these included *Adenia lobata, Treculia africana, Gouania longipetala, Diospyros sanza-minika* and *Garcinia mannii.*

Microdesmis zenkeri had highest occurrence (86%), followed by *Diospyros gabunensis* and *Tabernaemontana africana* with 54% each. *Xylopia villosa*, *Treculia africana* and *Adenia lobata*, were some of the species with the least frequency of 2% each.

The tallest species was *Ceiba pentandra* (93.67 m tall). Other tall species included *Alstonia boonei* (49.50 m), *Bombax brevicuspe* (45.00 m) and *Sterculia rhinopetala* (41.12 m). The shortest species measured was *Rothmannia longiflora* (3.80 m). Other short species included *Theobroma cacao*, (4.70 m) and *Lophira alata* (4.75 m).

Ceiba pentandra also had the largest basal area of 10.86 m^2. Other species that had large basal areas included *Alstonia boonei* (8.68m^2), *Bombax brevicuspe* (8.62 m^2) and *Terminalia ivorensis* (6.33 m^2). The smallest basal area of 0.01 m^2, was measured in *Adenia lobata, Casearia bridelioides, Cynometra megalophylla* and *Drypetes gilgiana*.

The distribution of woody stems in the Subri River Forest Reserve contained an abundance of small- to mid-size-diameter stems and relatively few large stems (Fig.2). The modal class of stem diameter was 0.0-10.0 cm comprising 52.34% of all woody plants.

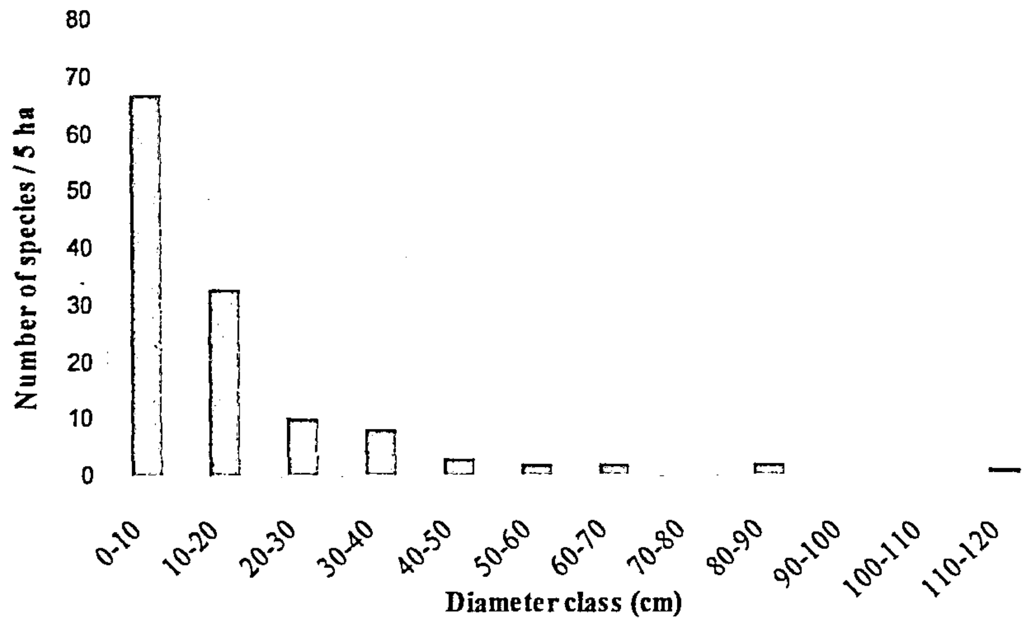

Fig. 3: Size structure diagram of species of Subri River Forest Reserve

Important value indices of woody species

The importance values of the 128 woody species were generally low. The most ecologically important species in the forest was *Microdesmis zenkeri,* which recorded an IVI of 20.09, largely due to the high relative density (Table 6). This was followed by *Ceiba pentandra*, whose IVI value (14.31) was largely due to the relative dominance. The least important species included *Casearia bridelioides*, *Drypetes gilgiana*, *Isolona campanulata*, *Memecylon afzelii* and *Scottellia klaineana*, each of which had an IVI of 0.28. The most dominant species were *Ceiba pentandra*, *Alstonia boonei* and *Bombax brevicuspe* with relative dominance of 13.67, 10.93, and 10.85, respectively.

Table 6: Important value indices of the woody Species.

Species	RDo (%)	RDe (%)	RFr (%)	IVI
Acacia pennata	0.03	0.79	1.18	2.03
Acioa dinklagei	3.12	0.49	0.67	4.28
Adenia lobata	0.02	0.10	0.17	0.29
Afrostyrax lepidophyllus	0.19	2.17	1.35	3.71
Afzelia bella	0.10	0.20	0.34	0.64
Albizia adianthifolia	2.20	0.20	0.34	2.74
Albizia zygia	0.76	0.30	0.17	1.23
Alchornea cordifolia	0.03	0.20	0.17	0.40
Alstonia boonei	10.93	0.20	0.34	11.47
Amphimas pterocarpoides	0.84	0.39	0.67	1.90
Aningeria robusta	0.30	0.39	0.67	1.36
Anopyxis klaineana	2.72	0.10	0.17	2.99
Antiaris africana	0.02	0.20	0.34	0.56
Antrocaryon micraster	0.06	0.79	0.67	1.52
Baphia nitida	0.05	1.48	1.18	2.71
Baphia pubescens	0.09	0.79	1.35	2.23
Blighia sapida	0.05	0.49	0.67	1.21
Blighia unijugata	0.06	1.18	0.67	1.91
Bombax brevicuspe	10.85	0.20	0.34	11.39
Brieya fasciculata	0.03	1.67	2.36	4.06
Buchholzia coriacea	0.02	0.20	0.17	0.39

Table 6 *continued*

Species	RDo (%)	RDe (%)	RFr (%)	IVI
Calpocalyx brevibracteatus	0.03	0.10	0.17	0.30
Casearia bridelioides	0.01	0.10	0.17	0.28
Ceiba pentandra	13.67	0.30	0.34	14.31
Celtis adolphi-friderici	0.08	1.28	1.52	2.88
Celtis mildbraedii	0.32	0.59	0.84	1.75
Celtis zenkeri	1.09	0.59	0.84	2.52
Cleidion gabonicum	0.04	0.39	0.34	0.77
Cleistopholis patens	0.29	0.30	0.51	1.10
Cola caricaefolia	0.01	0.20	0.34	0.55
Cola chlamydantha	0.04	0.69	0.51	1.24
Cola gigantea	0.19	0.59	0.67	1.45
Cola nitida	0.06	0.30	0.51	0.87
Copaifera salikounda	0.07	0.39	0.67	1.13
Cordia millenii	0.26	0.10	0.17	0.53
Craterispermum caudatum	0.05	1.18	1.54	2.75
Cynometra afzelii	0.39	0.79	0.84	2.02
Cynometra ananta	0.71	0.10	0.17	0.98
Cynometra megalophylla	0.02	0.10	0.17	0.29
Dacryodes klaineana	0.04	0.59	0.67	1.30
Desplastsia chrysochlamys	0.04	0.20	0.34	0.58
Dialium aubrevellei	1.10	0.20	0.34	1.64

Table 6 *continued*

Species	RDo (%)	RDe (%)	RFr (%)	IVI
Dialium guineense	0.03	0.20	0.34	0.57
Dioclea reflexa	0.07	0.10	0.17	0.34
Diospyros canaliculata	0.03	0.59	0.67	1.29
Diospyros gabunensis	0.07	6.01	4.55	10.63
Diospyros kamerunensis	0.06	1.77	1.35	3.18
Diospyros sanza-minika	0.08	0.10	0.17	0.35
Discoglypremna caloneura	0.22	0.39	0.67	1.28
Drypetes aubrevillei	0.04	0.10	0.17	0.31
Drypetes gilgiana	0.01	0.10	0.17	0.28
Drypetes principum	0.17	1.38	1.18	2.73
Elaeis guinnensis	4.57	0.30	0.34	5.21
Enantia polycarpa	0.19	1.38	1.85	3.42
Entada scelerata	0.02	0.20	0.17	0.39
Entandrophragma angolense	3.32	0.79	1.35	5.47
Entandropragma cylindricum	0.32	0.10	0.17	0.59
Erythroxylum manni	0.02	0.49	0.84	1.35
Fagara macrophylla	0.11	0.69	1.18	1.98
Fagara zanthoxyloides	0.89	0.39	0.51	1.79
Funtumia elastica	0.20	6.60	2.53	9.33
Garcinia mannii	0.03	0.10	0.17	0.30
Gouania longipetala	0.04	0.10	0.17	0.31

Table 6 *continued*

Species	RDo (%)	RDe (%)	RFr (%)	IVI
Grewia carpinifolia	0.04	2.86	3.37	6.27
Griffonia simplicifolia	0.04	0.99	1.01	2.04
Grossera vignei	0.11	0.10	0.17	0.38
Guarea cedrata	0.10	0.39	0.67	1.16
Hannoa klaineana	0.14	0.79	1.18	2.11
Hevea brasiliensis	0.63	0.30	0.51	1.44
Hexalobus crispiflorus	0.36	0.20	0.34	0.90
Homalium letestui	0.91	0.10	0.17	1.18
Irvingia gabonensis	0.18	0.30	0.17	0.65
Isolona campanulata	0.01	0.10	0.17	0.28
Khaya ivorensis	0.24	0.59	0.34	1.17
Landolphia calabarica	0.03	0.30	0.51	0.84
Lannea welwitschii	0.11	0.99	0.84	1.94
Lecaniodiscus cupanioides	0.02	0.39	0.51	0.92
Lophira alata	0.01	0.20	0.34	0.55
Macaranga barteri	0.31	0.49	0.67	1.47
Maesobotrya barteri	0.04	1.18	1.01	2.23
Mareya micrantha	0.02	0.30	0.34	0.66
Memecylon afzelii	0.01	0.10	0.17	0.28
Microdesmis zenkeri	0.03	12.81	7.25	20.09
Milicia excelsa	0.64	0.49	0.67	1.80

Table 6 *continued*

Species	RDo (%)	RDe (%)	RFr (%)	IVI
Mitragyna ciliata	0.12	0.30	0.51	0.93
Momordica anggustisepala	0.09	0.49	0.51	1.09
Monodora myristica	0.26	0.59	0.67	1.52
Musanga cecropioides	0.22	0.69	1.01	1.92
Myrianthus arboreus	0.45	0.87	2.36	3.68
Napoleonaea vogelii	0.79	0.30	0.51	1.60
Nauclea diderrichi	0.04	0.99	1.18	2.21
Nesogordania papaverifera	0.52	0.99	0.67	2.18
Omphalacarpum ahia	0.26	0.39	0.51	1.16
Parinari excelsa	0.13	0.30	0.51	0.94
Parkia bicolor	0.38	0.39	0.34	1.11
Pentaclethra macrophylla	0.56	0.30	0.17	1.03
Petersianthus macrocarpus	2.59	0.10	1.18	3.87
Phyllanthus discoideus	0.03	0.79	0.17	0.99
Piptadeniastrum africanum	5.16	0.59	1.18	6.93
Polyalthia oliveri	1.04	0.49	0.84	2.37
Pterygota macrocarpa	0.07	0.20	0.34	0.61
Pycnanthus angolensis	0.14	0.69	1.01	1.84
Ricinodendron heudelotii	1.25	0.39	0.51	2.15
Rinorea oblongifolia	0.03	0.69	0.51	1.23
Rothmannia hispida	0.33	0.20	0.34	0.87

Table 6 *continued*

Species	RDo (%)	RDc (%)	RFr (%)	IVI
Rothmannia longiflora	0.02	0.10	0.17	0.29
Salacia debilis	0.03	0.10	0.17	0.30
Santaloides afzelii	0.05	0.39	0.17	0.61
Scottellia klaineana	0.01	0.10	0.17	0.28
Scytopelalum tieghemii	0.30	0.30	0.51	1.11
Spathodea campanulata	0.04	0.10	0.17	0.31
Sterculia oblonga	0.09	0.30	0.51	0.90
Sterculia rhinopetala	0.70	0.89	1.01	2.60
Strombosia glaucescens	0.44	3.05	3.54	7.03
Tabernaemontana africana	0.05	7.59	4.55	12.19
Terminalia ivorensis	7.97	0.20	0.34	8.51
Theobroma cacao	0.02	0.10	0.17	0.29
Tieghemella heckelii	2.47	0.30	0.51	3.28
Treculia africana	3.20	0.10	0.51	3.81
Tricalysia discolor	0.01	0.30	0.34	0.65
Trichilia monadelpha	0.30	0.49	0.67	1.46
Trichilia prieuriana	0.31	1.28	1.69	3.28
Turraeanthus africanus	1. 72	4.43	3.88	10.03
Vitex micrantha	0.03	0.10	0.17	0.30
Xylia evansii	1.13	0.10	0.17	1.40
Xylopia quintasii	0.02	0.30	0.34	0.66

Table 6 *continued*

Species	RDo (%)	RDe (%)	RFr (%)	IVI
Xylopia staudtii	0.14	0.20	0.34	0.68
Xylopia villosa	0.02	0.10	0.17	0.29

Distribution of species according to Raunkiaer's frequency classes

The distribution of the 128 woody species into Raunkiaer's frequency classes showed that almost all the species (92.19%) encountered in the forest reserve were rare (Table 7). It was also observed that 3.91% of the species were of low frequency; 3.13% were of intermmediate frequency; only 0.78% was of moderately high frequency; whilst none was of high frequency or common.

Table 7: Distribution of species according to Raunkiaer's frequency classes.

Class code	Percentage Frequency	Number of species	% number of species	Remarks
A	0-20	118	92.19	rare
B	20-40	5	3.91	low
C	40-60	4	3.13	intermediate frequency
D	60-80	1	0.78	moderately high frequency
E	80-100	0	0.00	high frequency (common)

Plate 3: *Khaya ivorensis*, a representative of species mostly used for reproductive health

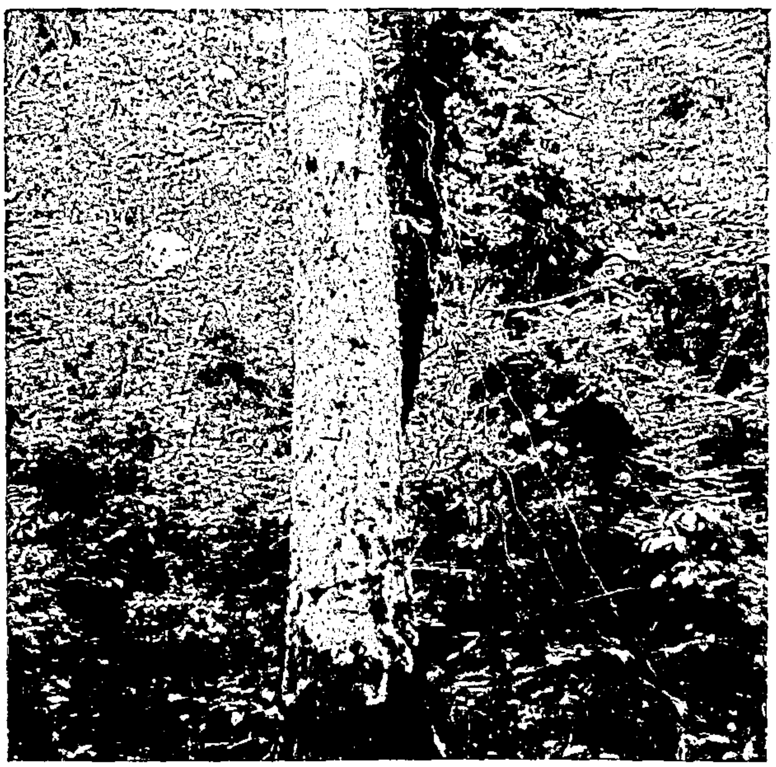

Plate 4: *Khaya ivorensis* with the bark removed for medicine

Plate 5: A portion of the forest with lianas (*Griffonia simplicifolia*)

Plate 6: A disturbed portion of Subri Forest Reserve

showing gaps and regeneration of species

Species diversity of woody plants

The diversity of the woody species in the forest reserve was generally high. The Simpson's index and Shannon-Weaver index gave 0.96 and 4.00, respectively. The Species evenness was also high (0.82).

Soil physico-chemical properties

The soils were acidic with a mean pH of 4.77±0.07 obtained from the 50 soil samples. The maximum and minimum pH values were 6.00 and 4.11, respectively. The texture of the soil was found to be sandy clay loam.

Woody medicinal species of Subri River Forest Reserve

Out of the 128 woody species encountered in the forest reserve, only 57 (44.53%) of them were cited for reproductive health conditions (Appendix 7). Forty eight (82.46%) were trees, 8 (14.04%) lianas and 2 (3.51%) shrubs/small trees. They belonged to 31 families. The families with the most cited species included Euphorbiaceae (5) and Meliaceae (5), followed by Mimosaceace (4) and Moraceae (4).

Approximately 28% (16) of the species were versatile in relation to their use, with a Relative Importance (RI) ranging from 1.03 to 2.00 (Appendix 7). The most versatile species used for the reproductive health conditions was *Alchornea cordifolia* (with an RI of 2), followed by *Khaya ivorensis* (with an IR of 1.71).

Correlation analysis

Linear correlation between the Relative Importance (RI) and the phytosociological parameter values of the 57 woody medicinal plant species of the Subri River Forest Reserve was non-significant. The respective correlation of relative importance with density, frequency, basal and important value index gave respective correlation coefficients of $r = -0.102$, $r = -0.192$, $r = 0.270$ and $r = 0.146$ ($p > 0.05$) respectively, (Appendix 8). The RI was negatively correlated with density and frequency but positively correlated with basal and IVI of the species.

CHAPTER FOUR

DISCUSSION

Ethnobotanical Studies

Tropical plants have been used for medicinal purposes since the evolution of man. Many of these tropical plants are used to treat and help cure a wide variety of diseases and all kinds of ailments. The accumulation of knowledge of plant use is passed on from generation to generation. It is the primitive people of all ages that had knowledge of medicinal plants, which they acquired as a result of trial and error (Plotkin, 1995). This knowledge is still alive and several hundred species are used in herbal remedies in indigenous system of medicines, where the whole plant or plant part or its extraction is used. The first step of ethnobotany is collecting detailed knowledge about the local and indigenous people (Plotkin, 1995).

Of the 80 persons interviewed in this study, 61.30% were men and only 38.80% were women. Men were predominantly represented in the sampling because women were less forthcoming with the information, since they did not want to divulge the secrecy shrouded in the practice of herbal medicine. Togola *et al.* (2005) reported that men dominated the practice of traditional medicine, and women seem to have less knowledge than men about traditional medicine. They attributed this to the fact that women mainly treat children and typical child diseases, while men treat both children and adults.

Traditional medicine practitioners, generally, tend to hide the identity of plants used for different ailments largely for fear of lack of patronage should the sufferer learn to cure himself. Another reason is the fear that they would be punished by authorities when their herbal practice is made known, since they are not legally registered. Herbal practice is their livelihood, hence they are unwilling to give it out for free. Others too claimed a lot of promises have been made by people who interviewed them and never fulfilled their promises, therefore, their lack of confidence in interviewers.

Elderly people above 40 years were mainly involved in herbal practice, comprising 83.80%. Only 6.30% of the interviewees were aged 20-30 years, while 10.00% were between 31-40 years. These findings are in agreement with Togola *et al.* (2005) who observed that only a few healers were below 40 years, with the youngest being 27 years. While traditional healing methods continue to be well used, several young people's knowledge of them is diminishing fast, as certain plants disappear from the environment and the older practitioners die, taking their specialist knowledge with them without passing it to younger generations. Naranjo (1995) argued that modernisation also contributes to the fast eroding and corroding and, at times, total disappearance of such precious knowledge.

Interestingly, 97.50% of the respondents acquired herbal practice or training verbally from human teachers, mainly parents and grandparents, by themselves and/or in dreams; only 2.50% had formal training. This supports the findings of Plotkin (1995) that knowledge about the plants can be obtained only by specialists or human teachers within an indigenous community. Plotkin (1995) further found that their knowledge is also derived directly from the plants themselves and in dreams. Pei (2005) also pointed out that traditional medical knowledge and practices are passed orally from generation to generation. This unwritten guideline or mode of information transfer is, however, grossly inadequate in that it lacks continuity. This implies that, with every specialist that dies without an apprentice, the great medical knowledge base of his culture dies with him.

Other causes for the rapid disappearance of this knowledge are adoption of global products, especially by younger people, extinction of species, urbanization and destruction of habitat, breakdown in traditional structure and certain natural causes like famine, flood, and wars (Mehrotra and Mehrotra, 2005).

Most of the respondents (68.80%) were illiterates, while only 1.30% attained tertiary education. This finding is in line with the results of other ethnomedicinal studies by Yineger and Yewhalaw (2007). This high illiteracy level may account for the reasons why knowledge of medicinal properties and uses of plants are not written down.

Most of the people interviewed were farmers, (82.50%), while only 2.50% claimed they were herbalists. This suggests that ethnobotanical knowledge can be best obtained from the indigenous people who use plants or have something to do with plants constantly or more often. The very low percentage of herbalists interviewed can also indicate the dying interest in herbal medicine. Majority of the respondents, mainly farmers, practised herbal medicine on part-time bases.

Mode of preparation and administration

The result of this study showed that more than one plant species were usually used for the preparation of remedies for reproductive health conditions. This could be attributed to possible additive or syne'rgistic effects of the plants (Igoli *et al.*, 2002; Bussman and Sharon, 2006). However, studies conducted by Macía *et al.* (2005) in Bolivia and Togola *et al.* (2005) in Mali, showed that most remedies were prepared from a single medicinal plant species.

Generally the preparation of remedies was in the form of infusions or decoctions and powdering. Some applications were prepared with a mixture of plants and ingredients, mainly pepper and ginger. The preparations were mainly taken orally or by enema and the dose varied from practitioner to practitioner. Dried and fresh plant materials were used mostly but in a few cases, either fresh or dry forms were used simultaneously.

Medical applications of the plants

Medicinal plants constitute the base of health care systems in many societies. The use of herbal medicine represents a long history of human interaction with the environment.

There were 12 species cited for abortion, among which *Momordica balsamina* and *Carica papaya* were the most frequently (16.67% each) used of species. Irvine (1961) in his earlier survey, recorded the use of the root and seeds of *Carica papaya* for abortion. The next most frequently (11.11%) used tree species was *Gossypium arboreum*, which had also been recorded by Irvine (1961) for abortion. However, in Irvine's (1961) study the root of *Gossypium arboreum* was used instead of the leaf as recorded in this study.

Though 12 species were recorded for abortion, most respondents were not forthcoming with information on the herbal preparations for abortion; less than 10% of the respondents gave their preparations. The main reason for their reluctance or total refusal was that "causing of abortion was an evil thing to do". The few respondents who disclosed their preparations however did it in secrecy. This attitude of traditional healers towards abortion may be a contributing factor to the high maternal death due to complications of abortion, especially, in Africa. Unsafe abortion claims the lives of tens of thousands of women in the world each year (Brookman-Amissah *et al.*, 1999). Khan *et al.* (2001) have noted complications of abortion as one of the regular causes of maternal deaths.

Breast cancer is one of the cancers afflicting women, contributing largely to poor reproductive health especially in Africa and the world as a whole. In this study, 28 species were claimed to either cure or manage breast cancer. *Spathodea campanulata* was cited as the most frequently used (8.16%) species for these purposes. There is no known literature to support this claim but *Spathodea campanulata* has been used for treating skin ulcers and other skin diseases (Irvine 1961; Mshana *et al.*, 2000). Nonetheless, Irvine (1961) has also stated that this species has varied medicinal purposes.

A total of 80 species were cited for complications during pregnancy. *Spathodea campanulata* was the most frequently used species for both abdominal pains (10.71%) and protrusion retention (9.09%) during pregnancy. Irvine (1961) has reported that the bark of this species is used for abdominal pain. *Synedrella nodiflora* was the most frequently cited (9.67%) species for bleeding during pregnancy.

Only 8 species were cited for contraceptives and each of them has the same frequency usage of 12.50%. Some of these species included *Discoglypremna caloneura*, *Alstonia boonei* and *Carica papaya*, which has also been cited frequently for abortion. It has been observed that most respondents were not forthcoming with the preparations for contraceptives too, as was the case for abortion. This may account for the low number of species recorded for this reproductive condition.

In this study, a total of 87 species were cited for use during labour or delivery. For prepartum, that is, before delivery or during labour, 35 species were cited as being used to facilitate delivery. Among these 35 species, *Carica papaya* was the most frequently used.

For postpartum, 52 species were cited and out of these, 28 species were recorded for placenta retention, that is, used for removing placenta and other remains after delivery. Again, *Carica papaya* was the most frequently used (29.43%) species. The barks of *Alstonia boonei* have also been reported by Irvine (1961) and Mshana *et al.* (2000) for this same purpose.

There were 8 species recorded for lactation failure. *Ficus capensis* and *Euphorbia hirta* were the most frequently cited with 25.00% each. *Euphorbia hirta* has been reported as being used to correct lactation failure by Dokosi (1998) and Mshana *et al.* (2000). *Ficus capensis* has been reported by Irvine (1961) for this same purpose in Ghana. Elsewhere, the bark and latex of *Alstonia boonei* are used to promote lactation (Laird *et al.*, 1997).

Musa paradisiaca was the most frequently used (22.73%) species for bleeding and pains after birth, among the 16 species recorded. *Fagara xanthoxyloides*, *Treculia africana* and *Lannea welwitschii* have been recorded by Mshana *et al.* (2000) for lower abdominal pains after birth.

Haemorrhoids or piles is one of the commonest conditions, which received a lot of prescriptions especially, from herbal practitioners in Ghana. In this study, a lot of herbal preparations were mentioned especially with *Gouania longipetala*, where it had highest frequency usage of 42.71%. *Anthocleista nobilis* and *Khaya ivorensis* also had high frequency usage of 4. 21%. Mshana *et al.* (2000) noted the uses of *Anthocleista nobilis* and *Khaya ivorensis* for haemorrhoids.

Hernia is one of the abnormal protrusions of a part of the organs, which affect men. Forty three (43) species were recorded for hernia, out of which *Guarea cedreta* had the highest frequency usage of 8.64%. Other woody species including *Alchornea cordifolia* have been reported for hernia by Mshana *et al.* (2000).

Infertility affects more than 80 million people worldwide but most of those who suffer from infertility live in developing countries. Infertility in both males and females was considered in this study and a total of 91 species was recorded for infertility. *Paullinia pinnata* which was one of the most frequently cited species for infertility in females had been earlier reported by Mshana *et al.* (2000) for infertility in females, while Irvine (1961) reported its use for infertility in males. Moreover, these were also mentioned by these authors for male sexual impotence. The current findings therefore agree with the findings of Irvine (1961) and Mshana *et al.* (2000). This could be due to the fact that both impotence and infertility are both related to male sexual behaviour.

Menstrual disorders occur in most women especially, those who are not yet mothers, that is, those who have not started bearing children. It has also received a lot of attention from most herbal practitioners, just as piles, and a lot of preparations are sold in the market for its treatment or relieve. *Alstonia boonei* was the most frequently used (6 %) species for menstrual disorders, followed by *Spathodea campanulata,* which had frequency usage of 5%. Mshana *et al.* (2000) reported the use of the stem-bark of *Spathodea campanulata* for menstrual pains.

Sexual impotence or aphrodisiac is one of the commonest conditions with so much attention from herbal practitioners, in addition to piles and menstrual disorders in Ghana. A lot of medications or preparations mostly as bitters are advertised every day in the electronic and print media. The species that stood out most among the 53 species for sexual impotence or aphrodisiac were *Sphenocentrum jollyanum* and *Cyperus esculentus*, with the frequency usage of 8.15% each. This result supports the use of these species for sexual impotency as stated by and Irvine (1961) and Mshana *et al.* (2000) respectively.

According to Ampofo (1993), infection is the major cause of infertility and the commonest cause of this infection is Sexually Transmitted Diseases (STDs), especially in males. The result of this survey indicated 27 species used for STDs especially gonorrhoea. STDs were combined because it was realised from the interviews that most of the respondents regarded every form of STDs as 'babasu', that is, gonorrhoea. *Momordica charantia* was most frequently (20.00%) species for STDs. Other most frequently used species included *Combretum smeathmannii* and *Ficus exasperata.* Earlier workers Irvine (1961), Dokosi (1998), and Mshana *et al.* (2000) reported the use of the root of *Combretum smeathmannii* for gonorrhoea. In addition to the species recorded here, leaves of *Ceiba pentandra* is also used for gonorhoea and syphilis (Idu *et al.*, 2005).

Plant parts used in medicine

A wide variety of plant parts is used for medicinal purposes and reports of the dominant parts are mixed. In this study, the most frequently employed plant parts were barks (32.49 %), roots (29.95%) and leaves (21.32%). It has earlier been reported that usually the stem bark is preferred for medicinal use in the *Caatinga* (in Brazil) due to its continuous temporal availability (Albuquerque and Andrade, 2002; Albuquerque *et al.*, 2005; Silva and Albuquerque, 2005). Blythe (2006) pointed out that the bark is the most common part of the plant used, as it contains most of the medicinal ingredients. The use of bark may negatively affect the plant since the bark contains phloem which transports food substances in the plant. However, Almeida *et al.* (2006) noted in their study that flowers were the most cited plant part used, accounting for 35% of the plant parts.

Some studies have found leaves as the most frequently plant parts used in remedy preparations (Giday *et al.*, 2003; Macía *et al.*, 2005; Togola *et al.*, 2005; Kamatenesi-Mugisham and Oryem-Origa, 2007). Togola *et al.* (2005), however, argued that the need for the use of stem bark will increase when the leaves are not available. In another study of plants used for wound healing in Dogonland (Mali), Inngjerdingen *et al.* (2004) found that the roots, followed by the leaves were the most frequently used plant parts. Nonetheless, the practice of exploiting perennial plant parts, such as roots of slow growing woody species, can result in a decline of both the size and distributions of populations of exploited plants species, and ultimately result in local extinction of these populations (Cunningham, 1993; Sheldon *et al.*, 1997; Dhillion and Amundsen, 2000). It could therefore be said that the period of harvesting plant material as well as the availability of the plant part may affect the plant part used in herbal preparations. This indicates that when a certain plant part is not available, the population collects another part of the same plant or an entirely different plant for the same purpose (Almeida *et al.*, 2006).

Taxonomic families and growth forms of the medicinal plant species

It has been recorded that more than 3,000 different plant species are used for traditional medicine in Ghana (Dokosi, 1969). In this study, a total of 185 medicinal plant species that are used for reproductive health was recorded. This number recorded from only 25 communities is quite high and may provide support for observations made by Dokosi (1969).

These species were distributed in 60 families and 155 genera. The families with most cited species for reproductive conditions were Euphorbiaceae (13) and Papilionaceae (10). Earlier workers in Ghana such as Irvine (1961), Dokosi (1998), and Mshana *et al.* (2000) recorded a high number of medicinal plants in these families.

Trees and shrubs were the most (66.49%) represented growth forms for remedy preparations in the study area. This could be due to the fact that these growth forms are available in almost all seasons as they are relatively drought resistant and are not affected by seasonal variations (Bussman and Sharon, 2006). This finding is in agreement with a current observation made by Yineger and Yewhalaw, (2007), where 62.97% of the medicinal plants were shrubs and trees.

Additionally, 72.97% of these species were woody including trees, shrubs and lianas. This may be related to the fact that woody species are a resource that is available all year long, unlike herbs, which are limited by the scarce rainfall (Albuquerque and Andrade, 2002).

Ecological Studies

Floristic composition and stand structure

Information on the floristic composition, simply expressed as a list of species, life form composition and structure of vegetation, is a necessary basis of all ecological work. Quantitative information on the structure of a plant community is therefore, desirable for planning, and evaluating the success of restoration and regeneration projects.

Strictly speaking, species diversity is species richness weighted by some measure of abundance, such as number of individuals or biomass. Diversity indices provide important information about rarity and commonness of species in a community and it is the most important aspect of plant distribution. The species richness of a forest ecosystem thus depends on the number of species there per unit area. The total of 128 woody species (including 11 lianas) belonging to 104 genera and 45 families identified in the 5 ha study area is low, considering the fact that as many as 60 to 70 species per hectare could be obtained in a West African tropical rain forest (Lawson, 1985). An inventory undertaken in 1991 recorded a total of 256 tree species and an estimated 269 tree species recorded for this vegetation suggests that the reserve is slightly lower in species composition (Forestry Commission, 2002). The seemingly low number of species may be due to past disturbances, for example logging, undergone by the forest (Pappoe, 1998). Nonetheless, Boakye-Yiadom (2002) recorded high species richness of 61 to 81 species per hectare in a similar work in this forest reserve.

Another measure of species diversity is the species evenness, which is the relative abundance with which each species is represented in an area. An ecosystem where all the species are represented by the same number of individuals has high species evenness, while an ecosystem where some species are represented by many individuals, and other species are represented by very few individuals has a low species evenness. The evenness of 0.82 is high, as compared to evenness between 0.53 and 0.62 recorded by Whitmore and Sayer (1992) in a similar work. This high evenness suggests that about 80% of the species were equally abundant (Magurran, 1991).

The species diversity of the forest reserve is very high. The Simpson's diversity index of 0.96 may mean that up to 96% of the species belonged to different species (Pascal and Pellissier, 1996), while the Shannon-Weaver diversity of 4.00 is higher than the range 3.14 and 3.49 recorded by Boakye-Yiadom (2002).

Species richness and species evenness are probably the most frequently used measures of the total biodiversity of a region. Global biodiversity is frequently expressed as the total number of species currently living on Earth, that is, its species richness. Therefore, by reducing the structural and species diversity of a forest, logging and silvicultural treatments can also produce a number of largely as yet unknown ecological repercussions. These may include reductions in numbers of pollinators, seed dispersers, alterations in plant-herbivore relationships and the possibility that timber exploitation may ultimately produce conditions in which it is difficult for many forest species to regenerate (Peters, 1996). Some studies do exist which attempt to evaluate changes in community ecology variables with logging, damage, regeneration, and silvicultural treatments both for useful plant species and for the plant community as a whole (Salick *et al.*, 1995; Peters 1996).

A condition that is often seen in tropical ecosystems is where disturbance of the ecosystem causes uncommon species to become even less common, and common species to become even more common. There may even be an increase in the number of species in some disturbed ecosystems but, as noted above, this may occur with a concomitant reduction in the abundance of individuals or local extinction of the rarer species. Numerous studies have related forest composition to the size and frequency of disturbances (Veblen, 1989; Whitmore, 1989). In general, plant communities respond to disturbances differently, and their responses vary with the type of disturbance, be it logging (Yoshida *et al.*, 2005) anthropogenic pressure, fires (Loeb, 2001), or natural tree falls.

The most important tool employed by ecologists in vegetation analysis is the Important Value Index (IVI), though vegetation can be described in terms of commonest species and/or numbers. One advantage of using IVI is that it dampens the effects of single large individuals, or infrequent species which, when present, are very abundant. The low IVIs recorded in this study indicates that most of the species in the forest were rare (Pascal and Pellissier, 1996). This was also confirmed by the Raunkiaer's frequency class distribution, where almost all the species (92.19%) were rare.

The preponderance of species notwithstanding, it has been noted so many of the trees found in the tropical rain forests are rare (Hubbell and Forster, 1986). The high number of rare species recorded in this study is in agreement with the generally acclaimed notion that most species are rare, rather than being common (Kershaw, 1979; Greig-Smith, 1983). The rarity of these species may be attributed to the occurrence of numerous sporadic species with low frequency (Oosting, 1956).

Dominant plants are the most noticeable that take up the most room and control some environmental conditions. The most dominant woody species in terms of basal area and height in the current study area was *Ceiba pentandra*, followed by *Alstonia boonei*. This is contrary to Boakye-Yiadom (2002) report that *Turraeanthus africanus* was the most dominant species in this forest. The difference in dominant species may due to varying responses of plant communities to disturbances.

The most ecologically important species (species with high IVIs) were *Microdesmis zenkeri* (20.09), *Ceiba pentandra* (14.31), *Tabernaemontana africana* (12.19) and *Alstonia boonei* (11.47). *Microdesmis zenkeri* was the most ecologically important species in this study because it had high relative density and relative frequency. However, its relative dominance was very low (0.03). Thus, *Microdesmis zenkeri* was the most frequently encountered and the most abundant species in the forest reserve, indicating that it was uniformly distributed in the forest.

The distribution of woody stems in the Subri River Forest Reserve is typical for a mature forest stand in that it contained an abundance of small- to mid-size-diameter stems and relatively few large stems (Hara, 1988). The species-size structure follows a "reverse J" curve and shows a characteristic decline in numbers of species with increasing size. This skewing of the stem-diameter distribution toward the early stages of gap-phase regeneration is widely accepted as a general trend for mature and aging forest (Hara, 1988).

The family that contributed most to the species composition in the survey was Euphorbiaceae, with 14 species. The rest were Annonaceae with 10 species, Mimosaceace and Sterculiaceae, both with 9 species each.

The success of any vegetation is correlated with its environment, while the dynamics of the forest ecosystem depends on the soil-environment equilibrium. Kimmins (1987) observed that the development of vegetation of any habitat relies on, at least, the physical nature of the soil and more especially on the pH of the soil. However, the pH is, influenced by the nature of the soil and the rate of leaching of bases. The mean pH of 4.77 ± 0.07 recorded indicates that the soil of the forest was acidic. This low pH of the forest may be due to the high rainfall, since natural acidification of soils is enhanced with increasing rainfall (Tisdale *et al.*, 1993).

Woody medicinal plant species of Subri River Forest Reserve

Most commonly used medicinal plants are sourced from a range of habitat types such as secondary forest, the edges of paths, farms, village peripheries and informal gardens kept by specialist healers, while species used for more severe illnesses, and many of those species considered most powerful are sourced from high or secondary forest (Thomas *et al.*, 1989; Laird *et al.*, 1997). The tropical forests thus, serve as sources of a large proportion of the world's recognized medicinal plants, providing today's 20 best-selling drugs (Balunas, 2005). Indeed, the rainforests are also sources of timber, food, fiber, fuel, ornamentals and other products for human needs and consumption.

Balick and O'Brien (2005) pointed out that many trees of medicinal importance are also used for timber, and continued logging of natural stands has significantly reduced their populations. *Milicia excelsa* is one such tree species in Central and West Africa, and it is heavily depleted due to selective logging pressures, and in some countries, such as the Congo, is endangered (Laird *et al.*, 1997). Logging operations can therefore, directly affect both present and future harvests of timber and medicinal species. They can lead to declines in species and forest structural diversity, and to unfavourable rates of basal area growth of species through destruction of seedlings, adolescent trees, soil surface and drainage patterns (Dykstra and Heinrich, 1992)

Among the 128 woody species in the Forest Reserve species, only 57 had therapeutic indication, which corresponds to 44.53% of the total number of species encountered in this survey. These 57 species used for reproductive health conditions were distributed into 32 families. Logging and other disturbances may have accounted for the low number of medicinal species.

Some of the woody medicinal species in this forest reserve included dominant species such as *Ceiba pentandra*, *Alstonia boonei* and *Terminalia ivorensis*. The top four ecologically dominant or important species *Ceiba pentandra*, *Tabernaemontana africana* and *Alstonia boonei* except *Microdesmis zenkeri*, are also of medicinal values. Though *Microdesmis zenkeri* is the most ecologically important species in this study, it has no medicinal uses for reproductive health conditions. This could be why it was abundant and uniformly distributed in the forest. However, Irvine (1961) recorded its medicinal uses in other African countries as cures for syphilis, gonorrhoea and aphrodisiac.

Out of the 57 medicinal plants, approximately 28% were versatile (most frequently used) in relation to their use for the reproductive health conditions, with a Relative Importance value exceeding 1. The most versatile species in this study was *Alchornea cordifolia* and had the greatest number of medicinal properties. The most versatile species is the most important plant (Silva and Albuquerque, 2005) hence, *Alchornea cordifolia* was the most important species for reproductive health. This analysis has some limitations, however, for a plant with few uses, but which is used frequently by many people, would tend to be awarded only low values (Almeida *et al.*, 2006). Nonetheless, *Alchornea cordifolia* not only had the highest IR (of 2), but also the highest frequency usage of 3.74% among the woody medicinal species of the forest. Though *Gouania longipetala* had the highest frequency usage of 4.19%, haemorrhoids accounted largely for that.

Silva and Albuquerque (2005) observed that the species with the highest RI values generally have the lowest phytosociological parameter values. They further confirmed that as the RI of a species increases, its density and frequency diminish. In this study, it was observed that as the RI of some of the species increased, their phytosociological parameter values such as density, frequency and important value indexes diminished thus agreeing with Silva and Albuquerque (2005). This was clearly observed in *Alchornea cordifolia*, *Trichilia monadelpha*, *Spathodea campanulata*, *Khaya ivorensis* and *Monodora myristica* among others. However, Albuquerque *et al.* (2005), in a regression analysis, found that frequency and density are not significant variables to explain the RI of medicinal species of Caatinga in Pernambuco state.

The relation between relative importance and phytosociological parameter values of woody medicinal species of the Subri River Forest Reserve was non-significant (p>0.05). Therefore, it could be said that the usage (RI) and ecological data of the woody medicinal species are not correlated and there was no much relationship between them.

Silva and Albuquerque (2005) also observed an inverse relationship between the usage (RI) of a plant and ecological data. However, Phillips and Gentry (1993) argued that there is a strong connection between ecological and usage data of a species and that the most common species are widely used. This suggests there may be variation from region to region, and studies are necessary in different localities (Silva and Albuquerque, 2005)

The families with highest number of woody medicinal species were Euphorbiaceae and Meliaceae. Interestingly, the two most important species recorded in this survey, *Alchornea cordifolia* and *Khaya ivorensis*, belong to these families, Euphorbiaceae and Meliaceae respectively. It could be deduced from this finding that Euphorbiaceae was the most important family, since it registered the highest number of woody medicinal species, as well as the most represented family for both ethnobotanical (14 species) and ecological (13) studies. However, early studies by Taylor (1960) indicated economically, Meliaceae is the most important family of trees in Ghana.

Besides logging, another continuing problem associated with medicinal plants is the regulation of their use. For most of these plants, there is nothing regulating how much of the plant should be used in the products sold or how the plant materials should be obtained. For instance, Balick and O'Brien (2005) observed that in Cayo district, at least 10 instances have been reported where whole trees of varying sizes have been cut down to facilitate harvesting (or stripping) of bark from stems and branches. Further more, they found for older trees, harvesting of complete circumference of the bark at chest height resulted in ring barking and death of large matured trees. Thus, the unchecked use and harvest of medicinal plants in the Subri River Forest Reserve may also account for the low number of medicinal species in the forest. Moreover, the use of mainly bark for reproductive health care may cause harm to the plant species, especially, when used excessively and this may also contribute to the low number.

Several benefits can be derived from the conservation of woody plant species with economic and medicinal relevance. Medicinal species must not be considered solely as a therapeutic resource, but also as a source of economic resources. Thus, it is necessary to establish strategies for developing techniques of sustainable management, allied to the maintenance of the equilibrium of tropical ecosystems. Silva *et al.* (1987) have argued that in addition to *in situ* ecological reserves of ecologically and/or economically important populations of individuals such as *Alchornea cordifolia, ex situ* reserves must be established to guarantee the perpetuation of genetic resources.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Traditional medicine has remained the most affordable and easily accessible source of treatment in the primary healthcare system of resource poor communities. A rich heritage of indigenous medicinal plant use and knowledge was also recognized.

Although a great majority of these plants are found in the rainforests, only 57 species, representing 44.53% of the total species encountered in this study were of medicinal value for reproductive health care. This seemingly low number of medicinal species may be due to intensive logging and over harvesting. Thus there is the need to conserve these species and plans put in place for their sustainable use.

Despite the high species diversity recorded (Simpson's index and Shannon-Weaver index of 0.96 and 4.00 respectively), the species richness was low. Only 128 woody species (11 including lianas) were encountered in the 5 ha area studied. The importance values and other phytosociological values for these species were also low. *Microdesmis zenkeri*, was the most ecologically important species with an IVI of 20.09, largely due to its relative density. This was followed by *Ceiba pentandra*, whose IVI (14.31) was largely due to its relative dominance.

Furthermore, 52.34% of woody plants fell in the stem diameter 0.0-10.0 cm interval, indicating that matured plant species were fewer.

Ceiba pentandra and *Alstonia boonei* were the most dominant woody medicinal species in terms of height and basal area. *Gouania longipetala* and *Alchornea cordifolia* were the most frequently used woody species for reproductive health care. Approximately 28% of the woody medicinal species were versatile in relation to their use. The most important species was *Alchornea cordifolia*, followed by *Khaya ivorensis*. On the whole, many medicinal plant species in the forest were rare. Further destruction of tropical habitats, such as this forest, with many of these important taxa would increase their scarcity.

The most important family in terms of number of species recorded was Euphorbiaceae. This family had the highest number of species for ethnobotanical and ecological studies. However, both Euphorbiaceae and Meliaceae were the most important families in terms of medicinal values, with 5 species each.

Results from this study indicate that people still patronise traditional medicine solely or alongside modern medicine, thus confirming reports by Alexander (1985). Additionally, the Subri forest is losing its species diversity and species number through logging and over harvesting of both timber and non-timber species.

Recommendations

The Ministry of Health should provide uniform training or training in general of traditional medical practitioners with a clearly defined organizational framework within which traditional healers should operate. Moreover, there should be training of more Traditional Birth Attendants (TBAs), especially in rural areas, to enhance reproductive health care, since health care centres are usually located far from easy reach in addition to the inability to afford health care services.

There should be more research on herbal medicine in order to document traditional knowledge, since most of this is not documented and easily lost from generation to generation. An inventory of our forest species would also serve as basis for conservation of important but dwindling species as well as the sustainable use of our forest species.

Health education pertaining to issues related to indigenous herbal medicine should be introduced in the school curricula at all levels of formal education by the government. This will create the awareness on the advantages of herbal medicine and proper use of herbal prepartions for therapeutic purposes. In so doing, traditional or folk medicine would be properly organized and formally integrated into the regular healthcare delivery system. Such measures would harmonize the practice of traditional medicine with the orthodox medicine rather than the disregard with which the later considers the former currently.

Ethnobotanists and other researchers must also consider the local people as counterparts to the investigation process, rather than merely as informants. This effort will help improve health care services in the country.

The Forest Services Department of the Forestry Commission should provide the local people with sustainable harvesting methods, adequate knowledge about forest management and knowledge about cultivation among others, to ensure the conservation and sustainable use of medicinal plants.

The Forestry Commission should encourage the establishment of herbal or botanical gardens, nurseries for valuable and vanishing rare medicinal plant species at various institutions, in order to ensure the availability of medicinal plants and sustained supply of authentic raw materials for herbal medicine. Further research should also be carried out on habitat, diversity, growth and development of these medicinal plants.

Finally, phytochemical, pharmacological and biological activity studies should also be conducted on the reported medicinal plant species of this study to gain more information about the possibilities of identifying the active ingredients for production of drugs. Analyses should also be carried out on the safety and efficacy of herbal remedies for reproductive health care as well as other considerations and to safeguard the lives of the rural folks who depend mainly on herbal medicine.

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APPENDICES

Appendix 1: Questionnaire used for ethnobotanical study

UNIVERSITY OF CAPE COAST

DEPARTMENT OF ENVIRONMENTAL SCIENCE

PLANTS FOR REPRODUCTIVE HEALTH PROJECT QUESTIONNAIRE

1. Date:............................ Code:...........................
2. Gender: Male [ ] Female [ ]
3. Age: 20-30yrs [ ] 31-40yrs [ ] 41-50yrs [ ] 51yrs & above [ ]
4. Educational qualification: None [ ] Basic [ ] Secondary [ ]
   Post-secondary [ ] Tertiary [ ]
5. Occupation: Herbalist [ ] Any other (specify)...........................
6. Any formal training in herbal/ plant medicine? Yes [ ] No [ ]
7. How was the training done? Apprenticeship [ ] School (specify) [ ]
   Any other (specify)....................................
8. Where do you practise your plant medicine? Herbal centre [ ] Market [ ]
   In vehicles [ ] By Hawking [ ] Home [ ] Any other (specify)...
9. For how long have you been practising herbalmedicine?..........................
10. Purpose of practice: Main occupation [ ] Part-time [ ]
    Any other (specify)................................

14\. Disease(s)/reproductive health for which plant is used........................

11\. Local (Akan) name(s) of plant (specify the dialect):..............................

....

15\. Plant part used in medicine: Root [ ] Stem [ ] Leaf [ ] Stem [ ]

Root bark [ ] Flower [ ] Fruit [ ] Seed [ ] Twig [ ]

19. How plant part is used: Fresh [ ] Dried [ ]

20. Method of preparation for use: Powdered [ ] Extracted with water hot [ ]

With cold water [ ] Extracted with local gin [ ] With mineral [ ]

Any other (specify)...........................

21. Mode of administration:..

22. Dosage:...

23. Other plants and/or ingredients with which the plant is used for preparation:

....

24. Other uses:..

25. Name and address of the person giving information about the medicinal

value of Plant...

....

....

26. Any other comments or information..

Appendix 2 (a): Particulars of respondents (interviewees)

Respondent	Address	Gender	Age	Occupation	Training	Education
Mosses Danquah	AH17, Ohen-BronuDaboase	1	4	1	2	1
Bright Annan	Ohen-Bronu Daboase	1	4	1	1	1
Appiah-Kubi	Box 18, Daboase	1	3	2	4	4
Kofi Attah	AH36, Ohen-Bronu, Daboase	1	4	1	3	1
Stephen Halm	SIPL, Daboase	1	2	3	2	1
Kwabena Tawiah	District Assembly, Daboase	1	3	4	3	0
George Tawiah	AH107, Ohen-Bronu, Daboase	1	4	1	3	1
John Kwarf	SIPL, Daboase	1	3	5	2	1
James Afaedzie	AH11, Ohen-Bronu, Daboase	1	2	6	2	1
Esi Attah	Daboase	2	4	1	2	0
Yaw Akyerem	Awiadaso	1	4	1	2	0
Boadu Kojo	Awiadaso	1	1	1	1	0

Appendix 2 (a) *continued*

Respondent	Address	Gender	Age	Occupation	Training	Education
Yaw Mensah	Awiadaso	1	4	1	3	0
Efua Agyeiwa	Kojokorang	2	4	7	2	0
Akua Amonu Ntiamoah	Kojokorang	2	3	1	3	1
Maame Hannah	Abosompim	2	3	1	3	0
Aba Bosuwa	Kojoaku	2	2	1	2	0
Kwabena Adjei	Odumase	1	4	1	2	0
Akua Nkrumah	Odumase	2	3	8	2	0
Kwesi Bukar	Mensah-Krom	1	3	1	2	0
Ama Appiah Tiwa	Mensah-Krom	2	4	1	1	0
Faustina Abena Ewuramah	Okete	2	4	1	1	0
Sule Sadique	Woyedeadwuho	1	4	1	2	1
Salifu Tamiawu	Mataheko	1	2	1	2	0
Kingsford Ahensah	Krofufrom	1	4	1	2	1
J. B. Quaidoo	Krofufrom	1	4	1	2	0
Nana Ama Ahenfua	Krofufrom	2	3	1	1	0
Esi Guaba	Krofufrom	2	3	1	1	0
Kofi Badu	Krofufrom	1	3	1	3	0

Appendix 2 (a) *continued*

Respondent	Address	Gender	Age	Occupation	Training	Education
Stephen Badu	Krofufrom	1	4	1	2	1
Maame Afua Poma	Adansi	2	4	9	2	0
Isaac Kyei Marfo	Adansi	1	4	1	1	1
Aba Nyamekye	Adansi	2	3	1	2	0
Afua Nyamo	Adansi	2	4	1	2	0
Maame Ama	Adansi	2	4	1	2	0
Stephen Quayeson	Adansi	1	4	7	5	1
Kwesi Bossman	Adansi	1	4	1	1	1
Esi Adisa	Abotaryie	2	4	1	1	0
Stephen Quiason	Anapensu-Camp	1	4	1	2	0
Kwame Alhassan	Essumang-Krom	1	4	1	2	0
Kojo Ibrahim	Essumang-Krom	1	4	1	2	0
Ama Serwah Okomfo	Botodwina	2	4	9	2	0
Nana Kwame	Botodwina	1	4	1	2	0
Akosua Mensah	Botodwina	2	3	1	2	0
Yaa Nkrumah	ES/77, Essaman	2	3	1	2	0

Appendix 2 (a) *continued*

Respondent	Address	Gender	Age	Occupation	Training	Education
Abena Ansah	Ohenefia, Essaman	2	2	1	3	0
Corfort Asamoah	ES/54, Essaman	2	3	1	3	0
Adwoa Tawiah	Essaman	2	4	1	3	0
Akua Akosombo	Essaman	2	4	1	3	0
Danda Kofi	Essaman	2	4	1	3	0
Martin Aboagye	AK50, Sekyere Krobo	1	3	1	2	1
Raymond Abukim Tawiah	AK74, Sekyere Krobo	1	4	1	2	0
Kweku Asante	Akrofi	1	1	1	2	0
Stephen Andoh	Akrofi	1	2	1	2	0
George Akrofi	Akrofi	1	3	1	2	0
Mamee Kumasi	Aboaboso 25	2	3	1	2	0
Gilbrael Molo	Aboaboso 45	1	4	1	2	0
Emmanuel Aggrey	Aboaboso	1	2	10	2	1
Kojo Baah	Adaa	1	3	1	2	1
Kwamena Kumi	Adaa	1	3	1	2	0
Christiana Awusi	Adaa	2	4	1	2	0
Maama Atta	Adaa	2	4	1	2	0

Appendix 2 (a) *continued*

Respondent	Address	Gender	Age	Occupa-tion	Trai-ning	Educa-tion
Jacob Adin	Adaa	1	4	1	1	0
Mallam Noohu	Ewirudukrom	1	4	1	2	0
Kweku Botwe	Ewirudukrom	1	4	1	2	0
Kofi Kyeremah	Ewirudukrom	1	4	1	2	0
Mary Quansah	Kwabaah	2	3	1	2	0
Akua Obinyim	Kwabaah	2	4	1	2	0
Joseph Boabeng	Kwabaah	1	2	1	2	1
Abaa Yaa	Kwabaah	2	4	1	6	0
James Edwin	Kwabaah	1	3	11	2	1
Emmanuel Acquah	Kwabaah	1	1	12	3	1
Atsu Azumah	Kwabaah	1	1	13	2	1
Ama Donkor	Kwabaah	2	4	1	6	0
Samuel Anyarku	Kwabaah	1	4	1	2	0
Mary Anyarku	Kwabaah	2	3	1	2	0
Daniel Isaac Kom	Kwabaah	1	4	1	2	1
Etsey Azumah	Kwabaah	1	1	1	1	1
Peter Affanyi	Adzieankyewo-damu	1	4	1	1	1
Margaret Tawiah	Adzieankyewo-damu	2	4	1	2	0

Gender

Male=1 Female=2

Age group (years)

20-30=1 31-40=2 41-50=3 ≥51=4

Education background

None=0 Basic=1 Secondary= Post secondary=3 Tertiary=4

Training

Self/Dream =1 Parent=2 Grandparent=3 TBA=4 Herbal Training=5 Husband=6

Occupation

Farmer=1 Evangelist=2 Foreman=3 Labourer=4 Driver=5 Pot Maker=6 Herbalist=7Trader=8 Pensioner=9 Blacksmith=10 Art craft=11 Student=12 Photographer=13

Appendix 2 b: Descriptive statistics on the respondents; Frequency table

Information	Frequency	Percent (%)
Gender		
Male	49	61.30
Female	31	38.80
Age group		
20-30	5	6.30
31-40	8	10.00
41-50	21	26.30
>50	46	57.50
Education		

None	55	68.80
Basic	24	30.00
Tertiary	1	1.30
Training		
Self/dream	12	15.00
Parent	52	65.00
Grandparent	12	15.00
Husband	2	2.50
Formal training	2	2.50
Occupation		
Farmer	66	82.50
Herbalist	2	2.50
Pensioner	2	2.50
Evangelist	1	1.25
Foreman	1	1.25
Labourer	1	1.25
Driver	1	1.25
Pot maker	1	1.25
Trader	1	1.25
Blacksmith	1	1.25
Art craft	1	1.25
Photographer	1	1.25
Student	1	1.25

Appendix 3: Taxononic information on medicinal plants

Scientific name	Local name (Akan)	Family	Habit
Abelmoschus esculentus (L.) Moench	Nkruma	Malvaceae	Herb
Acacia pennata Willd.	Sawee/Oguaben	Mimosaceae	W.C
Adenia cissampeloides (Planch. ex Benth.) Harms	Humakyɛm	Passifloraceae	Herb
Adenia lobata (Jacq.) Engl.	Nsurogya	Passifloraceae	W.C
Aframomum melegueta K. Schum.	Sensam/Famwisa	Zingiberaceae	Herb
Afrormosia laxiflora (Benth. ex Bak.) Harms	Anyɛn dua	Papilionaceae	Tree
Afrostyrax lepidophyllus Mildbr.	Duanyaw	Huaceae	Tree
Afzelia africana Smith	Opapao/Pepe	Caesalpinaceae	Tree
Ageratum conyzoides Linn.	Ahaban kankan	Asteraceae	Herb
Alafia multiflora (Stapf) Stapf-Kew Bull.	Okun-dada	Apocynaceae	W.C.
Albizia zygia Macbride	O̱kuro	Mimosaceae	Tree
Alchornea cordifolia (Schum. & Thonn.) Muell. Arg.	(O)Gyama	Euphorbiaceae	Tree
Allium ascalonicum Linn.	Gyeene/Anwew	Liliaceae	Herb
Allium cepa Linn.	Anyaw	Liliaceae	Herb
Alstonia boonei De Wild.	Nyamedua	Apocynaceae	Tree
Alternanthera pungens H. B. and K.	Mpatowa-nsoe	Amarathaceace	Herb

Appendix 3 *continued*

Scientific name	Local name (Akan)	Family	Habit
Amaranthus spinosus Linn.	Asantewa	Amarathaceace	Herb
Amphimas pterocarpoides Harms	Yaya	Papilionaceae	Tree
Anacardium occidentale Linn.	Atẽã	Anacardiaceae	Tree
Ananas comosus (Linn.) Merrill	Abrobe	Bromeliaceae	Herb
Anogeissus leiocarpus (DC) Guill &Perr.	Akula	Combretaceae	Tree
Anopyxis klaineana (Pierre) Engl.	Kokoti	Rhizophoraceae	Tree
Anthocleista nobilis G. Don	Wudifokɛtɛ	Loganiaceae	Tree
Argemone mexicana Linn.	Anansesemmɛyaa	Papaveraceace	Herb
Artocarpus communis Forst.	(A)borofo-nkate(ɛ)	Moraceae	Tree
Aspilia africana (Pers.) C. D. Adams	N/Mfofo	Asteraceae	Herb
Azadirachta indica A. Juss	Duagyene/Abodua	Meliaceae	Tree
Baphia nitida Lodd.	Odwen(e)	Papilionaceae	S/ST
Blighia sapida Konig	A(n)kye	Sapindaceae	Tree
Boerhavia diffusa Linn.	Ntrada/Nkokodwe	Nyctaginaceae	Herb
Bombax buonopozense P. Beauv.	Okuo/Akata	Bombacaceae	Tree
Bridelia grandis Pierre ex Hutch.	Pan-kotokrobo	Euphorbiaceae	S/ST
Bussea occidentalis Hutch.	Atawa/ Takorowa	Caesalpinaceae	Tree
Caesalpinia bonduc Roxb.	Oware-aba	Caesalpiniaceae	Shrub
Calliandra partoricensis Benth.	Ahwintsĩhwintsĩ	Mimosaceae	Shrub
Canthium glabriflorum Hiern	Gyapam-netsetser	Rubiaceae	Tree

Appendix 3 *continued*

Scientific name	Local name (Akan)	Family	Habit
Capsicum annum Linn.	Mboko/Mako	Solanaceae	Herb
Carica papaya Linn.	Borofere	Caricaceae	Tree
Cassia alata Linn.	Duawusu/Osempɛ	Caesalpinaceae	Shrub
Cassia occidentalis Linn.	Anansebrode/Mmofraborode	Caesalpinaceae	Shrub
Cassia podocarpa Guill. & Perr.	Peagoro/Duawusu	Caesalpiniaceae	Shrub
Ceiba pentandra (Linn.) Gaertn.	Onyina	Bombacaceae	Tree
Celtis adolphi-friderici Engl.	Asable/Esakosua	Ulmaceae	Tree
Celtis mildbraedii Engl.	Esa/Yisa	Ulmaceae	Tree
Celtis zenkeri Engl.	Esakoko	Ulmaceae	Tree
Chaetacme aristata Planch.	Esonoanka	Ulmaceae	S/ST
Chrysophyllum albidum G. Don	Akasaa/Adasema	Sapotaceae	Tree
Citrus aurantiifolia (Christm.) Swingle	Ankama	Rutaceae	Tree
Citrus medica var. *limonum* Brandis	Amomoe	Rutaceae	Tree
Citrus sineensis Osbeck	Ankapaa/Akutu	Rutaceae	Tree
Cleistopholis patens (Benth.) Engl. & Diels	Ngonenkyene/ Wisanenkyene	Annonaceae	Tree
Cnestis ferruginea DC.	Akitase/Apose	Connaraceae	Shrub
Cochlospermum tinctorium A. Rich.	Kokrosabia	Cochlopermaceae	Shrub
Cocos nucifera Linn.	Kube	Arecaceae	Tree
Cola gigantea A. Chev.	Watapuo/Wawapuo	Sterculiaceae	Tree

Appendix 3 *continued*

Scientific name	**Local name (Akan)**	**Family**	**Habit**
Cola nitida (Vent.) Schott. & Endl.	Bese/Besekyem	Sterculiaceae	Tree
Combretum smeathmannii G. Don	Ohwirem	Combretaceae	Shrub
Conopharyngia chippii Stapf	Kakapempe	Apocynaceae	Tree
Corynanthe pachyceras K. Schum.	Pamprama	Rubiaceae	Tree
Costus dubius (Afzel.)K. Schum.	Nsummen	Zingiberaceae	Herb
Crotalaria retusa Linn.	Mbofra-boredzewa	Papilionaceae	Herb
Cyperus esculentus Linn.	Atadwe	Cyperaceae	Herb
Datura suaveolens Humb. & Bonpl.ex Willd.	Pepeadiwu	Solanaceae	Herb
*Desmodium adscendens (*Sw.) DC.	Ananse/Nkatenkate	Papilionaceae	Herb
Dioclea reflexa Hook f.	Nte(w)hama	Papilionaceae	W.C.
Dioscorea cayenensis Lam.	Nkani/Nkamfo	Dioscoreaceae	Herb
Dioscorea dumetorum (Kunth) Pax	Ahabayere	Dioscoreaceae	Herb
*Discoglypremna caloneura (*Pax) Prain	Fetefre	Euphorbiaceace	Tree
Eclipta alba (Linn.) Hassk.	Ntum	Asteraceae	Herb
Elaeis guineensis Linn.	Abɛ/ Obɛten	Arecaceae	Tree
Entandrophragma angolense (Welw.) C. DC.	Edinam	Meliaceae	Tree
Euphorbia hirta Linn.	Animakoa/Ahenkodze	Euphorbiaceace	Herb
Fagara xanthoxyloides Lam.	Okãntõ	Rutaceae	Shrub

Appendix 3 *continued*

Scientific name	Local name (Akan)	Family	Habit
Ficus capensis Thunb.	Doma	Moraceae	Tree
Ficus exasperata Vahl Baule	Nyankyerene	Moraceae	Tree
Funtumia elastica (Preuss.) Stapf	Ofuruntum	Apocynaceae	Tree
Garcinia mannii Oliv.	Nsoko	Clusiaceae	Tree
Gossypium arboreum Linn.	Asaawa/Asaaba	Malvaceae	Shrub
Gouania longipetala Hemsl. ?	Homabiri/Sokurua	Rhamnaceae	W.C.
Grewia carpinifolia Juss.	Ntanta//Ntabuna	Tiliaceae	W.C.
Grewia mollis Juss.	Homabiri/Kyapotoro	Tiliaceae	S/ST
Grewia pubescens P. Beauv.	Mfoa/Ntanta	Tiliaceae	S/ST
Griffonia simplicifolia Bail.	O/Kagya	Caesalpinaceae	W.C.
Guarea cedreta (A. Chev.) Pellgr.	Kwabohoro	Meliaceae	Tree
Hannoa klaineana Pierre & Engl.	Hotoro-hotoro/Fotie	Simaroubaceae	Tree
Heliotropium indicum Linn.	Akokonyin-ne-dam	Boraginaceae	Herb
Hoslundia opposita Vahl	Aberewa-ani-kakyi	Lamiaceae	Shrub
Hunteria elliotii (Stapf) Pichon	Kanwere	Apocyanaceae	S/ST
Indigofera macrophylla Schum.	Agyegyensu	Papilionaceae	Shrub
Jatropha curcas Linn.	Adadze	Euphorbiaceae	S/ST
Justicia flava (Forsk.) Vahl.	Ntumunum	Acanthaceae	Herb
Khaya anthotheca (Welw.) C. DC.	(A)Kwabohoro	Meliaceae	Tree
Khaya ivorensis A. Chev.	Kumakrao	Meliaceae	Tree

Appendix 3 *continued*

Scientific name	Local name (Akan)	Family	Habit
Kigelia africana (Lam.) Benth.	Nufoten/Etua	Bignoniaceae	Tree
Lannea welwitschii (Hiern) Engl.	Kumenini	Anacardiaceae	Tree
Lecaniodiscus cupanioides Planch.ex Benth.	Dwindwera	Sapindaceae	Tree
Lophira alata Banks ex Gaertn.	Kaku	Ochnaceae	Tree
Maesobotrya barteri (Baill.) Hutch.	Apotrowa	Euphorbiaceae	S/ST
Mallotus oppositifolius (Geisel.) Muell. Arg.	Sataduaa	Euphorbiaceae	Shrub
Mangifera indica Linn.	Mãngo	Anacardiaceae	Tree
Manihot esculenta Crantz	Bankye	Euphorbiaceae	Shrub
Marantochloa ramosissima (Benth.) Hutch.	Aworom/ Ntsɛntrɛma	Maranthaceae	Herb
Mareya micrantha (Benth.) Muell. Arg.	Odubrafo	Euphorbiaceae	Tree
Mezoneuron benthamianum Baill.	Ekoobowerɛw	Nyctaginaceae	Shrub
Milicia excelsa (Welw.) C.C. Berg.	Odum	Moraceae	Tree
Milletia thonningii Baker	Pem/Ntsentsento	Papilionaceae	Tree
Millettia zechiana Harms	Fafraha	Papilionaceae	S/ST
Mitragyna stipulosa O. Kuntze	Baya	Rubiaceae	Tree
Momordica angustisepala Harms	Ahensaw/ Nyinya	Cucurbitaceae	W.C
Momordica balsamina Linn.	Nyinya	Cucurbitaceae	Herb

Appendix 3 *continued*

Scientific name	Local name (Akan)	Family	Habit
Momordica charantia Linn.	Nyinya	Cucurbitaceae	Herb
Monodora myristica Dunal	Awiaraba	Annonaceae	Tree
Morinda lucida Benth.	Konkroma	Rubiaceae	Tree
Musa paradisiaca L.	Borɛdze	Musaceae	Herb
Musa sapientum L.	Kwadu/Mpuwa	Musaceae	Herb
Musanga cecropioides R. Br.	(O)Dwuma	Moraceae	Tree
Myrianthus arboreus P. Beauv.	Anyankuma	Moraceae	Tree
Nauclea latifolia Smith	Ekumfodawase/Ekusia	Rubiaceae	Shrub
Newbouldia laevis Seem.	Kedzieku/Esisimansa	Bignoniaceae	S/ST
Nicotiana tabacum Linn.	Ataa/Towa	Solanaceae	Herb
Ocimum canum Sims	Eme Akokobasa/	Lamiaceace	Herb
Ocimum viride Willd.	Nunum	Lamiaceace	Shrub
Omphalocarpum ahia A. Chev.	Duapompo	Sapotaceae	Tree
Palisota hirsuta (Thunb.) K. Schm.	Somenini/Sombanyin	Commelinaceae	Herb
Parinari excelsa Sabine	Kotosima/Opam	Rosaceae	Tree
Paullinia pinnata Linn.	Toa-ntini	Sapindaceae	W.C.
Penianthus zenkeri (Engl.) Diels	Kramankote	Menispermaceae	H/SS
Pentaclethra macrophylla Benth.	Ekuama/Atawa	Mimosaceae	Tree
Petersianthus macrocarpus (P. Beauv.)Liben	A/Esia	Lecythidaceae	Tree

Appendix 3 *continued*

Scientific name	**Local name (Akan)**	**Family**	**Habit**
Phyllanthus fraternus Linn.	Nkatseha/ Awommaaguwakyi	Euphorbiaceae	Herb
Physalis angulata Linn.	Tototo/Nsunsu	Solanaceae	Herb
Picralima nitida (Stapf) Th. & Hél. Dur.	(O)kanwen(e)/ Owemba/Ekuama	Apocynaceae	Tree
Piper guineense Schum. & Thonn.	Surowisa/Sasima	Piperaceae	Herb
Piper umbellatum Linn.	Mumuaha	Piperaceae	Herb
Piptadeniastrum africanum (Hook. f.) Brenan	Dahoma	Mimosaceace	Tree
Pleiocarpa mutica Benth.	(O)kanwen(e)	Apocynaceae	Tree
Premna quadrifolia Schum. & Thonn.	Atantaba	Verbenaceae	S/ST
Pseudagrostistachys africana (Müll. Arg.) Pax & K. Hoffm.	Sukroma	Euphorbiaceae	Tree
Psidium guajava Linn.	Oguawa/Eguaba	Myrtaceae	Tree
Pupalia lappacea (Linn.) Juss.	Akukuamba	Amarathaceace	Herb
Pycnanthus angolensis (Welw.) Exell	Otie/Etsiw	Meristicaceae	Tree
Raphia hookeri Mann & Wendl.	Adobɛ	Arecaceae	Tree
Rauwolfia vomitoria Afz.	Kakapenpen	Apocynaceae	Tree
Ricinodendron heudelotii (Baill.) Pierre ex Pax	Wamma	Euphorbiaceae	Tree

Appendix 3 *continued*

Scientific name	Local name (Akan)	Family	Habit
Salacia debilis Walp.	Hama-kyerebɛn	Celastraceae	W.C.
Sansevieria liberica Ger & Labr.	Twiton	Agavaceae	Herb
Schwenckia americana Linn.	Agyenngyensu	Solanaceae	Herb
Scoparia dulcis Linn.	Nyankosonmina	Scrophulariaceae	Herb
Sida acuta Burm. f.	Mofransan/Obraneatuata	Malvaceae	Herb
Sida alba Linn.	Obraneatuata	Malvaceae	Herb
Solanum indicum Linn.	Nsusuaa	Solanaceae	Shrub
Solanum torvum Swartz	Samanntroba/Nsusuwa	Solanaceae	Shrub
Spathodea campanulata P. Beauv.	Osisirew/ Nufu Nsu	Bignoniaceae	Tree
Sphenocentrum jollyanum Pierre	Okramamkote/ Krakoo	Menispermaceae	H/SS
Spondias monbin Linn.	Atõaa	Anacardiaceae	Tree
Stachytarpheta angustifolia (Mil.)Vahl.	Abontennua	Verbenaceae	Herb
Stachytarpheta cayennensis (L.C. Rich.) Schau	Mpengu	Verbenaceae	Herb
Struchium sparganophora (Linn.) O.Ktze.	Suibirnyin	Asteraceae	Herb
Synedrella nodiflora Gaertn.	Mamponfoapow/ Tutummirika-kohwe-Σpo	Asteraceae	Herb
Tabernaemontana africanus T. Anderson ex S. Moore	Obonawa/Mamfohan	Apocynaceae	Tree

Appendix 3 *continued*

Scientific name	Local name (Akan)	Family	Habit
Talbotiella gentii Hutch. & Greenway	Ntakorowa	Caesalpiniaceae	Tree
Talinum triangulare (Jacq.) Willd.	Bokoboko	Portulcaceae	Herb
Tarrietia utilis Sprague	Nyankom	Sterculiaceae	Tree
Terminalia ivorensis A. Chev.	Emire	Combretaceae	Tree
Terminalia superba Engl. &Diels	Ofram	Combretaceae	Tree
*Tetrapleura tetraptera (*Schum. &Thonn.) Muell. Arg.	Prekese	Mimosaceae	Tree
Tetrorchidium didymostemon (Baill.) Pax	Abogyedua/ Sansannuro	Euphorbiaceace	Tree
Thalia geniculata Linn.	Babadua	Marantaceae	Shrub
Theobroma cacao Linn.	Kooko/Mpow-dua	Sterculiaceae	Tree
Tieghemella heckelii Pierre ex A.Chev.	(A)baku/Makore	Sapotaceae	Tree
Treculia africana Decne var.	Totim/Bibiritim	Moraceae	Tree
Trichilia monaldelpha (Thonn.) J. P.De Willde	Tanuro	Meliaceae	Tree
Trichilia prieuriana A. Juss	Kakadikro	Meliaceae	Tree
Turraea heterophylla Smith.	Ahunanyankwa	Meliaceae	Shrub
Uraria picta (Jacq.) DC.	Venovigbe (in Ewe)	Papilionaceae	Herb
Vernonia amygdalina Del.	Bowen(e)	Asteraceae	S/ST
Vernonia cinerea (Linn.) Less.	Hosikonu(in Ewe)	Asteraceae	Herb

Appendix 3 *continued*

Scientific name	**Local name (Akan)**	**Family**	**Habit**
Vernonia conferta Benth.	Awudefo-kete	Asteraceae	S/ST
Vitex doniana Sweet	Afetewa/Afua	Verbenaceae	Tree
Vitex grandifolia Gürke	Awama/Disinkro	Verbenaceae	S/ST
Vitex simplicifolia Oliv.	Abisa	Verbenaceae	Tree
Xylopia aethiopica (Dunal) A. Rich.	Hwenetia	Annonaceae	Tree
Xylopia quintassi Engl. & Diels	Obaa	Annonaceae	Tree
Zea mays Linn.	Eburow	Poaceae	Herb
Zingiber officinale Rosc.	Akakaduru	Zingiberaceae	Herb

W.C. = woody climber S/ST= shrub or small tree H/SS =woody herb or small shrub

Appendix 4: Species of woody plants ≥ 10cm and their taxonomic families.

Species	Family
**Acacia pennata* Willd.	Mimosaceae
Acioa dinklagei Engl.	Rosaceae
**Adenia lobata* (Jacq.) Engl.	Passifloraceae
Afrostyrax lepidophyllus Mildbr.	Huaceae
Afzelia bella Harms	Caesalpinaceae
Albizia adianthifolia (Schumach) W. F. Wright	Mimosaceae
Albizia zygia Macbride	Mimosaceae
Alchornea cordifolia (Schum. & Thonn.) Muell. Arg.	Euphorbiaceae
Alstonia boonei De Wild.	Apocynaceae
Amphimas pterocarpoides Harms	Papilionaceae
Aningeria robusta (A. Chev.) Aubrév. & Péllégr.	Sapotaceae
Anopyxis klaineana (Pierre) Engl.	Rhizophoraceae
Antiaris africana Engl.	Moraceae
Antrocaryon micraster A. Chev. & Guill.	Anacardiaceae
Baphia nitida Lodd.	Papilionaceae
Baphia pubescens Hook. f.	Papilionaceae
Blighia sapida Konig	Sapindaceae
Blighia unijugata Bak.	Sapindaceae
Bombax brevicuspe Sprague	Bombacaceae
Brieya fasciculata De Wild	Annonaceae
Buchholzia coriacea Engl.	Capparidaceae

Appendix 4 *continued*

Species	**Family**
Calpocalyx brevibracteatus Harms	Mimosaceae
Casearia bridelioides Mildbr. ex Hutch. & Dalz.	Samydaceae
Ceiba pentandra (Linn.) Gaertn.	Bombacaceae
Celtis adolphi-friderici Engl.	Ulmaceae
Celtis mildbraedii Engl.	Ulmaceae
Celtis zenkeri Engl.	Ulmaceae
Cleidion gabonicum Baill.	Euphorbiaceae
Cleistopholis patens (Benth.) Engl. & Diels	Annonaceae
Cola caricaefolia (G. Don) K. Schum.	Sterculiaceae
Cola chlamydantha K. Schum.	Sterculiaceae
Cola gigantea A. Chev.	Sterculiaceae
Cola nitida (Vent.) Schott. & Endl.	Sterculiaceae
Copaifera salikounda Heck.	Caesalpinaceae
Cordia millenii Bak.	Boraginaceae
Craterispermum caudatum Hutch.	Rubiaceae
Cynometra afzelii Oliv.	Caesalpinaceae
Cynometra ananta Hutch. & J. M. Dalz.	Caesalpinaceae
Cynometra megalophylla Harms	Caesalpinaceae
Dacryodes klaineana (Pierre) H. J. Lam.	Burseraceae
Desplatzia chrysochlamys (Mildbr. & Burret) Mildbr. & Burret	Tiliaceae

Appendix 4 *continued*

Species	**Family**
Dialium aubrevellei Pellégr.	Caesalpinaceae
Dialium guineense Willd.	Caesalpinaceae
**Dioclea reflexa* Hook f.	Papilionaceae
Diospyros canaliculata De Wild.	Ebenaceae
Diospyros gabunensis Gürke	Ebenaceae
Diospyros kamerunensis Gürke	Ebenaceae
Diospyros sanza-minika A. Chev.	Ebenaceae
*Discoglypremna caloneura (*Pax) Prain	Euphorbiaceace
Drypetes aubrevillei Léandri	Euphorbiaceace
Drypetes gilgiana (Pax) Pax & K. Hoffm.	Euphorbiaceace
Drypetes principum (Muell. Arg.) Hutch.	Euphorbiaceace
Elaeis guineensis Linn.	Arecaceae
Enantia polycarpa Engl. & Diels	Annonaceae
**Entada scelerata* A. Chev.	Mimosaceae
Entandrophragma angolense (Welw.) C. DC.	Meliaceae
Entandropragma cylindricum (Sprague) Sprague	Meliaceae
Erythroxylum manni Oliv.	Erythroxylaceae
Fagara macrophylla Engl.	Rutaceae
Fagara xanthoxyloides Lam.	Rutaceae
Funtumia elastica (Preuss.) Stapf	Apocynaceae
Garcinia mannii Oliv.	Clusiaceae

Appendix 4 *continued*

Species	Family
**Gouania longipetala* Hemsl.	Rhamnaceae
**Grewia carpinifolia* Juss.	Tiliaceae
**Griffonia simplicifolia* Bail.	Caesalpinaceae
Grossera vignei Hoyle	Euphorbiaceace
Guarea cedreta (A. Chev.) Pellégr.	Meliaceae
Hannoa klaineana Pierre & Engl.	Simaroubaceae
Hevea brasiliensis (Kunth) Muell Arg.	Euphorbiaceace
Hexalobus crispiflorus A. Chev.	Annonaceae
Homalium letestui Pellégr.	Samydaceae
Irvingia gabonensis Baill.	Irvingiaceae
Isolona campanulata Engl. & Diels	Annonaceae
Khaya ivorensis A. Chev.	Meliaceae
**Landolphia calabarica* (Stapf) E. A. Druce	Apocynaceae
Lannea welwitschii (Hiern) Engl.	Anacardiaceae
Lecaniodiscus cupanioides Planch.ex Benth.	Sapindaceae
Lophira alata Banks ex.Gaertn.	Ochnaceae
Macaranga barteri Muell. Arg.	Euphorbiaceae
Maesobotrya barteri (Baill.) Hutch.	Euphorbiaceae
Mareya micrantha (Benth.) Muell. Arg.	Euphorbiaceae
Memecylon afzelii G. Don	Melastomataceae
Microdesmis zenkeri Pax	Euphorbiaceae

Appendix 4 *continued*

Species	**Family**
Milicia excelsa (Welw.) C.C. Berg.	Moraceae
Mitragyna ciliata Aubr. & Pell.	Rubiaceae
**Momordica angustisepala* Harms	Cucurbitaceae
Monodora myristica Dunal	Annonaceae
Musanga cecropioides R. Br.	Moraceae
Myrianthus arboreus P. Beauv.	Moraceae
Napoleona vogelii Hook. & Planch.	Lecythidaceae
Nauclea diderrichii (De Wild.) Mirrill	Rubiaceae
Nesogordonia papaverifera (A. Chev.) R. Capuron	Sterculiaceae
Omphalocarpum ahia A. Chev.	Sapotaceae
Parinari excelsa Sabine	Rosaceae
Parkia bicolor A. Chev.	Mimosaceae
Pentaclethra macrophylla Benth.	Mimosaceae
Petersianthus macrocarpus (P. Beauv.) Liben	Lecythidaceae
Phyllanthus discoideus (Baill.) Muell. Arg.	Euphorbiaceae
Piptadeniastrum africanum (Hook. f.) Brenan	Mimosaceace
Polyalthia oliveri Engl.	Annonaceae
Pterygota macrocarpa K. Schum.	Sterculiaceae
Pycnanthus angolensis (Welw.) Exell	Meristicaceae
Ricinodendron heudelotii (Baill.) Pierre ex Pax	Euphorbiaceae
Rinorea oblongifolia (C. H.Wright) Marquand ex Chipp	Violaceae

Appendix 4 *continued*

Species	Family
Rothmannia hispida (K. Schum.) Fagerh.	Rubiaceae
Rothmannia longiflora Salisb.	Rubiaceae
**Salacia debilis* Walp.	Celastraceae
**Santaloides afzelii* (R. Br. ex Planch.) Schellenb.	Connaraceae
Scottellia klaineana Chipp	Flacourtiaceae
Scytopetalum tieghemii (A. Chev.) Hutch. & Dalz.	Scytopetalaceae
Spathodea campanulata P. Beauv.	Bignoniaceae
Sterculia oblonga Mast.	Sterculiaceae
Sterculia rhinopetala K. Schum.	Sterculiaceae
Strombosia glaucescens var. *lucida* J. Leonard	Olacaceae
Tabernaemontana africanus T. Anderson ex S. Moore	Apocynaceae
Terminalia ivorensis A. Chev.	Combretaceae
Theobroma cacao Linn.	Sterculiaceae
Tieghemella heckelii Pierre ex A. Chev.	Sapotaceae
Treculia africana Decne var.	Moraceae
Tricalysia discolor Brenan	Rubiaceae
Trichilia monaldelpha (Thonn.) J. P.De Willde	Meliaceae
Trichilia prieuriana A. Juss.	Meliaceae
Turraeanthus africanus (Welw. ex C. DC.) Péllégr.	Meliaceae
Vitex micrantha Gürke	Verbenaceae
Xylia evansii Hutch.	Mimosaceae

Appendix 4 *continued*

Species	Family
Xylopia quintassi Engl. & Diels	Annonaceae
Xylopia staudtii Engl. ex Hutch. & J. M. Dalz.	Annonaceae
Xylopia villosa Chipp	Annonaceae

(* Means liana or woody climber)

Appendix 5: Number of species in families.

Family	Number of species	
	Ethnobotanical Study	Ecological Study
Acanthaceae	1	-
Agavaceae	1	-
Amarathaceace	3	-
Anacardiaceae	4	2
Annonaceae	4	10
Apocyanaceae	9	4
Arecaceae (Palmae)	3	1
Asteraceae (Compositae)	8	-
Bignoniaceae	3	1
Bombacaceae	2	2
Boraginaceae	-	1
Bromeliaceae	1	-
Burseraceae	-	1

Appendix 5 *continued*

Family	**Number of species**	
	Ethnobotanical Study	**Ecological Study**
Caesalpinaceae	9	8
Capparidaceae	-	1
Caricaceae	1	-
Celastraceae	1	1
Clusiaceae (Guttiferae)	1	1
Cochlopermaceae	1	-
Combretaceae	4	1
Commelinaceae	1	-
Connaraceae	1	1
Cucurbitaceae	3	1
Cyperaceae	1	-
Dioscoreaceae	2	-
Ebenaceae	-	4
Erythroxylaceae	-	1
Euphorbiaceace	13	14
Flacourtiaceae	-	1
Huaceae	1	1
Irvingiaceae	-	1
Lamiaceace	3	-
Lecythidaceae	1	2

Appendix 5 *continued*

Family	Number of species	
	Ethnobotanical Study	Ecological Study
Liliaceae	2	-
Loganiaceae	1	-
Malvaceae	4	-
Marantaceae	2	-
Melastomataceae	-	1
Meliaceae	8	7
Menispermaceae	2	-
Meristicaceae	1	1
Mimosaceace	6	9
Moraceae	7	5
Musaceae	2	-
Myrtaceae	1	-
Nyctaginaceae	2	-
Ochnaceae	1	1
Olacaceae	-	1
Papaveraceace	1	-
Papilionaceae	10	4
Passifloraceae	2	1
Piperaceae	2	-
Poaceae (Graminae)	1	-

Appendix 5 *continued*

Family	Number of species	
	Ethnobotanical Study	Ecological Study
Portulcaceae	1	-
Rhamnaceae	1	1
Rhizophoraceae	1	1
Rosaceae	1	2
Rubiaceae	5	6
Rutaceae	4	2
Samydaceae	-	2
Sapindaceae	3	3
Sapotaceae	3	3
Scrophulariaceae	1	-
Scytopetalaceae	-	1
Simaroubaceae	1	1
Solanaceae	7	-
Sterculiaceae	4	9
Tiliaceae	3	2
Ulmaceae	4	3
Verbenaceae	6	1
Violaceae	-	1
Zingiberaceae	3	-

Appendix 6: Density, Percentage Frequency, height and basal area of woody plants in the forest.

Species	Density (Per 5 ha)	Percentage Frequency	Height (m)	Basal area (m^2)
Acacia pennata	1.6	14	15.43	0.05
Acioa dinklagei	1	8	28.36	2.48
Adenia lobata	0.2	2	9.00	0.01
Afrostyrax lepidophyllus	4.4	16	15.30	0.15
Afzelia bella	0.4	4	18.50	0.08
Albizia adianthifolia	0.4	4	32.75	1.75
Albizia zygia	0.6	2	20.00	0.60
Alchornea cordifolia	0.4	2	10.50	0.02
Alstonia boonei	0.4	4	49.50	8.68
Amphimas pterocarpoides	0.8	8	18.28	0.67
Aningeria robusta	0.8	8	14.10	0.24
Anopyxis klaineana	0.2	2	32.00	2.16
Antiaris africana	0.4	4	5.45	0.02
Antrocaryon micrasta	1.6	8	6.53	0.02
Baphia nitida	3	14	6.73	0.04
Baphia pubescens	1.6	16	7.50	0.07
Blighia sapida	1	8	7.82	0.04
Blighia unijugata	2.4	8	9.43	0.05
Bombax brevicuspe	0.4	4	45.00	8.62

Appendix 6 *continued*

Species	Density (Per 5 ha)	Percentage Frequency	Height (m)	Basal area (m^2)
Brieya fasciculata	3.4	28	8.14	0.03
Buchholzia coriacea	0.4	2	8.25	0.02
Calpocalyx brevibracteatus	0.2	2	8.40	0.02
Casearia bridelioides	0.2	2	6.70	0.01
Ceiba pentandra	0.6	4	93.67	10.86
Celtis adolphi-friderici	2.6	18	7.31	0.06
Celtis mildbraedii	1.2	10	9.88	0.25
Celtis zenkeri	1.2	10	24.17	0.87
Cleidion gabonicum	0.8	4	6.03	0.03
Cleistopholis patens	0.6	6	18.03	0.23
Cola caricaefolia	0.4	4	13.25	0.01
Cola chlamydantha	1.4	6	9.13	0.03
Cola gigantea	1.2	8	11.85	0.15
Cola nitida	0.6	6	9.77	0.05
Copaifera salikounda	0.8	8	12.05	0.06
Cordia millenii	0.2	2	16.00	0.20
Craterispermum caudatum	2.4	18	7.10	0.04
Cynometra afzelii	1.6	10	17.13	0.31
Cynometra ananta	0.2	2	18.20	0.57
Cynometra megalophylla	0.2	2	13.40	0.01

Appendix 6 *continued*

Species	Density (Per 5 ha)	Percentage Frequency	Height (m)	Basal area (m^2)
Dacryodes klaineana	1.2	8	7.30	0.03
Desplastsia chrysochlamys	0.4	4	7.45	0.03
Dialium aubrevellei	0.4	4	19.80	0.88
Dialium guineense	0.4	4	11.60	0.03
Dioclea reflexa	0.2	2	30.00	0.05
Diospyros canaliculata	1.2	8	8.03	0.03
Diospyros gabunensis	12.2	54	8.79	0.06
Diospyros kamerunensis	3.6	16	8.91	0.05
Diospyros sanza-minika	0.2	2	12.00	0.06
Discoglypremna caloneura	0.8	8	16.73	0.18
Drypetes aubrevillei	0.2	2	10.00	0.03
Drypetes gilgiana	0.2	2	6.40	0.01
Drypetes principum	2.8	14	10.66	0.14
Elaeis guinnensis	0.6	4	13.20	3.63
Enantia polycarpa	2.8	22	11.41	0.15
Entada scelerata	0.4	2	20.05	0.01
Entandrophragma angolense	1.6	16	27.69	2.64
Entandropragma cylindricum	0.2	2	19.70	0.26
Erythroxylum manni	1	10	10.40	0.01
Fagara macrophylla	1.4	14	24.44	0.88

Appendix 6 *continued*

Species	Density (Per 5 ha)	Percentage Frequency	Height (m)	Basal area (m^2)
Fagara zanthoxyloides	0.8	6	25.25	0.71
Funtumia elastica	13.4	30	13.06	0.16
Garcinia mannii	0.2	2	6.75	0.02
Gouania longipetala	0.2	2	11.1	0.03
Grewia carpinifolia	5.8	40	18.23	0.03
Griffonia simplicifolia	2	12	18.92	0.03
Grossera vignei	0.2	2	10.00	0.09
Guarea cedrata	0.8	8	9.38	0.08
Hannoa klaineana	1.6	14	11.43	0.11
Hevea brasiliensis	0.6	6	15.17	0.50
Hexalobus crispiflorus	0.4	4	14.25	0.29
Homalium letestui	0.2	2	23.00	0.72
Irvingia gabonensis	0.6	2	13.43	0.14
Isolona campanulata	0.2	2	6.40	0.01
Khaya ivorensis	1.2	4	20.77	0.19
Landolphia calabarica	0.6	6	22.67	0.03
Lannea welwitschii	2	10	3.00	0.09
Lecaniodiscus cupanioides	0.8	6	5.28	0.01
Lophira alata	0.4	4	4.75	0.01
Macaranga barteri	1	8	14.50	0.24

Appendix 6 *continued*

Species	Density (Per 5 ha)	Percentage Frequency	Height (m)	Basal area (m^2)
Maesobotrya barteri	2.4	12	7.50	0.03
Mareya micrantha	0.6	4	7.70	0.02
Memecylon afzelii	0.2	2	7.40	0.01
Microdesmis zenkeri	26	86	6.35	0.24
Milicia excelsa	1	8	18.32	0.51
Mitragyna ciliata	0.6	6	9.53	0.10
Momordica angustisepala	1	6	15.68	0.07
Monodora myristica	1.2	8	13.43	0.21
Musanga cecropioides	1.4	12	23.66	0.17
Myrianthus arboreus	3.8	28	12.74	0.36
Napoleonaea vogelii	2	14	5.77	0.03
Nauclea diderrichi	0.6	6	19.67	0.62
Nesogordania papaverifera	2	8	13.93	0.42
Omphalacarpum ahia	0.8	6	13.17	0.21
Parinari excelsa	0.6	6	10.40	0.10
Parkia bicolor	0.8	4	17.10	0.31
Pentaclethra macrophylla	0.6	2	26.00	0.44
Petersianthus macrocarpus	0.2	14	16.30	2.06
Phyllanthus discoideus	1.6	2	8.00	0.03
Piptadeniastrum africanum	1.2	14	81.50	4.10

Appendix 6 *continued*

Species	**Density (Per 5 ha)**	**Percentage Frequency**	**Height (m)**	**Basal area (m^2)**
Polyalthia oliveri	1	10	10.86	0.82
Pterygota macrocarpa	0.4	4	12.25	0.05
Pycnanthus angolensis	1.4	12	18.16	0.11
Ricinodendron heudelotii	0.8	6	29.68	1.00
Rinorea oblongifolia	1.4	6	6.43	0.02
Rothmannia hispida	0.4	4	7.65	0.26
Rothmannia longiflora	0.2	2	3.80	0.01
Salacia debilis	0.2	2	21.00	0.02
Santaloides afzelii	0.8	2	31.25	0.04
Scottellia klaineana	0.2	2	5.00	0.01
Scytopelalum tieghemii	0.6	6	15.77	0.24
Spathodea campanulata	0.2	2	7.20	0.03
Sterculia oblonga	0.6	6	12.03	0.07
Sterculia rhinopetala	1.8	12	41.12	0.56
Strombosia glaucescens	6.2	42	11.66	0.35
Tabernaemontana africana	15.4	54	7.40	0.04
Terminalia ivorensis	0.4	4	33.00	6.33
Theobroma cacao	0.2	2	4.70	0.01
Tieghemella heckelii	0.6	6	18.67	1.96
Treculia africana	0.2	6	34.00	2.54

Appendix 6 *continued*

Species	Density (Per 5 ha)	Percentage Frequency	Height (m)	Basal area (m^2)
Tricalysia discolor	0.6	4	5.10	0.01
Trichilia monadelpha	1	8	10.04	0.24
Trichilia prieuriana	2.6	20	11.75	0.25
Turraeanthus africanus	9	46	21.99	1.37
Vitex micrantha	0.2	2	7.00	0.02
Xylia evansii	0.2	2	25.00	0.90
Xylopia quintasii	0.6	4	7.97	0.02
Xylopia staudtii	0.4	4	17.50	0.11
Xylopia villosa	0.2	2	9.00	0.02

Appendix 7: Relative Importance (RI) of the woody medicinal species of Subri River Forest Reserve

Species	NCS	NP	RI
Acacia pennata	0.14	0.08	0.22
Adenia lobata	0.29	0.23	0.52
Afrostyrax lepidophyllus	0.14	0.08	0.22
Albizia zygia	0.29	0.15	0.44
Alchornea cordifolia	1.00	1.00	2.00
Alstonia boonei	0.71	0.62	1.33
Amphimas pterocarpoides	0.14	0.08	0.22
Anopyxis klaineana	0.57	0.46	1.03
Baphia nitida	0.71	0.54	1.25
Blighia sapida	0.43	0.31	0.74
Ceiba pentandra	0.43	0.23	0.66
Celtis adolphi-friderici	0.14	0.08	0.22
Celtis mildbraedii	0.29	0.15	0.44
Celtis zenkeri	0.14	0.08	0.22
Cleistopholis patens	0.14	0.08	0.22
Cola gigantea	0.71	0.46	1.17
Cola nitida	0.57	0.31	0.88
Dioclea reflexa	0.14	0.08	0.22
Discoglypremna caloneura	0.57	0.38	0.95
Elaeis guineensis	0.86	0.77	1.63

Appendix 7 *continued*

Species	NCS	NP	RI
Entandrophragma angolense	0.86	0.46	1.32
Fagara xanthoxyloides	0.29	0.15	0.44
Funtumia elastica	0.14	0.08	0.22
Garcinia mannii	0.29	0.15	0.44
Gouania longipetala	0.57	0.54	1.11
Grewia carpinifolia	0.14	0.08	0.22
Griffonia simplicifolia	0.14	0.23	0.37
Guarea cedreta	0.29	0.23	0.52
Hannoa klaineana	0.29	0.15	0.44
Khaya ivorensis	0.86	0.85	1.71
Lannea welwitschii	0.86	0.46	1.32
Lecaniodiscus cupanioides	0.29	0.23	0.52
Lophira alata	0.29	0.15	0.44
Maesobotrya barteri	0.57	0.31	0.88
Mareya micrantha	0.14	0.08	0.22
Milicia excelsa	0.29	0.38	0.67
Momordica angustisepala	0.43	0.23	0.66
Monodora myristica	0.86	0.77	1.63
Musanga cecropioides	0.14	0.08	0.22
Myrianthus arboreus	0.14	0.08	0.22
Omphalocarpum ahia	0.29	0.15	0.44

Appendix 7 *continued*

Species	NCS	NP	RI
Parinari excelsa	0.14	0.08	0.22
Pentaclethra macrophylla	0.14	0.08	0.22
Petersianthus macrocarpus	0.14	0.23	0.37
Piptadeniastrum africanum	0.29	0.23	0.52
Pycnanthus angolensis	0.43	0.23	0.66
Ricinodendron heudelotii	0.57	0.54	1.11
Salacia debilis	0.29	0.15	0.44
Spathodea campanulata	0.86	0.77	1.63
Tabernaemontana africanus	0.57	0.54	1.11
Terminalia ivorensis	1.00	0.69	1.69
Theobroma cacao	0.57	0.31	0.88
Tieghemella heckelii	0.14	0.08	0.22
Treculia africana	0.29	0.15	0.44
Trichilia monadelpha	1.00	0.69	1.69
Trichilia prieuriana	0.14	0.08	0.22
Xylopia quintassi	0.14	0.08	0.22

NSC=Number of Corporeal Systems treated by species

NP=Number of Properties of the species

Appendix 8: Correlation analysis between the Relative importance and phytosociological parameter values of woody medicinal plants.

Correlations: Density, IR

Pearson correlation of Density and IR = -0.102; P-Value = 0.452

Correlations: Frequency, IR

Pearson correlation of Frequency and IR = -0.192; P-Value = 0.153

Correlations: B.A, IR

Pearson correlation of B.A and IR = 0.270; P-Value = 0.042

Correlations: IVI, IR

Pearson correlation of IVI and IR = 0.146; P-Value = 0.278