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ASSESSING THE AVAILABILITY, ACCESS AND USE OF MEDICINAL PLANTS IN THE LAWRA AND NANDOM DISTRICTS OF THE UPPER WEST REGION.

BY

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DECLARATION

I hereby declare that except with the exception of references that have been cited and dully acknowledged in the study, this work is my own undertaking under efficient supervision towards the award of Master of Philosophy in the Environmental Science Programme of the University of Ghana. This work has never been presented wholly or partially in any other institution for the award of another degree.

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ABSTRACT

Medicinal plants are species of plants whose parts or whole contains active ingredients that can be used for therapeutic purposes or as a precursor for the synthesis of drugs and the efficacy of which depends on the active chemical constituents and their pharmacological effects. Despite the diverse roles played by medicinal plants species, they are constantly under threat due to factors such as habitat loss and destruction, land use, land cover changes from agriculture and forestry, fragmentation and degradation, bush burning and wild fires, direct impacts of economic activities and the influx of invasive species.

A study to assess medicinal plants and their alternative uses, their access and the collection practices in the Lawra and Nandom districts is reported here. The study further ascertained parts of medicinal plants mostly collected, rate of collection and sources of acquisition and the impacts of medicinal plants on livelihoods and their marketability in the Lawra and Nandom district, factors that threaten their availability and evaluate the threats to medicinal plants.

Households were randomly sampled in four communities under the Lawra and Nandom district of the Upper West Region involving a sample size of four hundred people. The study design employed questionnaires administered within the individual households. Focus group discussion was conducted in two separate communities.

Medicinal plants as an ecosystem service is the primary source of treatment for diseases in the Lawra and Nandom districts. Malaria is the commonest disease treated by the use of medicinal plants. In the course of treatment, diverse species of plants including *Azadirachta indica, Mangifera indica* and *Carica papaya* are used in the treatment. Aside the treatments of diseases medicinal plants also serve as fuel in the communities under study.

There are more medicinal plants available in the Lawra district than the Nandom district. No planning precedes the collection of medicinal plants in both districts. A practice that leaves much to be desired as it contradicts WHO recommendation for the collection of medicinal plants. The major source of acquisition of medicinal plants in both district are farms and the wild.

The leaves of the plants are the plant parts mostly collected for treatment, purposes which when effectively controlled won't be much of a problem to biodiversity but with overexploitation and impacts of semi-arid climate matters could be worsened as most plants may not survive the harsh weather conditions or could adapt by changing their phytochemical properties. Cultivation of medicinal plants in the two districts is very limited to the planting of trees of therapeutic potentials around homes of respondents.

Medicinal plants augment living conditions of respondents as they save money and time. Biodiversity is enhanced by traditional laws meant to protect various locations such as farms, places of worship and cemetery against bush burning, road construction and farming activities.

Medicinal plants are available, accessible and are utilized primarily for treating ailments and alternatively as a source of fuel in the Lawra and Nandom districts. There is however, the need for further in-depth studies with regards to the impacts of threats on medicinal plants and their distribution.

DEDICATION

I dedicate this research to my wife, parents, brothers and sisters. Without you nothing is the same in this world. You gave me hope and increased my faith in the midst of all odds. May you read this thesis from the beginning to the end.

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This research like any other successful work done in my life couldn't have been completed without the help of the almighty God. So sincerest gratitude to Him who knows all things, does all things and sees to the success of all things.

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Furthermore, there were occasions of challenges and situations that sometimes cause one to slip or look back. In such moments my colleagues in class rendered a helping hand or shared in the predicament. Thanks brothers and sisters for making this dream come true.

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LIST OF ABBREVIATIONS

OHCHR……..……………………………. Office of the High Commission of Human Rights

WHO..……………………….…………….……………World Health Organization

GDP…………………………………………………………..Gross Domestic Product

GHAFTRAM……............ Ghana Federation of Traditional Medicine Practitioners' Association

AIDS……………………………………......Acquired Immune Deficiency Syndrome

IUCN…………………………….....…………International Union for Conservation of Nature

FAO   …………………………….…………………..Food and Agriculture Organization

UNESCO ………………….. United Nations Educational, Scientific and Cultural Organization

GACP……………………………………... Good Agricultural and Collection Practices

USD …………………………………………………….……… United States Dollar

ETP ………………………………………………………….Evapotranspiration

CHAPTER ONE

1.0 Introduction

The diversity of medicinal plants in various parts of the world is very encouraging and rewarding to traditional communities and herbal medicinal industry (Benzie, 2011). The Royal Botanical Gardens in their report titled, "The State of World's Plants", states that over 30,000 plant species have at least one documented use (Alongi, 2002). It is further stated in the report that, the largest numbers of plants with documented uses are those that have been utilized as medicines.

Over the years special attention has been drawn to availability, access and use of medicinal plants partly due to the interest in complementary medicine in industrial countries and in part resulting from the interests of the international pharmaceutical industry (Koudouvo, 2011). The Food and Agriculture Organization (FAO) of the United Nations in a paper titled "Medicinal Plants for Forest Conservation and Health Care" states categorically that, an estimated 80% of the populations of developing countries rely on traditional medicines, mostly plant drugs, for their primary health care needs (Plants, 2017). This among other factors keeps increasing the demand for medicinal plants worldwide and surprisingly, the bulk of the material traded is still from wild harvested sources on forest lands and only a very small number of species are cultivated (Mosihuzzaman, 2008).

A medicinal plant is any plant which in one or more of its organs contains substance that can be used for therapeutic purposes (OHCHR, 2015). The World Health Organization (WHO) technical report on the selection of essential drugs in 1997 also considers medicinal plants as plants with one or more of its organs containing substances that can be used for the therapeutic purposes or which are precursors for the synthesis of useful drugs (Pilon, 2016). Medicinal plants are found in vast numbers all over the world and most people rely upon the organic herbal drugs and medicines (Sheen, 2017).

Medicinal plants are reservoirs of curative elements used by a large population of Africans in the treatment of various diseases such as malaria, diabetes, mental disorders, cancer, hypertension and human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) (Okigbo, 2009). Phytochemical screenings of most of these plants have led to the discovery of several beneficial constituents such as alkaloids, tannins, saponin, and others with therapeutic potentials. Actually it was in the course of such biotic screening that the well acclaimed anti HIV drugs from plant such as *Ancistrocladus korupensis* containing the alkaloid, *michellamine* A and B was discovered (Okigbo, 2009).

The most common parts of medicinal plants used for therapeutic purposes are their roots, stem, back, leaves, fruits and flowers (Sofowora, 2013). Most often, extracts from these parts are the panacea for curing most dreaded diseases in very remote areas of the globe such as the Lawra and Nandom districts where indigenes have to walk several kilometers from their villages to get access to modern health assistance (Gautam, 2016).

The health and well-being of humans all over the world is of great priority to a particular state (UN, 2007). Healthy human resources automatically translate into high productivity, a better GDP and a better economy (ILO, 2011). Perhaps this is why successive governments allocate enormous resources to the provision of health services in Ghana (Pilon, 2016). Even though stringent measures are put in place for individuals of all walks of life to access health facilities in various parts of Ghana, it's undoubtedly evident that some communities are still deficient (Yeboah, 2008).

Most often than not such communities resort to the use of medicinal plants or traditional medicine that is cheaper, readily available and easy to use (Gyasi, 2011). The people of Lawra and Nandom districts are no exception in this regard.

Additionally according to the Ghana Federation of Traditional Medicine Practitioners' Association (GHAFTRAM), there are 45000 recognized and licensed herbalists through various associations in Ghana and they are responsible for treating 80% of the Ghanaian populace who rely on medicinal plants as a source of primary health (Imoro, 2013). The Lawra and Nandom districts like any other rural community in Ghana rely on medicinal plants for their basic health needs. The study gears towards unearthing the availability, access and use of these plants and the factors that hinder their perpetuation in the Lawra and Nandom districts.

1.1 Conceptual Framework
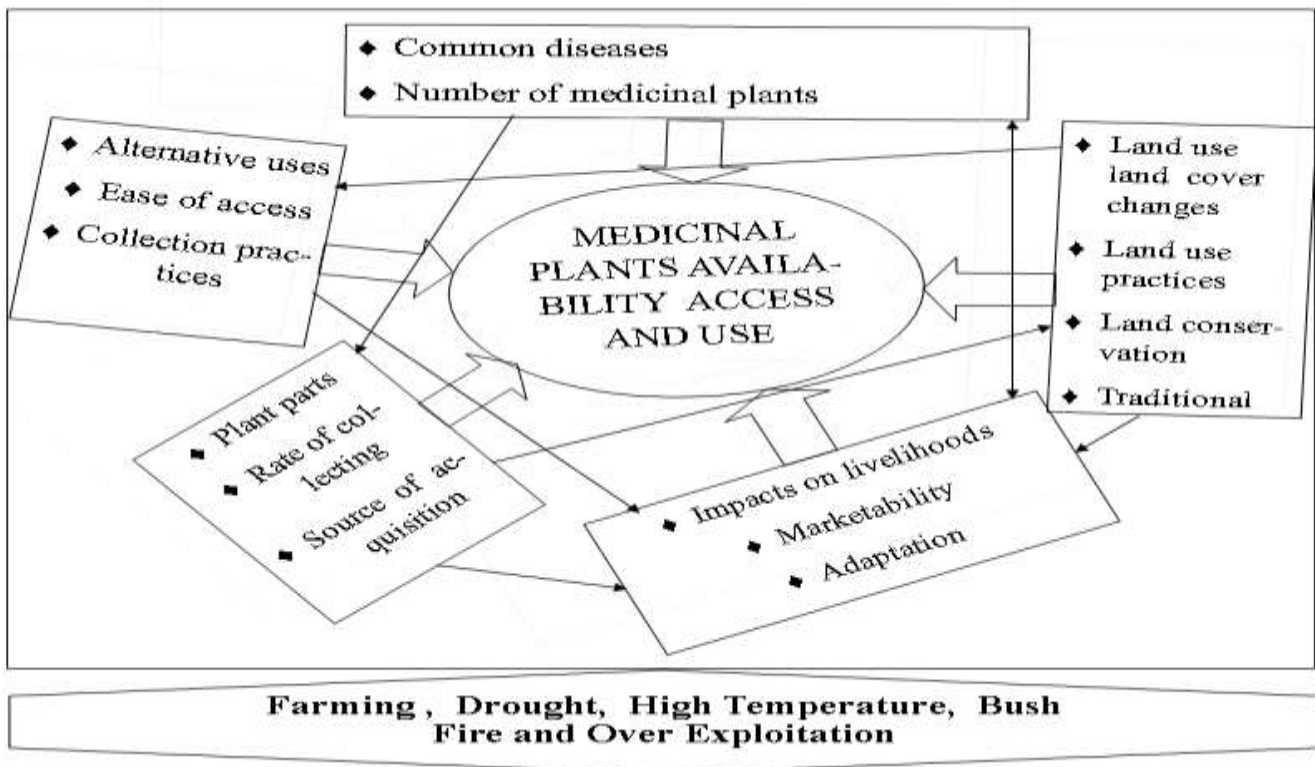
Figure 1: Conceptual framework illustrating factors affecting medicinal plant availability, access and use.

The study adopted the conceptual framework designed by Smith-Hall (2012), which illustrates with specificity the factors affecting the availability, access and use of medicinal plants at the immediate and underlying household levels.

As illustrated in the conceptual framework above, the factors influencing medicinal plants occur in diverse forms and do affect the livelihoods of indigenes directly or indirectly. The immediate causes which are the causes that closely precede the availability, access and use of medicinal plants in the study are: common diseases, number of medicinal plants used, alternative used, ease of access and what have you, affect medicinal plant availability, access and use directly and indirectly.

The underlying causes are those that take so many years to manifest and are represented in the framework by farming, drought, high temperature, bush burning and over exploitation.

1.2 Problem Statement

Research on medicinal plants has been going on for quite some time now in Ghana. A study by Witol (2010) looked at the sustainability and use of medicinal plants in the Upper West region of Ghana. Similar works done by Imoro (2013) concentrated on the identification of various species and the provision of their scientific names. In most of these studies however, the scope of subjects under study were limited to traditional herbalist or key informants in the study area.

Despite the important functions played by plants of diverse species such as the provision of food, shelter, medicine, clothing, fibre, fuel and more importantly the air we breathe in, plants especially those in the wild are constantly under threat due to factors such as habitat loss and destruction, land use, land cover changes from agriculture and forestry, fragmentation and degradation, bush burning and wild fires, direct impacts of economic activities and the influx of invasive species (Silva, 2008).

The over exploitation of medicinal plants all over the world has kept the survival and perpetuation of most species under threat (Alves, 2007). Coupled with other anthropogenic practices such as bush burning, cultivation of land for agricultural purposes, erosion, drought, other land use, land cover changes, the non-sustainable collection of medicinal plants leaves so much to be desired especially in rural areas where survival of community members depends to a large extent on the ecosystem provisions including medicinal plants.

The people of Lawra and Nandom to a large extent are farmers. Communities under these districts rely so much on ecosystems services provided by medicinal plants for their health needs. With the effects of harsh weather in semi-arid areas like the Lawra and Nandom districts, poverty and the dry seasonal occurrence of bush burning the services provided by medicinal plants cannot be sustained and this could affect the lives of people.

Aside other climatic variables, the major bone of contention with regards to threat to the availability, access and use of medicinal plants among community members are land use, land cover changes emanating from agriculture and forestry projects, degradation of the land and more prominently wild fires and bush burning (Redford, 2008). With the effects of the above factors, the availability, access and use of medicinal plants in the Lawra and Nandom district is of eminent concern to the rural people.

1.3 Justification of the Study

Data concerning the availability, access, use of medicinal plants and the factors that influence these seem inadequate in Ghana. It is therefore prudent that such a study is conducted in diverse locations of the country to ascertain the true situation on the ground. More importantly, the study was not limited to herbalist or key informants as in the case of Imoro (2013) and Witol (2010) but extended to the

household level so as to enable individuals who benefit from the use of medicinal plants bring out their inputs.

Actually it is presumed that with the threats to availability, access and use of medicinal plants, the extinction of medicinal plants and medicine men which presents a more hidden health risk to both developing countries and industrialized societies is eminent (Kiringe, 2005). It's in the light of this and the quest to provide more sustainable measures to the hazards of over exploitation, poor collection practices and excessive land use land cover changes that this research was carried out.

1.4 Main Objective

The main objective of the study was to assess the availability, access and use of medicinal plants in the Lawra and Nandom districts of the Upper West Region.

1.4.0 Specific Objectives

The specific objectives are the following:

1. To identify common ailments and the medicinal plants used to treat them in the traditional and orthodox medicine.
2. To assess alternative uses of medicinal plants, their access and the collection practices employed in the Lawra and Nandom district.
3. To determine medicinal plant parts mostly collected the rate of collection and sources of acquisition in the two districts.
4. To ascertain the impacts of medicinal plants on livelihoods and their marketability in the Lawra and Nandom district.
5. To determine factors that threaten the availability of medicinal plants in the Lawra and Nandom districts.

CHAPTER TWO

2.0 Literature Review

The use of medicinal plants as food, curative and preventive medicinal preparations for humans and livestock can be traced several centuries ago (Lulekal, 2008). Commoner cases in point are the documented early history from 5000 to 4000 BC in China, and 1600 BC by Syrians, Babylonians, Hebrews and Egyptians (Lulekal, 2008). In these earliest times, very little was known about medicinal plants, the constituents that made them so important to man was not known and not much scientific study had gone into the use of medicinal plants (Ekor, 2014). Though orthodox medicine has advanced tremendously the use of medicinal plants and the importance they play in orthodox, traditional and herbal medicine is enormous and has come to stay (Pan, 2014).

In the paper titled, Medicinal Plants for Forest Conservation and Health Care, the Food and Agriculture Organization (FAO) states that "In recent years, there has been a growth of interest in traditional medicine, in partly driven by the interest in complementary medicine in industrial countries and also from the interests of the international pharmaceutical industry (Bodeker, 1997).

The competing claims of usage of medicinal plants from the global to the local and rural household level put pressure on the livelihoods of local communities all over the world. The livelihood of local community dwellers is therefore of utmost importance as researchers try to intervene in the ever

increasing attraction to medicinal plants access, use and availability within the private and public sector as well as development project implementers (Joshi, 2014).

The attempt to quantify the effect of medicinal plants on the livelihoods of rural folks especially in developing countries hasn't been that successful as most activities surrounding the availability, access, use and consumption patterns are not efficiently documented and shrouded in secrecy to the benefit of multibillion pharmaceutical companies around the globe (Gautam, 2016). This is because, overexploitation of medicinal plants though an extra source of income to most rural folks around the globe is marginal and rather puts the survival such of medicinal plants species in danger. When medicinal plant species are depleted, the immediate effect would be on the rural community dwellers and not the pharmaceutical companies because medicinal plants serve their immediate primary health needs.

The five main livelihood capitals as stipulated by Joshi (2014) are: Human capital, Social Capital, Physical Capital, Natural Capital and Financial Capital - the impacts of medicinal plants on all of these is undoubted in the livelihood and welfare of both developed and developing nations around the globe. Globally the human capital of every nation is sustained by a vibrant and healthy working force. Most rural communities in Ghana are peasant farmers and they mostly go to work with very bizarre circumstances in terms of the farm implements used and the dangers and hazards of the environment. However by the use of medicinal plants to keep them healthy, they save time and money in search of orthodox treatment.

2.1 Medicinal Plants

Of course various definitions of medicinal plants exists in literature, for instance in the study titled, "Drug Discovery from Plants", it is opined that, medicinal plants are species of plants whose parts or whole contains active ingredients that can be used for therapeutic purposes or as a precursor for the

synthesis of drugs and the efficacy of which depends on the active chemical constituents and their pharmacological effects (Salim, 2008). It is therefore practical to say that, it is the constituents of these plants that make them medicinal, even though in some cases almost every part of the plant has diverse benefits medically.

The term medicinal plants as used in the European Red List for Medicinal Plants refers to herbal teas, spices, food, dietary supplements, and cosmetics (Allen, 2014). The inclusion of overlapping uses of medicinal plants is globally accepted in the definition of medicinal plants as it aides in avoiding the fixed focus of medicinal plants with modern pharmaceutical application.

The study conducted by Salim (2008) emphasized that, the plant constituents which make them medicinal are largely the secondary metabolites, which are derived biosynthetically from plant primary metabolites i.e., carbohydrates, amino acids, and lipids, and are not directly involved in the growth, development, or reproduction of plants. The study further reiterates that the secondary metabolites referred to, can be classified variably into classes like alkaloids, terpenoids, and phenolics. Though, this is true and efficiently proven, enormous roles played by other parts of medicinal plants such as fibre and others which play significant role in the growth and perpetuation of various plants, need recognition as well.

In a study, Wink (2011) states that, most secondary metabolites are important for the wellness of the plant producing them, in that they serve other purposes like producing defense compounds against microbes, competing plants and herbivores – in some instances too, other functions such as signal compounds which attract various pollinating and seed-dispersing animals is usually noticed. In addition to this Muanda *et al*, (2011) also stated in their article that, phenolic compounds including flavonoids are important in plant defense mechanisms against invading bacteria and other types of environmental stress. To a large extent too, most natural products have multiple functions so to conclude that secondary

metabolites do not play direct role in the growth of medicinal plant leaves much to be desired (Pandey, 2009).

Defense is a mechanism exhibited by most species of the wild to protect themselves against predators, thus the exercise of defense mechanisms by plants of all species through secondary metabolites needs much recognition and also an area that needs in-depth study (Wink, 2011). Additionally plants produce a high diversity of natural products or secondary metabolites with the prominent function of protection against predators and microbial pathogens on the basis of their toxic nature and repellence to herbivores and microbes and some of which also are involved in defense against abiotic stress (e.g. UV-B exposure) and also important for the communication of the plants with other organisms. This is to confirm that, though defense mechanism may not plant direct involvement in the growth of plants they are very much essential like any other function related to growth (Vicente, 2011).

The various parts of medicinal plants are not different from any other plant. However with regards to medicinal plants, these parts contain phytochemical compounds that make them unique for medicinal purposes. Thus the roots, back, stem, leaves, flowers, fruits and seeds of any medicinal plant are embedded with flavonoids, alkaloids, phenols, carotenoids, polyphenols, terpenes, glucosinolates, isothiocyanates and many others which all have diverse benefits (Pengelly, 2004). These compounds are formed through series of biosynthetic with the assistance of specific enzymes into other forms, often unstable intermediate compounds, until finally a complex, stable macromolecule is formed.

2.2 Uses of Medicinal Plants

The World Health Organization (WHO) monographs on selected medicinal plants categorizes the medicinal uses of these plants into three: firstly those uses supported by clinical data and includes medical indications that are well established in some countries and have been validated by clinical

studies documented in the scientific literature - secondly uses described in pharmacopoeias and well established documents and includes medicinal uses that are well established in many countries and are included in official pharmacopoeias or governmental monographs – the third category being uses described in traditional medicine and refers to indications described in unofficial pharmacopoeias and other literature, and to traditional uses (Pan *et al.*, 2014).

Selected plants have been used empirically as drugs and food supplements for quite some centuries now – initially they were used as traditional preparations but with latter technological advancement as pure active principles – in recent times, there have been a renewed interest from the Western world in herbal medicines and the increasing agency to develop effective drugs has made the use of medicinal plants in the pharmaceutical and scientific communities, the Centre of attention (Taylor, 2001).

The use of herbal medicines represents approximately 40% of all healthcare services delivered in China while the percentage of the population which has used herbal medicines at least once in Australia, Canada, USA, Belgium, and France is estimated at 48%, 70%, 42%, 38%, and 75%, respectively (Foster *et al.*, 2003). Before the eighteenth and nineteenth centuries it was usually a normal practice to find medicinal plants in the lawns and gardens of most families in Europe. In Japan, there is enormous evidence that, herbal medicinal preparations are in very high demand than pharmaceutical drugs (Bukar, 2016).

The abuse of antibiotics and other important drugs meant for curing deadly diseases such as tuberculosis, AIDS etc. has rendered most orthodox drugs ineffective, so the world is presently in dying need of antibiotics and other drugs of importance. Thus plants with medicinal properties and believed to potentially provide the way forward in treating ailments such as: stomach disorders, fever, nausea,

vomiting, piles, cancer, arthritis, diabetes, dysentery, diarrhea, jaundice, cuts and wounds, asthma, typhoid, bronchitis, kidney and bladder stones, leprosy and various other diseases (Tizazu, 2006).

Africa bears a long history of people plant interaction but the documentation of Africa's medicinal plants started with the arrival of European colonists (Nigro, 2004). The use of medicinal plants is still alive in Africa (Malan, 2015). In most rural communities of Africa, medicinal plants are harvested from the wild to treat all manner of ailments. Current estimates suggests that most remote communities in Africa depend on medicinal plants for primary health care (Bukar *et al*., 2016). Additionally its was observed by Maliwichi-Nyirenda *et al*, (2011), that the number of traditional practitioners in Tanzania who rely on medicinal plants as primary source of ingredients for treatment, were 30, 000 to 40,000 as compared to the 600 orthodox medical doctors. Similarly in Malawi, Zalzal *et al*., (1987), expresses the essential need for the use of medicinal plants in alleviating ailments as its confirmed in their work that, 17,000 traditional medicinal practitioners as compared to 35 medical doctors practice in the country.

Research works like that of Bukar *et al*., (2016) attests to the use of medicinal plants diversely such as: *Phytolacca dodecandra* in the control of schistosomiasis, *Catharanthus roseus* as an antitumor agent and *Ricinus communis* among others as a laxative. African countries such as Botswana, Lesotho, Namibia, South Africa, Sudan, Egypt, Cameroon, Nigeria, Rwanda and many others are all associated with special medicinal plants for treatment of diverse ailments as well as exporting to the international community periodically.

Most rural folks in Ghana used some medicinal plants for centuries until they are scientifically proven to be potential curative measures for diverse forms of diseases. A typical case in point is the use of boiled moringa leaves, mixed with koose (spicy baked beans) in the Upper West Region and commonly eaten

on market days and homes for decades. Until the laboratory work on moringa was done to confirm its medicinal constituents, it had always been consumed in Ghana as food.

Medicinal plants are noted for their enormous overlapping uses as herbal teas, spices, food, dietary supplements, and cosmetics (Allen *et al*., 2014). Additionally, based on screening results and analysis of several medicinal plants by Köhler (2002), *Microglossa pyrifolia* was adjudged among others as one of the most potent antimalarial plant and the extracts of which are also used for treating abdominal pains, rheumatism, diarrhea in Ghana. The leaves of *Cassia occidentalis* are used in the treatment of malaria in Ghana as well (Malan, 2015). Other plants noted for their medicinal properties and used by rural folks in Ghana for treating various ailments include: yellow berry extracts for jaundice, shea butter for fractures of the bone, mushrooms for fibrous and stomach ailments and the lists goes on.

2.3 Phytomedicines

Phytomedicines or drugs made from the use of medicinal plants mostly include crude vegetable drugs (herbs) and other galenical preparations (extracts, fluid extracts, semisolid extracts, powdered extracts, tinctures etc.) which according to a study made by Taylor *et al*., (2001) are categorized into complex mixtures containing wide varieties of compounds e.g. infusions, essential oils, tinctures or extracts and those used as pure chemically defined active principles. According to an article by Shawn *et al*., (2011) herbs refer to plants that dies back to the ground each year without forming woody stem tissue – they include plants that have culinary, medicinal, aromatic, or ornamental uses, some of which form woody stems.

In a paper titled "Medicinal Plants For Forest Conservation and Health" Bodeker (1997) elaborates the potentials of medicinal plants by their ability to be isolated into pure active compounds for formulation

into drugs like quinine, reserpine, digoxin etc. - isolate intermediates for the production of semi-synthetic drugs and for the preparation of standardized galenical (extracts, powders, tinctures, etc.).

2.4 Alternative Uses of Medicinal Plants

Aside the uses of medicinal plants which is the centre of attention of the global community; there are other alternative uses of medicinal plants that are worth mentioning when assessing the availability, access and use of medicinal plants. In Australia, medicinal plants such as *Thymus vulgaris, Origanum vulgare* serve as food and by its bacteriostatic effect, is used as dry matter directly which is increasingly important for the large number of farmers using organic/biodynamic methods in Austria (Lipman, 2009).

The European Red List for Medicinal Plants asserts that about 350 plants have been determined for multiple uses like food, establishing ex-situ production, horticulture, animal feed, construction and structural materials, manufacturing chemicals, fuels, handicrafts and jewelry, poisons, research and other accessories (Allen, 2014). One prominent and common medicinal plant species in Europe as confirmed by Allen (2014) is *Veratrum album*, which has principally been used in orthodox medicine – aside this, there is the extensive use of the pulverized roots this plant species as an insecticide on currants and gooseberries in Europe and occasionally as an ointment to treat skin diseases such as scabies or to kill lice.

Plants, especially those of medicinal value, cannot be established without reference to their role in traditional worship and rituals in Africa. In some parts of Africa various plant species are believed to possess magical powers and are therefore used for the spiritual health of rural folks, getting rid of witchcraft and other mishaps, appeasing the gods and ritual burial practices (Myren, 2011). Sacred groves or small areas of lands mostly biologically diversified and ear marked by local indigenes, and

religious bodies for worship are wide spread in Africa. Late these areas have become are centers of attention for research in plant medicine (Ray & Ramachandra, 2010).

In Ghana extracts of plants such as the neem tree *Azadirachta indica* products, have consistently been used variously as antifungal and antibacterial products in the field of agriculture. Additionally, its wood products serve as construction materials for building local houses. In an article written by Imoro *et al* (2013), stated that, medicinal plants are regularly exploited for feeding livestock and in some cases, serves as firewood in the kitchen.

Another essential use of medicinal plants in Ghana is in the field of agriculture where these plants are applied in weed control. The term given to this practice is allelopathy and it refers to the natural interaction involving secondary metabolites or allelochemicals produced by plants, bacteria, fungi, and algae that influence positively or negatively the growth and development of agricultural and biological systems – essentially explored in sustainable weed control (Appiah, 2017). Notable among these plants in Ghana is *Azadirachta indica*. Even though most of these uses haven't been backed by any scientific underpinnings, the views of communities involved in various studies with regards to this matter needs to be respected and further enquiries made to ascertain their authenticity. In most rural communities in Ghana, medicinal plants contribute to the daily needs of individuals by serving as food, spices, oil, beverages, pesticides, animal feed, firewood, construction materials and ritual practices.

2.5 Medicinal Plant Parts Uses

Various parts of plants used as medicines are chosen based on the level of concentration of a particular phytochemical. Whilst roots of some plants are used in some cases – others require the use of the back, fruits, seeds etc. According to Vidyarthi (2013) different plant parts, such as leaves, roots, tubers,

seeds, fruits, flowers, fruiting body, bark, stems, and wood are frequently used for the treatment of ailments.

Various parts of plants produce secondary metabolites in enormous quantities. It is common to find the same secondary metabolite such as alkaloids in different plant species, a situation explained as species of plants sharing some genetic relationship in the past. A typical feature of secondary metabolites is storage of complex mixtures in relatively high concentrations, sometimes in organs which do not produce them (Wink, 2011). It is therefore essentially required that the specific part of the medicinally plant containing the particular phytochemical is identified and isolated for use.

Generally it is asserted that, each part of a medicinal plant is responsible for treating particular ailments, thus the roots, back; fruits or leaves could be the essential requirement for a particular treatment. It is also common to find individuals mixing various parts such as roots and leaves, back and fruits etc. for a particular treatment (Doughari, 2009). This implies that, the phytochemical in the roots or some other parts of some medicinal plants are the only medicinal constituents of that plant. It's however not a general phenomenon, for instance in the case of *Moringa oleifera* every part of it, from the roots to fruits, flowers and seeds are medicinal.

Though the identification of the specific part of the medicinal plant of concern should be the center of attention, it does not apply to all medicinal plants. For instance taking the photochemistry of *Moringa oleifera* as an example, the stem is reported to possess phytochemicals such as: alkaloids, Vanillin, β-sitosterol, β-sitostenone and 4-hydroxymellin – gum has been associated with: L-arabinose, -galactose, -glucuronic acid, and L-rhamnose, -mannose and –xylose – the flowers is said to contain: sucrose, D-glucose, traces of alkaloids, wax, quercetin and kaempferat (Cruz-Vega *et al*., 2009). No wonder it is known as the wonder plant. So it's essential to know that, most often more than a single part of a plant

could be found possessing medicinal properties that can be of utmost importance (Smith-Hall *et al.*, 2012).

2.6 Arid and Semi-Arid Regions

It has been observed over the last few years that, nearly half of the world is facing issues related to aridity. Encouraged with the vision of alleviating the suffering of people within these localities numerous scientific researches have been conducted within these regions (Landforms & Processes, 2017). Various methods have been used to categorize or classify the arid and semi-arid areas of the globe, notable among them and the most widely and commonly used is the climate classification schemes which range from those employing biophysical factors, such as precipitation, temperature and vegetation type, to classifications based on the movement of distinct atmospheric air masses or incoming solar radiation, through to schemes that classify climate by regional vegetation and soil types (Leech, 2014).

UNESCO delineated four main classes or degrees of aridity that is commonly used by climatologist and biologist to correspond to major geographic categorization. With the letter P for precipitation in the areas of concern and ETP for evapotranspiration, the categorizations are as follows: hyper-arid zones (P/ETP<0.03) , arid zones (0.03<P/ETP<0.20), semi-arid zones (0.20<P/ETP<0.50) and sub-humid zones (0.50<P/ETP<0.75) but for the purpose of this study two are of utmost importance – that is arid zone (0.03 < P/ETP < 0.20) which are characterized by a scattered vegetation, bushes, mall woody, succulent, thorny or leafless shrubs, annual rainfall of 80-150 mm and 200-350mm and interannual rainfall variability is 50 to 100 percent – the other is the semi-arid zone (0.20 < P/ETP < 0.50) also characterized by: savannah and tropical scrub, rainfall variability, variable mean annual rainfall between 300-400mm and 700 or even 800mm in the Mediterranean and an inter annual rainfall variability between 25 and 50 percent in the tropical latitudes (Sheen, 2017).

Other distinctive characteristics notable and worth mentioning in relation to arid and semi-arid areas are widely-spaced and highly-specialized vegetation, alkaline, rocky and sandy soils, interior or non-existent drainage, dust storms and irrigation agriculture and the one upon which all the others depend, the level of temperature and precipitation (Leech, 2014).

The world is experiencing a drastic change in climate variables such as temperature, precipitation and rainfall. Studies conducted by Das (2016) in arid and semi-arid regions such as India suggests varying effects of these climatic changes on medicinal plants. This was well investigated by Datta (2013), who concluded that, in combination with elevated temperatures, decreased precipitation could cause reduction in availability of irrigation water and increase in evapotranspiration, leading to severe crop water-stress conditions. The frequency and intensity of extreme weather in Africa is predicted to increase as a result of climate change (Africa, 2009). With rainfall pattern as low as 100mm/year, drought is already permanent in countries such as Algeria, Egypt, Libya, Mali, Morocco, Mauretania, Niger, Sudan, Chad and Tunisia (Torres, 2015). Hence, the need for alternative measures of sustaining the availability, access and use of medicinal plants is of utmost importance to rural folks under arid and semi-arid zones of the Africa.

The dry land areas in Ghana are located within the northern and upper regions. The Nandom and Lawra district are located within these dry land areas popularly known as the Guinea Savannah with characteristic features such as short grasses, few woody plants, drought and fire resistant trees such as baobab, dawadawa, shea trees and acacia.

In Ghana the semi-arid areas under which this study was conducted are the Lawra and Nandom districts (Bizikova, 2012). Such localities are characterized by dry lands, widely – spaced highly specialized vegetation, alkaline, rocky and sandy soils, interior or non-existent drainage, dust storms and irrigation agriculture. More prominent within these localizations is the reduced precipitation in the form of rainfall

which has been confirmed by an analysis of Northern Ghana climate patterns in the last sixty years (Amikuzuno, 2012).

There is no much information within the guinea savannah region of Ghana to suggest and confirm that the availability, access and use of medicinal plants are at threat because of changes in climatic variables. Ghana experiences two seasons each year, the rainy season is marked by farming activities and green vegetation all around the northern belt. In the dry season however, almost every grass and the lesser plants dry up. Dealers in medicinal plants around these areas have only suggested increase in distances to find plants needed for their businesses but it hasn't been scientifically proven whether the hash whether conditions really has got to do with absence and availability of medicinal plants (Imoro *et al*., 2013).

2.7 Access to Medicinal Plant

Access as used here means the ease at which dealers and users obtain medicinal plants for use. As at the moment there exists very little efforts in most parts of the globe towards the cultivation of medicinal plants, for this reason a large chunk of medicinal plant products found in the global market are sourced from the wild (Sofowora *et al,* 2013). With decreasing availability of indigenous resources and the introduction of new species, socioeconomic transformation, indigenous knowledge effacement and climate change it's becoming more difficult than ever to access medicinal plants easily (Kunwar *et al*., 2016).

In Africa, a study conducted by Malan (2015) states that, some medicinal plants are easy to come by but others are scarce or no longer found in the region. Globally the African continent contributes about twenty five percent (25%) of the world trade in biodiversity (Com, 2010). In as much as the percentage may look insignificant especially when compared to other regions of the world, the situation on the African continent is compounded due to the lack of documentation and the illegal paths of medicinal

plant   trade   (Room*etal*,2015).
The African continent has been encouraged to develop a monograph on their medicinal plants; coupled with this and other national documentation the issue as to difficulty in accessing medicinal plants at the local level can be best determined (Kala *et al*, 2006).

In Ghana the MOH (2014) in an annual report stated that, access to medicinal plants has not been smooth in recent times mostly due to anthropogenic activities such as agriculture, indiscriminate bush burning, deforestation, over grazing, over exploitation, indiscriminate harvesting etc. Undoubtedly, there is enough evidence to suggest that in the midst of these practices, medicinal plants and other plants in general could be threatened in diverse ways (Chen *et al.*, 2016). However, in the midst of this conundrum, difficulty in access has only been expressed in various studies as the distance travelled by say herbalist before obtaining a particular species of plant and not the actual absence of the species (Roy & Roy, 2016). Therefore, the study on the availability, access and use of medicinal plants threw more light in this area and also delved into in depth discussion and analysis at the household level.

2.8 Collection Practices of Medicinal Plants

The indiscriminate collection of medicinal plants is a practice which does not only threaten the survival and perpetuation of most species but a factor widely accepted in most ethno botanical surveys as a cause that could lead to the extinction of most medicinal plant species.

Apart from the health related recommendations associated with the collection of medicinal plants, the WHO has guidelines on good agricultural and collection practices (GACP) for medicinal plants which recommends that, collection practices should ensure the long - term survival of wild populations and their associated habitats, therefore management plans for collection should provide a framework for

setting sustainable harvest levels and describe appropriate collection practices that are suitable for each medicinal plant species and plant part used (roots, leaves, fruits, etc.) (WHO, 2003).

Africa remains transfixed in a high fertility/high mortality syndrome that scars and puts pressure on living standards generally (Xiao, 2015). In the study conducted by Nishteswar (2014) the importance of good collection practice is well stated that, climate, temperature, rain fall, day light requirement, altitude, methods of cultivation, effect of lunar cycle, collection from wild area, soil condition and methods of collection, processing and storage have impact on the secondary metabolites of the plant and ultimately have effect on the therapeutic efficiency of the drug. It therefore implies that for maximum efficacy from the phytochemical properties of a medicinal plant, the collection practice, time of collection and other factors mentioned above must be seriously considered (Pan, 2013).

The study further enlightens that there are various collection practices of medicinal plants however, the most destructive and one that serves as a threat to the survival of various species is destructive harvesting, that is harvesting the whole plant with the roots, bark, stem, leaves, and flowers. The author emphasized that approximately more than 90% of the species are used in trade and continue to be sourced from the wild of which about two third are harvested by destructive means leading to rapid decline in the availability of many medicinal plant species. There is little work available with regards to collection practices of medicinal plants in Ghana, however traditionally practices by rural dwellers such as consultation of the gods and ritual practices before searching for species of plants in the wild is very common in most rural communities.

In other countries like China, Great Britain and the United States, before an individual enters the wild to collect medicinal plants, permits and other documents are issued by government authorities and the traditional land owners (Malik, 2010). This is an important practice absent in most areas of Ghana especially the arid and semi-arid regions where climate variations is more prominent. Notable adherence

to such rules and regulations are mostly associated with the protected zones in Ghana such as: the Kakum National Park, the Mole Wild Life Reserve. However if dealers from all walks of life conscientiously pay heed to such important laws, it will go a long way to improve and enhance biodiversity and tremendous perpetuation of medicinal plant availability in Ghana.

2.9 Marketability of Medicinal Plants

Marketability of medicinal plants as used in the study refers to the sale and purchase of medicinal plants between individuals in communities within the Lawra and Nandom districts of the Upper West Region. With reference to the 2003 WHO report, 30% of pharmaceuticals sold worldwide contained compounds derived from plant materials as global sales of herbal products totaled an estimated sum of 600 million USD in 2002 (Bukar, 2016). Actually the global market for plant-derived chemicals such as pharmaceuticals, fragrances, flavours, colour ingredients and many others is estimated at US$800 million per year (R. Singh, 2015). Other researchers such as Sofowora (2013) estimated the global market value of medicinal plant products to be exceeding $100 billion per annum.

It is further stated by Bodeker (1997) that, the international trade in medicinal plants is now a multi-billion dollar industry and local harvesting patterns have shifted from sustainable local harvesting to commercial gathering without regard to the regeneration of species for future yields. Additionally Asia's herbs feed Europe's need for herbal medicines while America's stocks of native ginseng are dwindling due to demand in Asia (Ekor, 2014). Recently Bulgaria, Germany and Poland came in the limelight of the export of medicinal plant products – in Germany for instance over 1500 plant species from 200 families and 800 genera have been processed into medicinal products (Bukar, 2016).

A new precedence has been set in the world towards the exploitation of medicinal plants where most activities are clandestinely conducted so as to gain more profits by giant international companies at the

expense of the well-being of local indigenes as their environment get degraded and alternatives forms of livelihoods are depleted. As recommended by the WHO, all countries need to develop policies and standards to regulate the exploitation and trade of medicinal plants so as to avoid another mass extinction.

The pioneers of medicinal plant trade until now are the European Union and a few countries such as China and India who have well established quality control measures and have developed regional and national guidelines for good agricultural and collection practices for medicinal plants (WHO, 2003). By virtue of this such countries are making billions of dollars through the production and export of medicinal plants. In expressing the predicament about medicinal plant market in India, Ved (2007) reported that, the sheer magnitude of the people using plants for health care (about 70% of the country's population) and the diversity of plant species used in these practices make the assessment of demand and supply of medicinal plants in the country a complex affair. Thus for the country to effectively harness the potentials of medicinal plants, effective control within the sector with the requisite laws and policies needs to be implemented.

Demand for herbal medicines in the North and expanded demand for medicinal plants in national and international health care has led to significant changes in traditional patterns of medicinal plant harvesting and, as in the case of *Prunus africana* in Cameroon that placed some species under threat (Bodeker, 1997). In South Africa, over 500 species of medicinal plants have been commercialized (R. Singh, 2015). This affirmation by Ekor (2014) work explains the extend at which pharmaceutical companies are relying on medicinal plants for their operations and further heightens the intensity at which exploitation of plant materials ongoing in Africa.

Medicinal products collected can have very high value in the final products like: antibiotics and antiretroviral drugs, however most rural collectors in Africa typically receive only a small share of the processed drugs, either because they are unaware of the real value or are unable to market it in the form wanted by buyers or are unable to market to these buyers (FAO, 2005). More so the fact that most rural communities in Africa sell medicinal plants with little or no processing enhances the effect of climate change on the availability, access and use of these plants because, they are easy to retrieve from the wild and passed over to producers of pharmaceutical drugs with little cost (Hall, 2012).

Medicinal plant trade or marketability of medicinal plants in Ghana have been tackled by various researchers but prominence goes to Van Andel *et al*, (2012). In their study on Ghana's Herbal Market they demystified the mysteries surrounding medicinal plant trade in Ghana. In the study, it was estimated that approximately 951 tons of crude herbal medicine were sold at Ghana's herbal markets in 2010, with a total value of around US$ 7.8 million - 20 to 30% of the Ghanaian medicinal flora was encountered during this survey (Van Andel et al., 2012).

Additionally, the study conducted by Smith-Hall *et al*., (2012) showed that in the year 2012 the most sold medicinal plant species in Ghanaian markets were *Xylopia aethiopica, Monodora myristica* and *Aframomum melegueta*. Though these percentages do not reflect the true situation in the whole Ghana because of the sample size and the limited scope, the writers suggested for further study to be conducted around the area, due to the absence of data especially with regards to those exported, it was well established that, huge amounts of money is involved in this trade, so the need for good regulatory and policy directions so as to control over exploitation of medicinal plants.

2.1.0 Effects of Land Use Land Cover Changes on Medicinal Plants

Ecosystem services referred to as the benefits man enjoys by using the natural resources of the ecosystem just as in the acquisition of medicinal plants for treating ailments and supporting livelihoods more often than not, is altered by anthropogenic activities and even within areas under conservation and protection, the threat mostly looms as visitors with diverse interests interact with flora and fauna to the detriment of biodiversity (Tangarife, 2017).

Mankind's quest for improved well-being has resulted in continuous pressure to transform landscapes, with the said transformation driven by land use changes, urbanization, production activity, and protective measures in addition to climate variability and other environmental drivers (Tangarife, 2017). Land has been altered severally for the survival of the human population and in many occasions, it is these anthropogenic activities that further expose the environment we so cherish to various forms of heinous destructions.

Several anthropogenic activities and drivers, such as forestry plantations, mining, agriculture and urbanization, directly and indirectly transform landscapes. Two of the most extensive drivers of landscape changes are firstly, the demand for primary and secondary housing and secondly the expansion of the forestry and agricultural industries (Swann, 2013).

Presently the commonest source of medicinal plants in most indigenous localities around the world is the wild. Medicinal plants from the wild are cheaper and for the rural folks they have access to plant materials as and when they are need. However, in some cases the practices of rural community dwellers such as increasing commercialization of agricultural lands puts the survival of such important plants at risk.

It's significant and indeed prudent to mention that, land conversion to agriculture in East Africa has outpaced the proportional human population growth in recent decades Lanz (2016) and this trend is very peculiar in countries such as Kenya, Tanzania and Uganda where its feared that the impacts of land use land cover changes could lead to changes in biological diversity, soil degradation and the ability of biological systems to support human needs. A very obvious feature in this assertion, that can be easily verified by mere observation is the presence of more trees and shrubs on uncultivated land than cultivated areas (Berg, 2006).

Additionally, Woldeyohannes (2018) in a study realized that, the destruction and fragmentation of shrub land and natural grassland led to the decline of wild plants and animals previously prominent in the basin.

In Ghana, estate developers have taken over several acres of land in the capital, lands previously used for vegetable farming have been converted into residential areas (Nchanji, 2017). There are similar complaints from various regions of the country, notably among them in recent times is the illegal exploration and destruction of natural resources so as to acquire gold.

Another impending disaster that has greatly changed the land scape and possesses numerous threats to biodiversity and the sustainability of medicinal plants in the West African Sub Region is the rearing of cattle. Cattle rearing is a very lucrative business in Ghana, however the inability of government to set up ranches and officially demarcate grazing sites have led to over grazing and destruction of farms along cattle paths. Not only do they destroy farms Asase (2017) emphasizes that biodiversity and especially medicinal plant are destroyed as well.

It is further important to mention that, not only is land use and land cover changes a threat to biodiversity and for that matter, threat to availability of medicinal plants, planting methods and other

farming systems such as mixed farming, vegetable farming, mixed cropping and the quest for commercial cash crops all have impacts on the soil as they affect fertility and biodiversity through chemical change (Maitima, 2009).

2.2.0 Distribution of Medicinal Plants

The diversity of medicinal plants in various locations around the globe has a direct link with activities around the area (Appiah et al., 2017). Areas demarcated for pastoral activities, commercial agriculture etc. have some peculiar characteristics of medicinal plants. For instance Maitima *et al.,* (2009) study, demonstrated that, in areas that were used for pastoral activities the presence of some annual grass such as *Eragrostis superba, Pennisetum polystachion, Heteropogon contortus* and others was an indication of over grazing. Similar situation due to farm practices and soil management, species such as Oxalis *corniculata, Bidens pilosa, Senecio obyssinic*a and Ananas *comosus* (Pineapple), *Helianthus annuus* (Sunflower) and *Carica papaya* (Pawpaw) were all found in areas under coffee and banana cultivation. This further elucidates the extent at which farming practices and other anthropogenic activities influence the diversity of medicinal plants and hence a matter of great concern to the sustainable growth and survival of various species of medicinal plants.

In scrubland land areas, biodiversity of plant matter strives and this is very much prominent with undisturbed areas (Maitima, 2009). This sort to portray the likelihood that, parts of communities protected against anthropogenic activities stand the chance of encouraging plant diversity and that also implies a conducive environment for wild medicinal plants to strive.

The notion that precipitation and other factors contributes a great deal to the type of vegetation within an area cannot be overemphasized, thus more effective and efficient studies needs to be conducted around this area. Arid and semi – arid regions are noted for their low precipitation content, thus the effect of this

on biodiversity and perpetuation of medicinal plant species have been considered a great deal so as to find alternative measures for the survival of medicinal plant species in such localizations. There is therefore the need for deliberate and concerted efforts to develop appropriate conservation and sustainable management strategies for threatened or endangered medicinal plant species (IFIC, 2011).

The study was geared towards assessing medicinal plants and their alternative uses, their access and the collection practices in the Lawra and Nandom districts. Additionally the study further ascertained parts of medicinal plants mostly collected, rate of collection and sources of acquisition and the impacts of medicinal plants on livelihoods and their marketability in the Lawra and Nandom district. Factors that threaten the availability of medicinal plants was further evaluated and the efforts of members of communities towards protecting biodiversity brought to the lime light.

CHAPTER THREE

3.0 Methodology

3.1.0 Study area

This study was carried out in the Lawra and Nandom districts of the Upper West Region. These two districts are located in the semi-arid regions of northern Ghana. Both districts falls within the Guinea Savannah Zone and are characterized by short grasses and few woody plants (Ghana Statistical Service, 2010). A typical characteristic of these plants is their ability to withstand drought and harsh weather conditions. Prominent among them are Dawadawa (*Parkia biglobosa*), Baobab (*Adansonia digitata*), Acacia (*Acacia murrayana*) and Shea butter (*Vitellaria paradoxa*) trees.

The vegetation is very congenial for livestock production and most household engage in this practice to earn income. The districts are also influenced by a prolonged dry season during which all or most vegetation cover dry up and are susceptible burning by wild fires. Bush burning reduces the vegetation cover, which leads to reduction in transpiration and thus the annual rainfall within the districts. The torrential rain usually follows the dry season and is also marked by soil erosion.

Aside the harsh weather conditions of the two districts and poverty, members of communities have been battling and seeking sustainable means of copping with climate change and its impending disasters.

Medicinal plants serves as their primary source of treating ailments, therefore the study identified their availability, access and use within both districts.

3.1.1 Nandom District

The Nandom District lies in the north western corner of the Upper West Region of Ghana between Longitude 2°25 W and 2°45W and Latitude 10°20 N and 11°00 S. It is bounded to the East and South by the Lambussie and Jirapa Districts respectively and to the North and West by the Republic of Burkina Faso. The total area of the District is put at 567.6 square km. This constitutes about 3.1% of the Region's total land area. The District is constituted by 84 communities with 86% of the inhabitants living in rural areas.

3.1.2 Lawra District

According to the Ghana Statistical Service report for the 2010 population census The Lawra District is one of the eleven districts that make up the Upper West Region and derives its legal existence from Legislative Instrument (L.I) 1434 of 1988 (PNDCL 207, Act 462). It lies in the north - western corner of the Upper West Region in Ghana. It is bounded to the north by Nandom District, to the east by Lambussie - Karni District to the south – west and west by the Republic of Burkina Faso.

DISTRICT MAP OF NANDOM
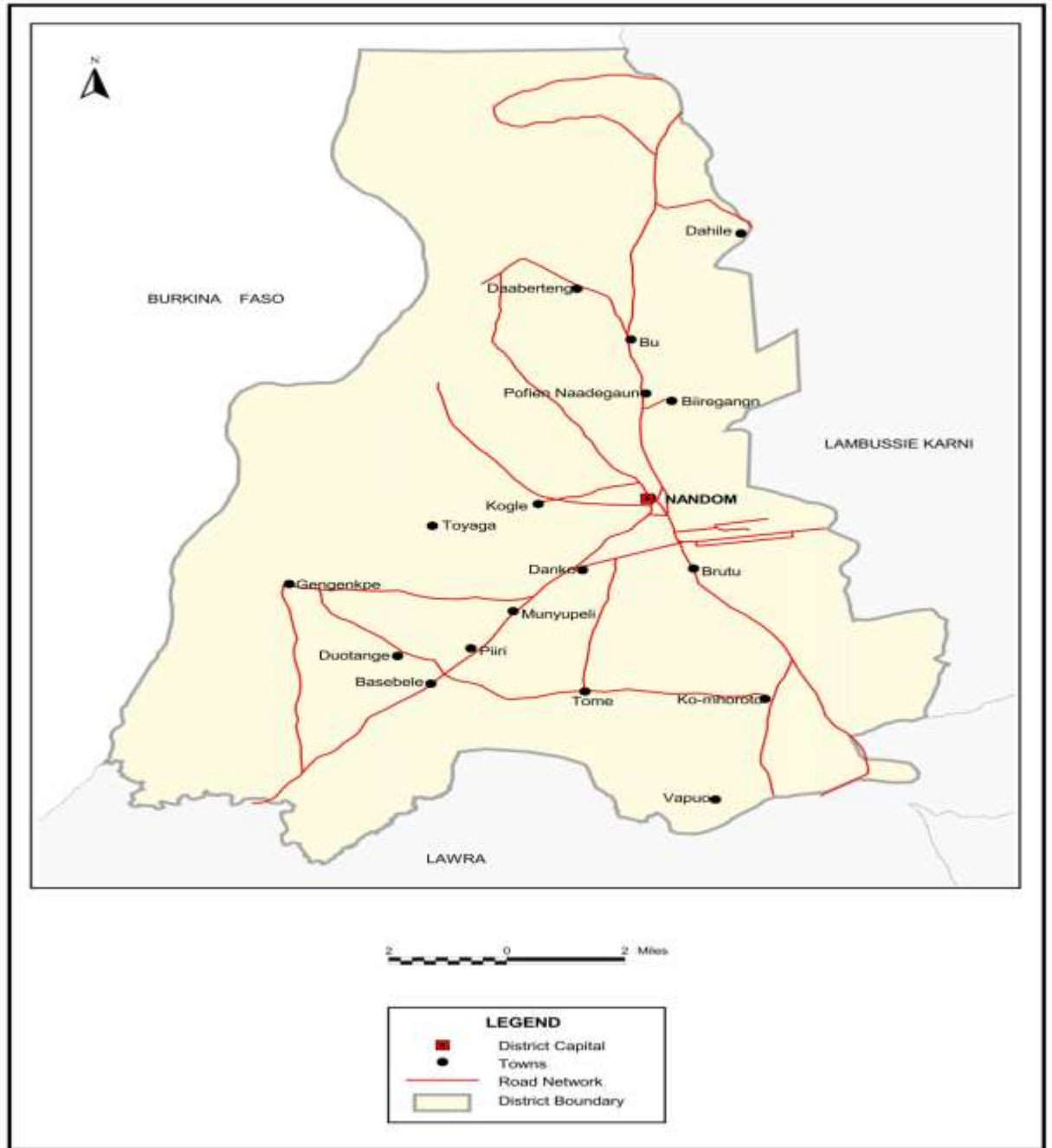
Ghana Statistical Service, 2010.

DISTRICT MAP OF LAWRA
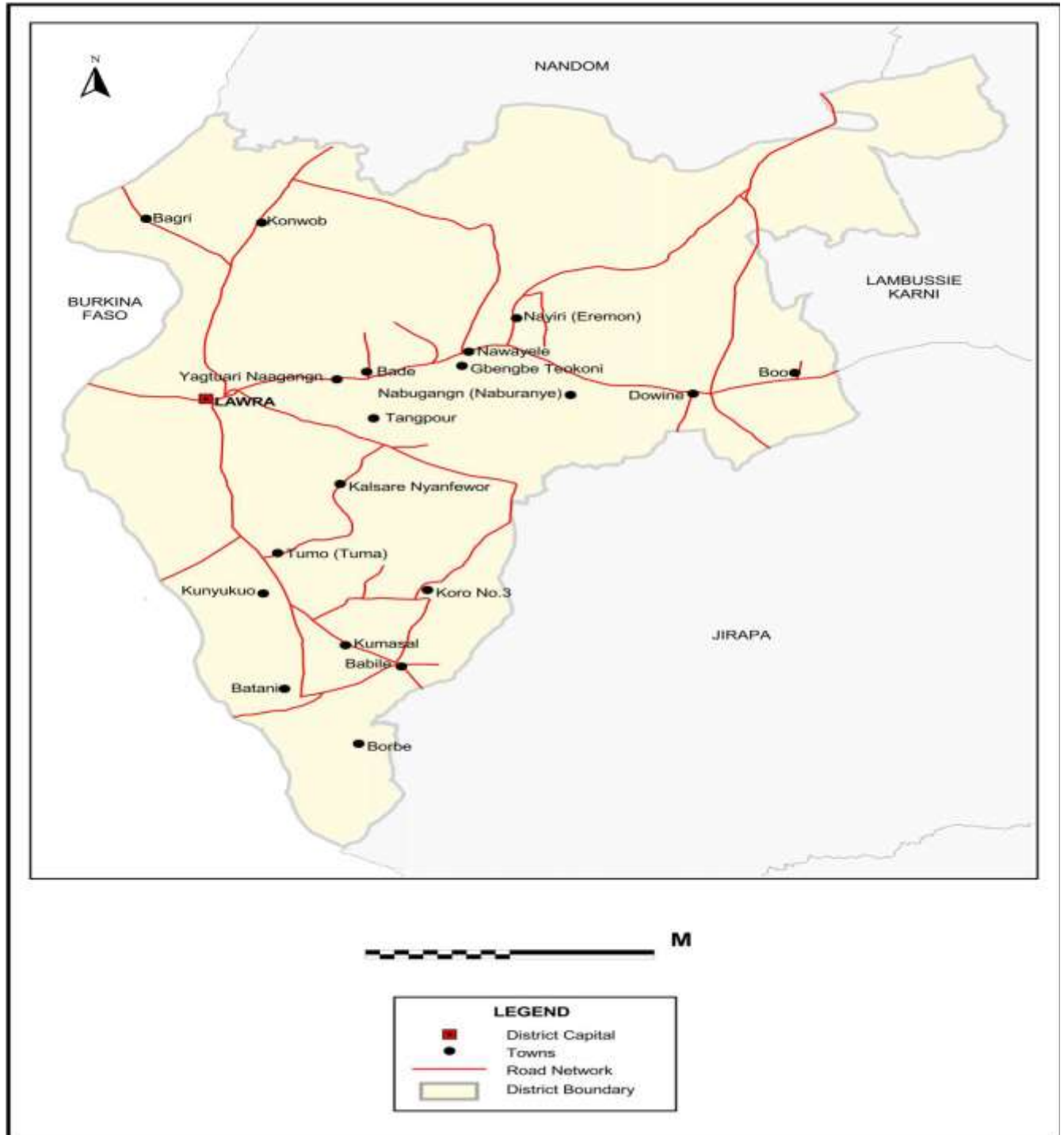
Ghana Statistical Service, 2010.

3.2. Methods

Access to medicinal plants as used in the study is intertwined to that used in computer science which is the ability of people in the community to gain access to medicinal plants. Availability as used in the study refers to the abundance of diverse species of medicinal plants within the study area that is practically used as herbal medicine.

3.1.0 Data collection

Both qualitative and quantitative data were collected using field observation, plant sample collection, questionnaire survey and formal and informal dialogue and focus group discussion. Additionally a focus group discussions consisting of ten participants were held in selected communities. The communities under each district were selected by simple random sampling. Households within each community were then selected randomly for questionnaire administration.

3.2.0 Survey and Group Discussion

Questionnaire and focus group discussion tools enquired about the access of community members to these medicinal plants and also unraveled the collection practices in the districts. Structured questionnaire was administered to respondents with the household head being the first. All members of the household aged above eighteen years were interviewed. Respondents were asked among other questions, the specific plant parts used as medicine, the habitats where they are collected and the ease at which they get access to medicinal plants.

A semi-structured questionnaire was also administered. Questions posed to respondents involved both close ended and open ended questions. With open ended questions respondents were encouraged to express the impacts of medicinal plants on their lives. Closed ended questions was also be used.

3.3. Types of data

Primary and secondary data was used in the study. Primary data was obtained directly from the field of study. Secondary data from the Lawra and Nandom District Assemblies such as district annual reports, household data and population census data was acquired to ascertain trends in the availability, access and use of medicinal plants over the past thirty years. Additionally other stakeholders such as the traditional authorities, traditional healers, educational institutions and the ministry of food and agriculture were consulted for secondary data.

3.4. Determination of Sample Size

To determine the sample size of this study, the equation below was used (Singh, 2014).

$$n = \frac{N}{1+Ne^2}$$

Where:

❖ n is the size of the sample.

❖ N is the total population in the study area.

❖ e is the maximum allowable error .

According to the Ghana Statistical Service, the total number of households of the Lawra and Nandom Districts in the 2010 population census sums up to 16617. The study estimated a 95% confidence interval for the distribution. This implies that a margin of error of 0.05 was allowed. This provided a sample size as shown below.

$$n = \frac{16617}{1 + 16617 * 0.05^2}$$

$$n = \frac{16617}{41.545} \qquad n = 400$$

3.5 Data analysis

For the purpose of this study the blending strategy was adopted for analysis of data from the field. Blending strategy by Creamer (2018), refers to a strategy for data consolidation where a variable, category, or theme generated from one type of analysis is tested using another type of data or where a variable, category, or factor is created by combining qualitative and quantitative data. Descriptive statistical analyses were used to analyze data from the field. Cross tabulation of variables associated with each objective were used to determine the relationship between the two districts and thus make comparisons. Thus data from number of species of medicinal plants collected, frequency of collection per month, period of collection per year, number of medicinal plants collected, type of usage among others was analyzed using SPSS version 20.

The relationship between the availability, access and use of medicinal plants and other variables for each objective were examined by correlation.

CHAPTER FOUR

Results

The results of the study are presented in this chapter. Demographic characteristics, common ailments and the medicinal plants used to treat them, alternative uses of medicinal plants, the access and the collection practices employed, medicinal plant parts mostly collected, the rate of collection and sources of acquisition, livelihoods impacts of medicinal plants and their marketability in the Lawra and Nandom districts are presented.

4.1.0 Demographic Characteristics

A descriptive analysis of the demographics of respondents from Lawra and Nandom districts is presented in Figure 3, 4, 5 and 6. About 49.5% of respondents for the study were covered in the Lawra district and 50.5% of respondents were in the Nandom district. Within each district four communities were randomly sampled for questionnaire administration.

The following communities were sampled from Lawra district: Konwob, Dazuuri, Bompari and Tabia, while communities from the Nandom districts comprised of: Bu, Beltalglu, Bille-Gangn and Guo. The communities that recorded maximum coverage in the study with a percentage of 12.7% was from Bu, Betalglu and Bille-Gangn in the Nandom district. The lowest of 10.4% respondents was from Dazuuri in the Lawra district. The figure 2 illustrates the districts and communities covered in the study.

Name of community

Legend:
- Konwob (L)
- Dazuuri (L)
- Bompari (L)
- Tabia (L)
- Bu (N)
- Betalglu (N)
- Bille - Gangn (N)
- Guo

Pie chart values: 14.43%, 10.45%, 12.19%, 12.44%, 12.69%, 12.69%, 12.69%, 12.44%
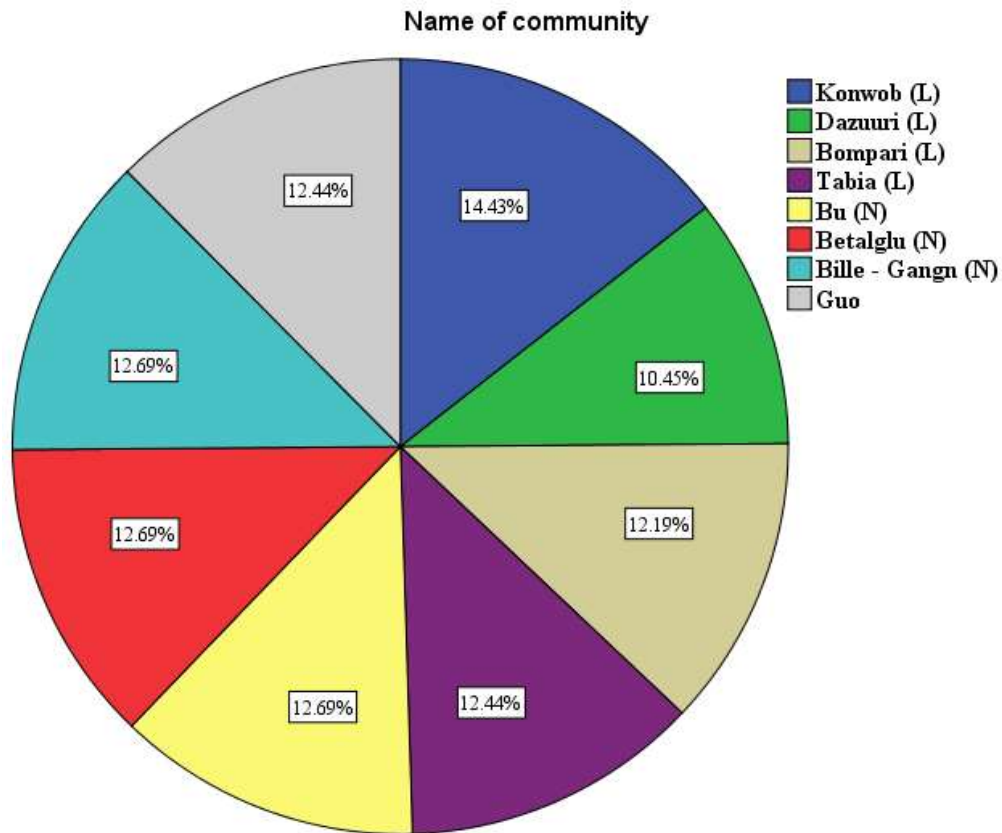
Figure 2: A pie chart illustrating communities covered under the study.

About 77.4% of respondents studied were farmers. A marginal 0.7% respondent was engaged in charcoal burning. The highest age category of respondents under study comprising of 50.5% of the sample population, ranged between 41 years and above and this represented 203 of the sample population. Additionally, 5.5% of respondents ranging from the ages of 21 years to 25 years were the lowest of the age groups to participate in the study. Furthermore, 48% among those who participated in the study were males and the remaining 52.2% were females. The study also revealed that 45.3% play the role of family heads. The highest household sizes from 75.9% of the sample population was five and above. The lowest household size comprised of an individual, making 2% of the respondents.

Lawra and Nandom districts were predominantly occupied by the Dagaaba people, about 99.3% of the total respondents, with the Sisaala ethnic group the lowest in the two districts, making 0.2% of the total respondents. The study further revealed that, 29.6% respondents were illiterates, with 1.3% educated in vocational institutions. Figure 3, 4, 5 and 6 depict the demographic characteristics of the occupational status, ages, number of persons in a household and level of education in the Lawra and Nandom districts.
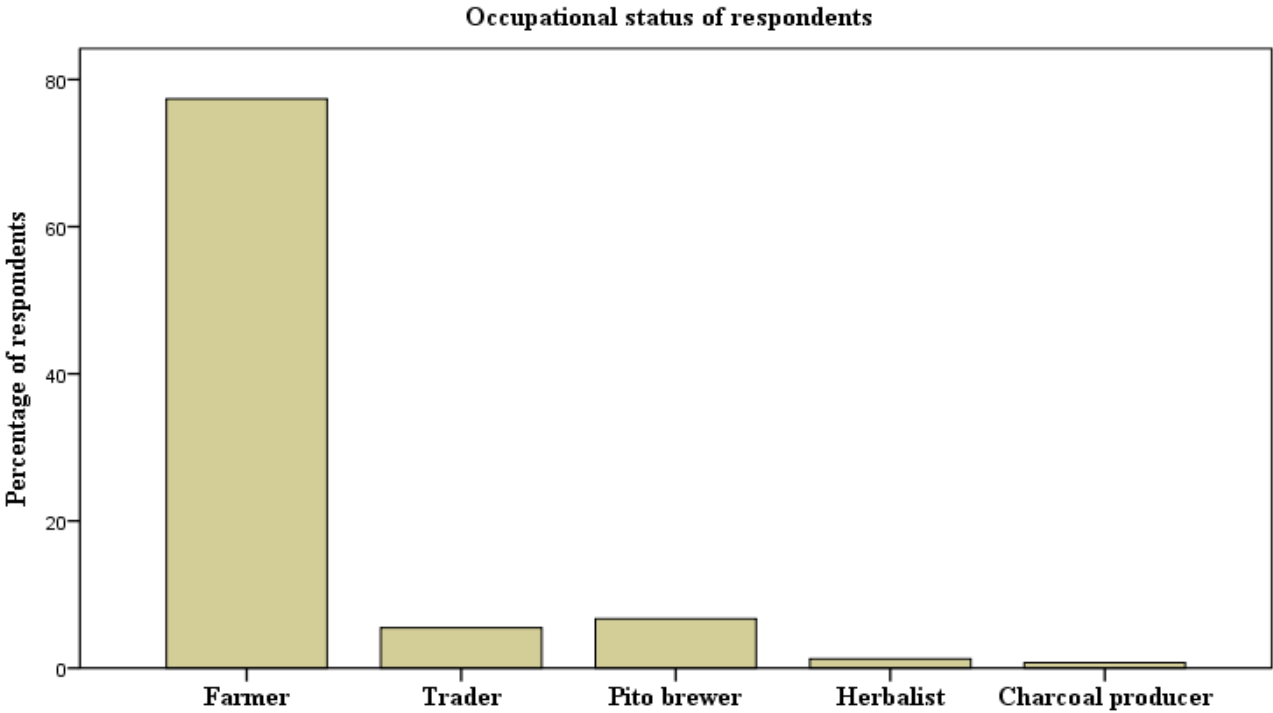
Figure 3: Bar chart showing the occupational status of respondents
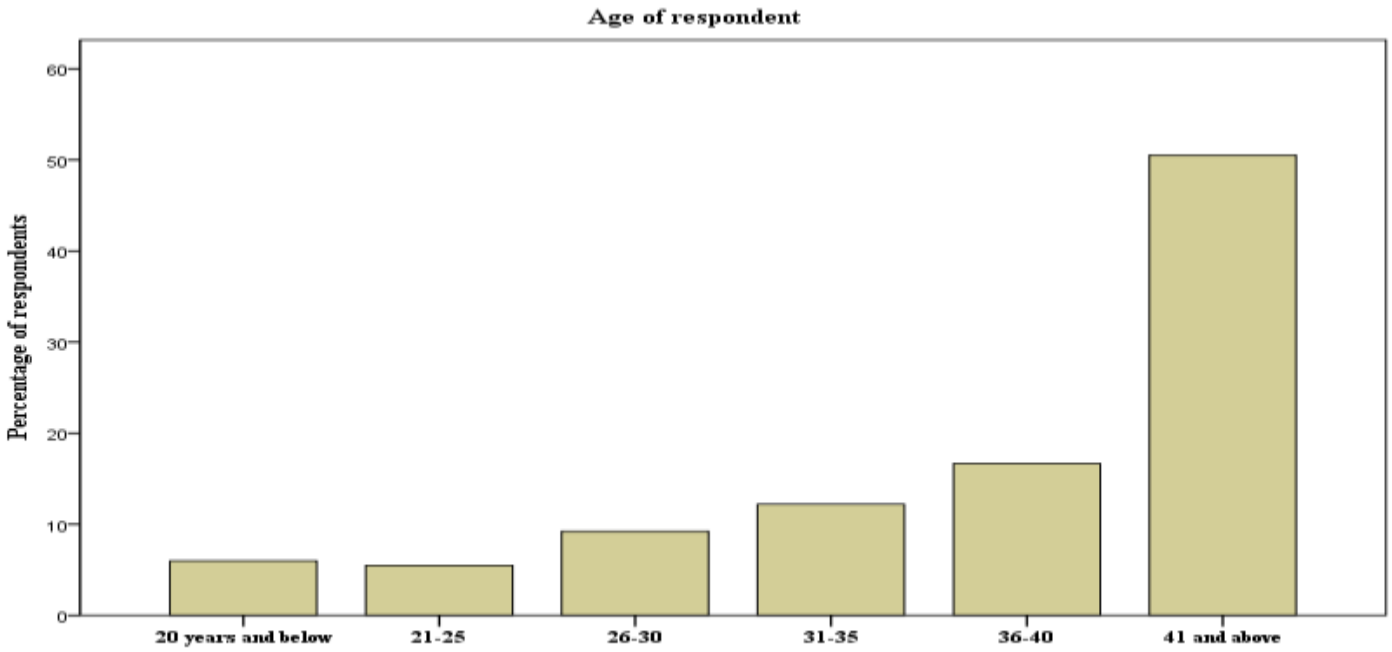
Figure 4: Illustrates age groups of respondents
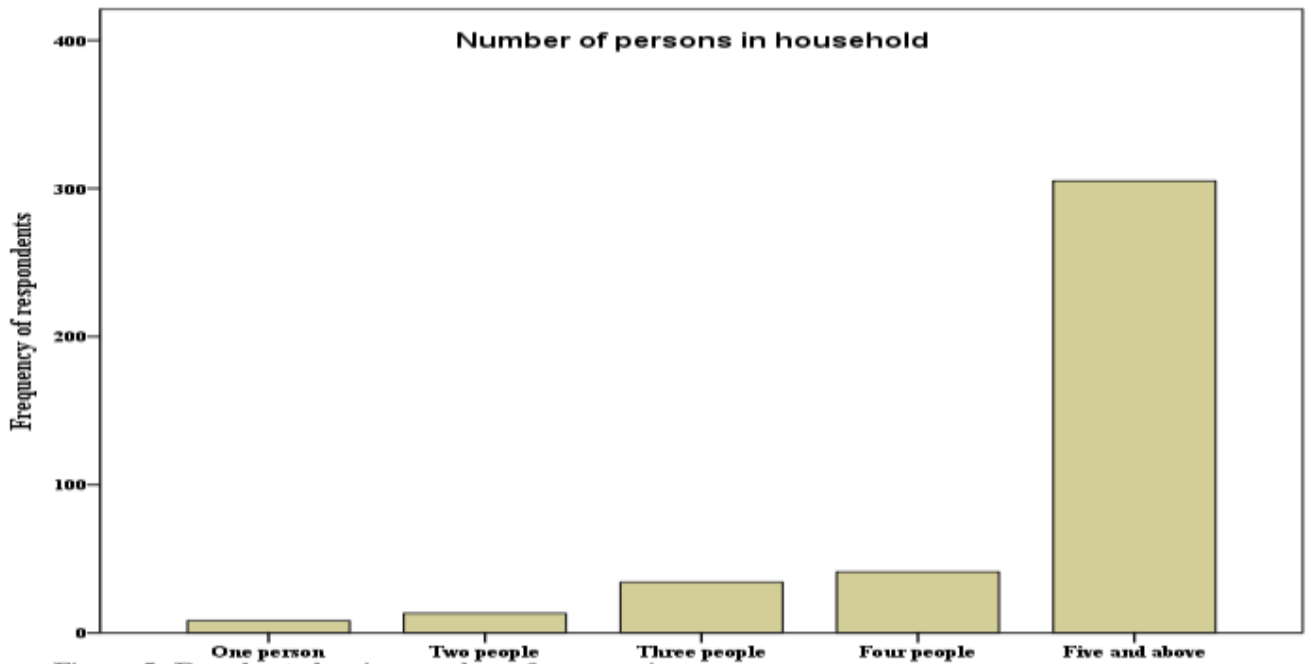
Figure 5: Bar chart showing number of persons in household

Educationan status of respondents
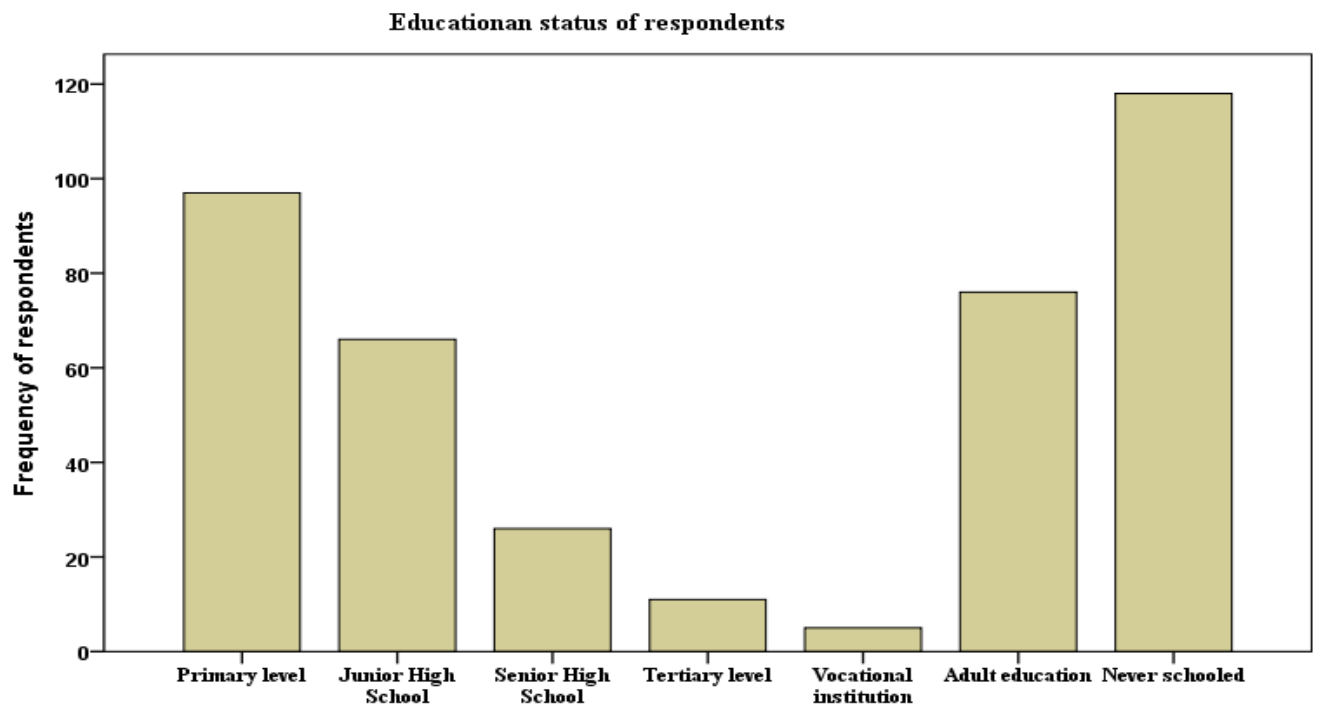
Figure 6: Bar chart showing educational status of respondents

4.1.1 Identification of common ailments and the medicinal plants used to treat them in the traditional and orthodox medicine.

The discriptive statistical analysis was used to identify most common diseases in the two districts, reasons why the use of medicinal plants is prefered, and the number of medicinal plants used in the course of treatment revealed the followig results.

The most common disease rendered was malaria in both districts making 60.45% of respondents and the lowest prevailed disease in the two districts being upper respiratory track infections accrued from 4.8% of respondents study as illustrated on Figure 7. Sixty four percent of respondents used medicinal plants as a means of treating ailments because of their affordability. This is illustrated on Figure 8. In treating a particular ailment 32.4% used more than one plants for the treatment of a particular ailment.
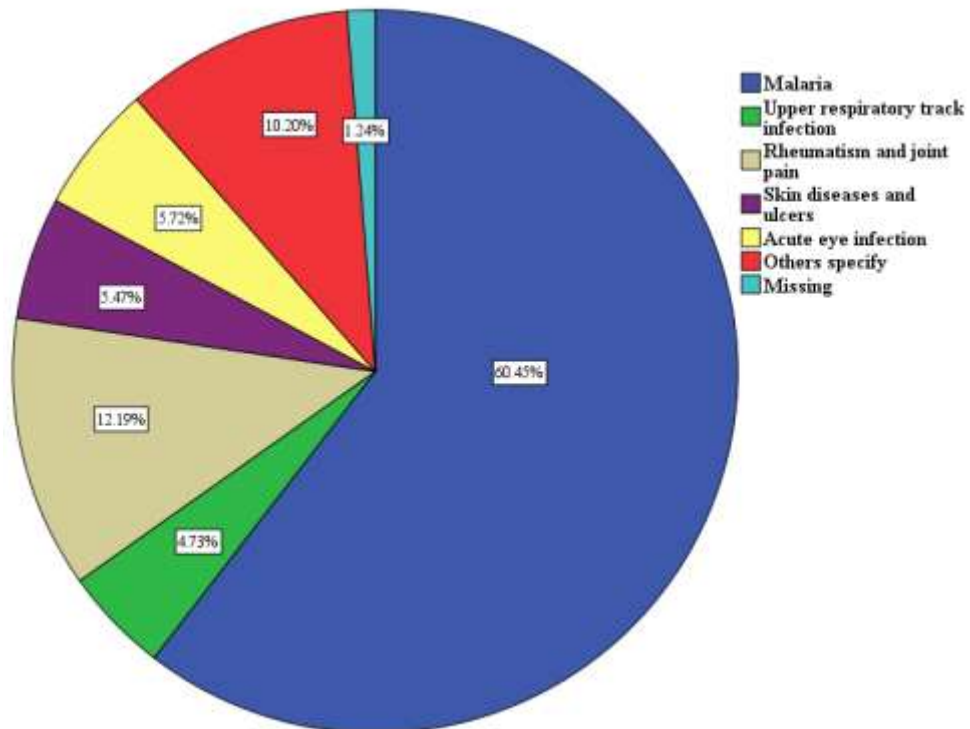
Figure 7: A pie chart illustrating percentages of commonest disease recorded
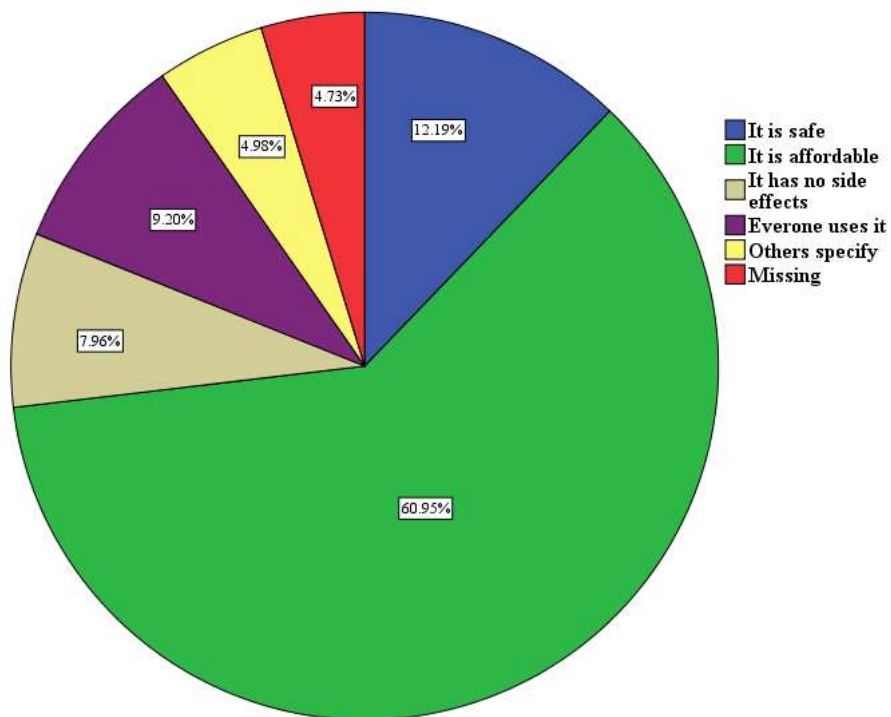
Figure 8: A pie chart illustrating the reasons subjects use medicinal plants as means of treating ailments

An independent sample t-test performed between sex of respondents and the commonest diseases and the reason why they use medicinal plants in treatment showed significance difference p = 0.00. This implies that, there is evidence that, the sex of respondents has influence on common diseases in the districts and their reason for using medicinal plants as means of treatment. Similarly, independent sample t-test between commonest diseases in the two districts and their reason for using medicinal plants and the household sizes of subjects produced insignificant Pearsons Correlation Coefficients of p = 0.504 and p = 0.231 respectively on table 1 below.   A bivariate correlation conducted between the commonest diseases in Lawra and Nandom districts and the reason for using medicinal plants as means of treatement revealed pearsons correlation coeffecient of 0.85, that is p = 0.85 as shown in the table below. Additionally, the correlation between commonest ailments in the two districts and the number of medicinal plants used for treatment resulted in a negative correlation coefficient of - 0.52, that is p = -0.52. Below are tables for illustrations.

Table 1: Independent Samples Test between commonest diseases and reason for using medicinal plants.

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
Commonest disease in the community	Equal variances assumed	2.663	.104	-.669	308	.504	-.42219	.63126	-1.66432	.81995
	Equal variances not assumed			-1.111	8.133	.298	-.42219	.37996	-1.29589	.45152
Reason for using medicinal plants as treatment	Equal variances assumed	3.012	.084	-1.200	295	.231	-.49313	.41091	-1.30181	.31556
	Equal variances not assumed			-2.790	6.321	.030	-.49313	.17674	-.92032	-.06593

Table 2: Bivariate correlation between commonest disease in the community and number of medicinal plants used in treating ailment.

		Commonest disease in the community	Number of medicinal plants used in treating ailment
Commonest disease in the community	Pearson Correlation	1	-.052
	Sig. (2-tailed)		.344
	N	397	339
Number of medicinal plants used in treating ailment	Pearson Correlation	-.052	1
	Sig. (2-tailed)	.344	
	N	339	343

Table 3: Bivariate correlation between commonest disease in districts and reason for using medicinal plants.

		Commonest disease in the community	Reason for using medicinal plants as treatment
Commonest disease in the community	Pearson Correlation	1	.085
	Sig. (2-tailed)		.097
	N	397	379
Reason for using medicinal plants as treatment	Pearson Correlation	.085	1
	Sig. (2-tailed)	.097	
	N	379	383

A cross tabulation of the results using the variables of commonest disease in the district, their reason for using medicinal plants as treatement, and the number of medicinal plants used in the treatment process, was carried out and the results obtained. In addition to the cross tabulation a pearsons correlation coefficient was calculated for each variable expressed.

The two districts recorded malaria as the predominant ailment. Thus 57.2% making 139 of respondents considered malaria as the commonest ailment in the Lawra district and 42.8% making 104 was acrued from the Nandom district. About 4.3% of the respondents had acute eye infection in the Lawra district, and 5.3% of respondents were observed with upper respiratory truck infection in the Nandom district. There was no significant correlation between the two variables as illustrated in Figure 9.
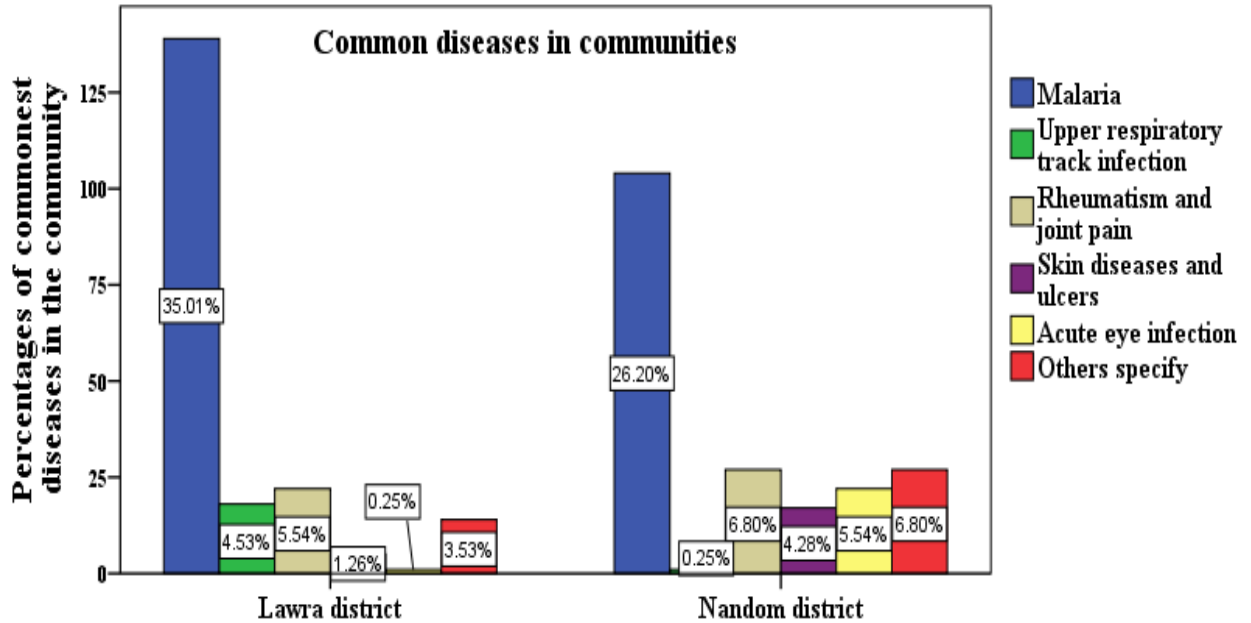
Figure 9: Cross tabulation of Lawra and Nandom districts against common ailments.

The cross tabulation between the two districts with the reason for using medicinal plants as means for treating ailments revealed that 39.16% respondents from the Lawra district were of the view that medicinal plants are affordable and thus, the reason for use to treat ailments. Comparatively 24.8% respondents from the Nandom district cited affordability as the reason for using medicinal plants for treating ailments. This is illustrated on Figure 10. The least attribution from the Lawra district was 0.26% respondents as compared to 4.70% respondents from the Nandom district.
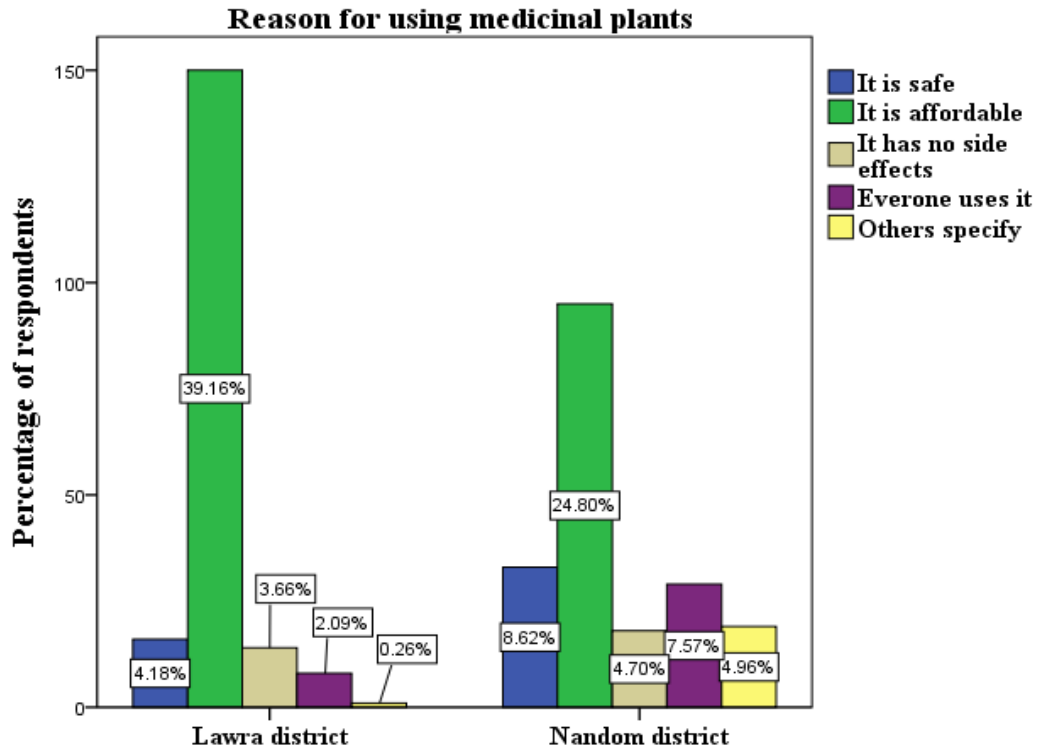
Figure 10: Cross tabulation between Lawra and Nandom district and their reasons for using medicinal plants as means of treating ailments.

The cross tabulation of the number of medicinal plants used in treating ailments in the two districts resulted in 66.7% of users from the Nandom district using plants numbering five and above in treating a particular ailment. Sixty two point two percent of users in Lawra district used four plants at a go in treating ailments.

Table 4: Is an illustration of the number of medicinal plants used in treating ailments as against the districts from which they are used.

Name of district	Number of medicinal plants used in treating ailment					Total
	One	Two	Three	Four	Five and above	
Lawra district	34.8%	47.3%	52.3%	62.2%	33.3%	46.6%
Nandom district	65.2%	52.7%	47.7%	37.8%	66.7%	53.4%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

4.1.2 Assessment of alternative uses of medicinal plants, their ease of access and the collection practices employed in the Lawra and Nandom district.

As illustrated on figure 11, 29.2% of respondents observed that, apart from the medicinal benefits of medicinal plants, they are also used as firewood in their kitchens. The least of this category, 0.3% were of the view that medicinal plants are also used for cultural practices such as rituals for burying the dead in the two districts. About 42.3% of respondents had their plants materials close to homes. Additionally 9.2% of this category accessed their medicinal plants species just around their houses as illustrated on Figure 12.

Other uses of medicinal plants

■	Food
■	Animal feed
■	Pesticides
■	Cultural practices
■	Firewood
■	Building houses
■	Making agricultural tools
■	Others specify
■	Missing
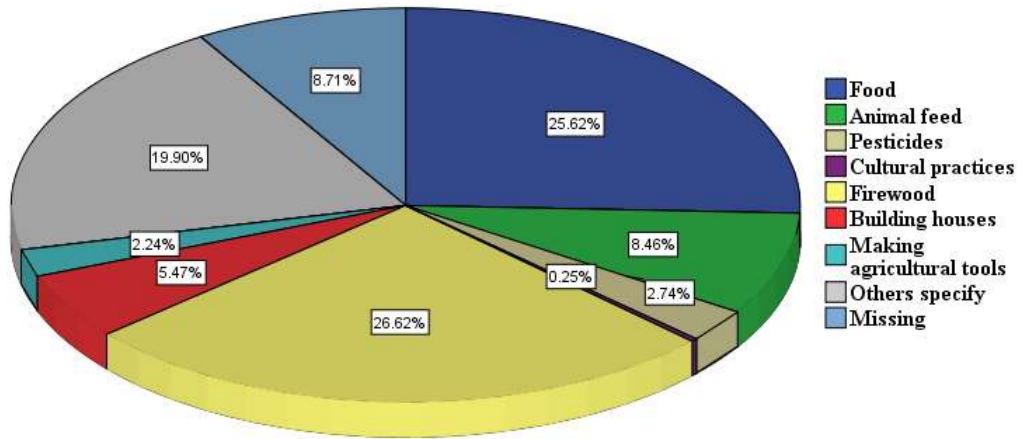
Figure 11: A pie chart showing alternative uses of medicinal plants
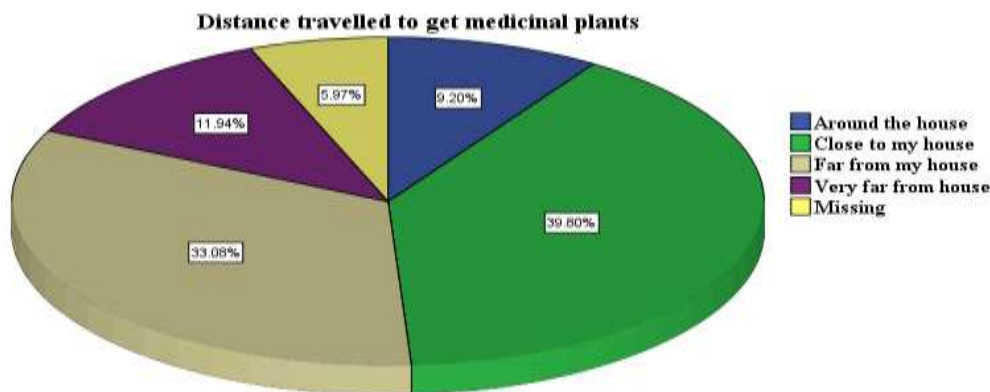
Figure 12: A pie chart illustrating the distance respondence move to access medicinal plants

A cross tabulation between the two districts and respondents view of the availability of medicinal plants between now and the past thirty years was conducted. It was realized that, within the Lawra district the percentage of respondents who were of the view that medicinal plants are available and easy to come by as compared to thirty years ago was 32.51% more than those who taught otherwise. This is illustrated on Figure 13. In the Nandom district however, 32.51% less of the of the total respondents indicated medicinal plants were less available and difficult to come by as compared to 30 years ago.

There was significant ($X^2 = 0.00$) difference in availability of medicinal plants between the districts as illustrated on Table 5 below.
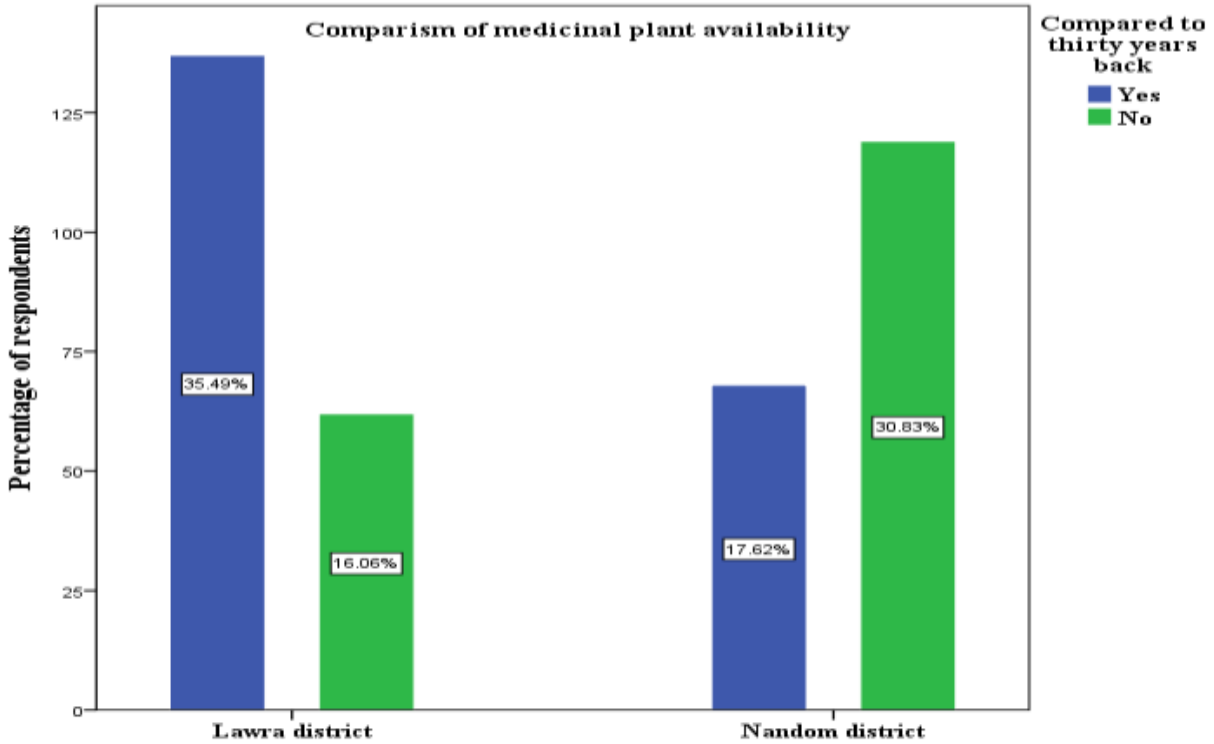
Figure 13: A bar chart illustrating a cross tabulation of name of districts against subjects view of present comparism of availability of medicinal plants to that of thirty years ago.

Table 5: Chi-Square Tests for comparison of medicinal plant availability in the past thirty years between two districts

	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	40.841	1	.000		
Continuity Correction	39.547	1	.000		
Likelihood Ratio	41.570	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	40.735	1	.000		
N of Valid Cases	386				

Table 6 illustrates that 25.1% of respondents suggested bush fire as the reason for reduction in medicinal plant availability. Other factors such as, heavy rains, overgrazing, no attention given to medicinal plants were mentioned.

The manner and ways medicinal plants were harvested in the two districts was analysed and illustrated on Figure 15. About 71.6% respondents harvested plant materials by cutting various plant parts in the Lawra district. Also 16.1% harvested plant materials by plucking various parts.

The Nandom district on the other hand recorded peeling as the most method used in harvesting medicinal plants for use. Additionally 87.1% of respondents in Nandom asserted to this and the least method used was cutting which accrued to 28.4 %.

Reasons	Frequency	Percent	Valid percent
Bush fire	44	10.9	25.1
Bush burning and drought	14	3.5	8.0
Bad farming practices, deforestation and over grazing	14	3.5	8.0
Drought	9	2.2	5.1
Deforestation	30	7.5	17.1
Deforestation and drought	10	2.5	5.7
Deforestation and bush burning	29	7.2	16.6
Deforestation and over grazing	2	0.5	1.1
Demand is high	1	0.2	0.6
Frequent usage of agro chemicals	1	0.2	0.6
Heavy rains and felling trees	1	0.2	0.6
Increasing population and usage	6	1.5	3.4
No attention given to medicinal plants	1	0.2	0.6
Over exploitation	9	2.2	5.1
Overgrazing and bush burning	2	0.5	1.1

They are far from the community	1	0.2	0.6
Total	175	43.5	100.0

Table 6: Reasons medicinal plants are unavailable now as compared to thirty years ago.
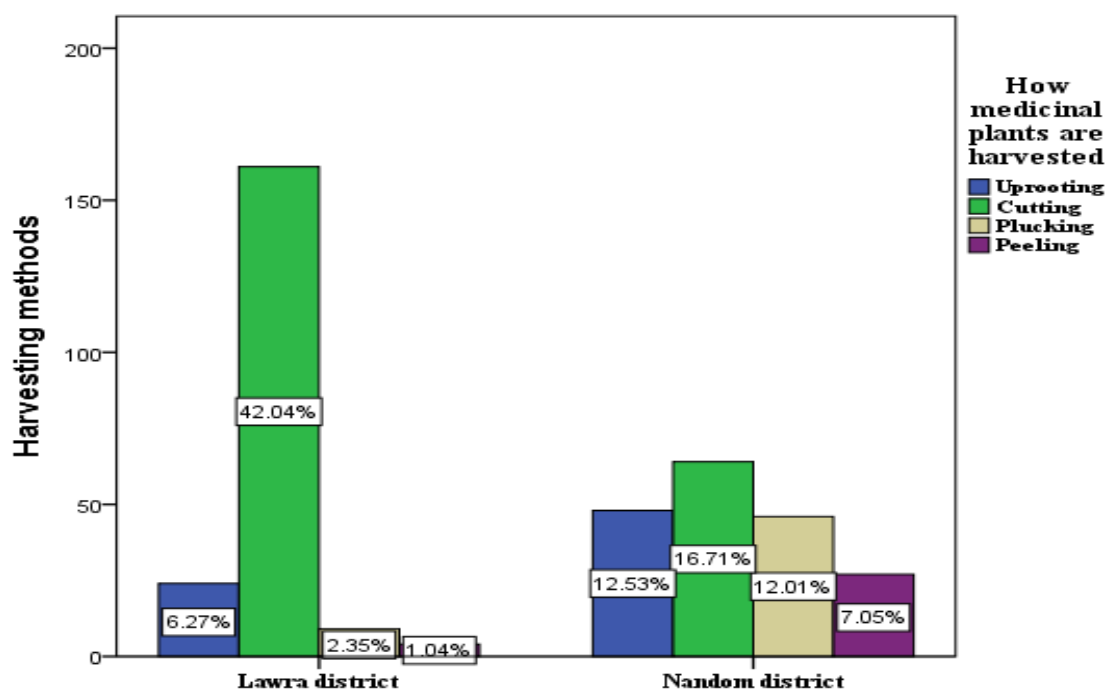
Figure 15: Cros tabulation of Lawra and Nandom districts and the methods they employ in harvesting medicinal plants.

4.1.3 Determination of medicinal plant parts mostly collected the rate of collection and sources of acquisition in the two districts.

The sources of acquisition of medicinal plants for use, suggested attempted cultivation attempts of medicinal plants, frequency of harvesting medicinal plants, alternative sources of medicinal plants and the parts of plants used for medicine was presented in Figure 16, Table 6 and Table 7.

It was revealed 41.6% of respondents from both districts accessed medicinal plants from their farms. Additionally 38.5% and 1.6% of the respondents indicated that the natural ecosystem and the market as their source of medicinal plants respectively.

Very little cultivation of medicinal plants occurs in the two districts. This was indicated that 14.7% who were involved in the cultivation of medicinal plants as compared to the 85.3% not involved in any form of cultivation at all. *Mangifera indica* and *Carica papaya* were the two most cultivated medicinal plants within the two districts. Those involved in a combined cultivation of mango and pawpaw, and mango alone were 21.2% out of the total sample population.
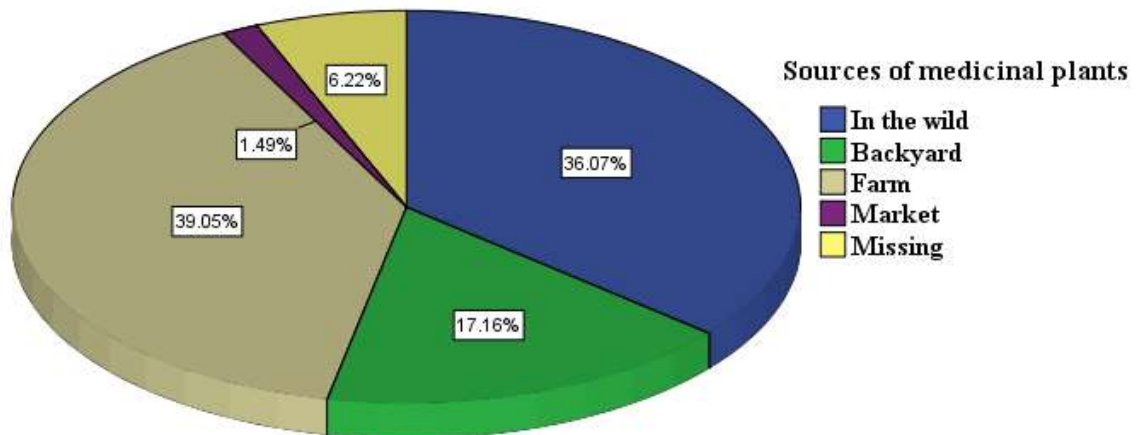
Figure 16: A pie chart illustrating sources respondents obtain their plant products for use.

Table 7: Cultivation of medicinal plants for use

Medicinal plant cultivation	Frequency	Percent	Valid Percent
Yes	57	14.2	14.7
No	330	82.1	85.3
Total	387	96.3	100.0

Table 8: Names of medicinal plants cultivated

Names of medicinal plants	Frequency	Percent	Valid Percent
Eucalyptus and pawpaw (*Eucalyptus globulus* and *Carica papaya)*	1	0.2	1.5

Guava and mango (*Psidium guajava* and *Mangifera indica)*	1	0.2	1.5
Guava (*Psidium guajava*)	1	0.2	1.5
Lemon plant (*Citrus sp*)	1	0.2	1.5
Moringa *(Moringa oleifera)*	11	2.7	16.7
Mango and pawpaw (*Mangifera indica* and *Carica papaya*)	14	3.5	21.2
Moringa and mango (*Moringa oleifera* and *Mangifera indica*)	2	0.5	3.0
Mango (*Mangifera indica*)	14	3.5	21.2
Moringa, Mango and gourd (*Moringa oleifera, Mangifera indica* and *Lagenaria siceraria*)	1	0.2	1.5
Mango and sweat potato (*Mangifera indica* and *Ipomoea batatas*)	1	0.2	1.5
Mango, achiapple and pawpaw (*Mangifera indica* and *Carica papaya*)	1	0.2	1.5
Moringa and bitter leaf plant (*Moringa oleifera* and *Vernonia sp*)	2	0.5	3.0
Moringa and guava (*Mangifera indica* and *Lagenaria siceraria)*	3	0.7	4.5
Moringa and pawpaw (*Mangifera indica* and *Carica papaya*)	1	0.2	1.5
Moringa, bitter leaf plant and pawpaw (*Moringa oleifera, Vernonia sp* and *Carica papaya*)	1	0.2	1.5
Moringa, pawpaw and guava (*Moringa oleifera, Carica papaya* and *Psidium guajava*)	1	0.2	1.5
Mango, pawpaw and tick (*Mangifera indica*, *Carica papaya* and *Bixa orellana*)	1	0.2	1.5
Millet (*Pennisetum glaucum*)	1	0.2	1.5
Tick and mango (*Bixa orellana* and *Mangifera indica*)	4	1.0	6.1

Pawpaw (*Carica papaya*)	4	1.0	6.1
Total	66	16.4	100.0

Results of frequency of harvesting medicinal plants are presented in Figure 17. It was revealed that 31% of the respondents harvested medicinal plants once every month as compared to 1.6% who collected medicinal plants four times every month. The parts of medicinal plants used as medicine was mostly the stem, roots, back, leaves, fruits, seeds, tubers and wood as illustrated on figure 18. Out of this 62.5% of respondents used leaves for treatment and 0.3% used tubers as medicines.

Frequency of harvesting medicinal plants
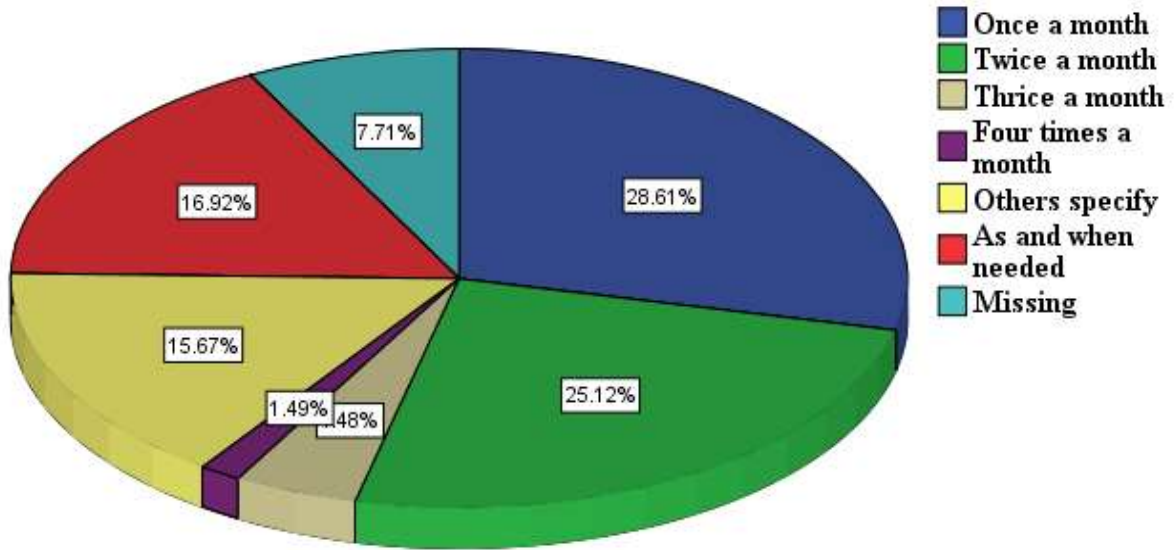
Figure 17: A pie chart illustrating the frequency at which respondents harvests medicinal plants within the two districts

Parts of plant used as medicine
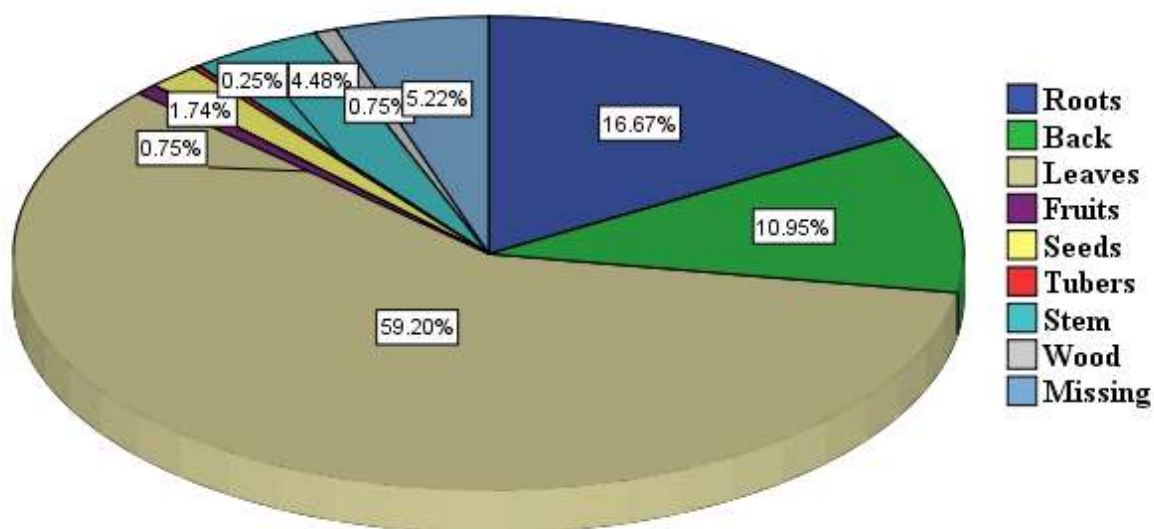
Figure 18: A pie chart illustrating medicinal plant parts used

It was revealed from the study that 29.44% respondents from the Lawra district acquired medicinal plants for use in their farms as compared to the 12.2% from the Nandom districts. This was followed by, 17.24% and 21.22% of respondents who obtained medicinal plants from the wild for respective distinct. With regards to the market as a source of medicinal plants, the Lawra district recorded 0.27% and Nandom district, 1.33%. Results on attempts of community members to consciously involve in the cultivation of medicinal plants indicated that respondents in the Nandom district cultivated more medicinal plants represented by 43.15% compared to the 42.12% from the Lawra district. Figures 19 and 20 give illustrations of the output.

Sources of medicinal plants
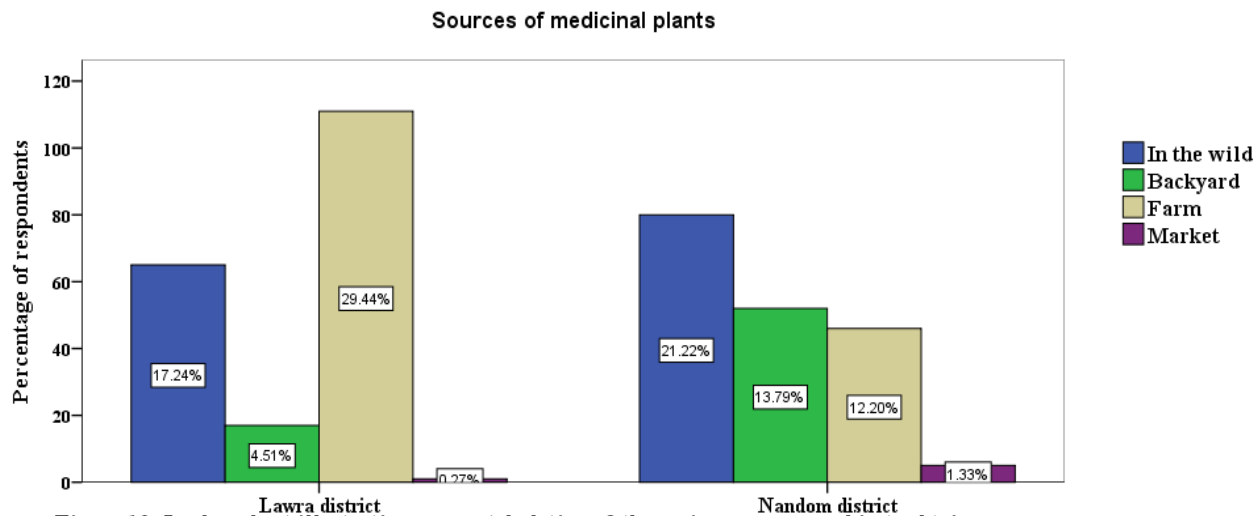
Figure 19: Is a bar chart illustrating a cross tabulation of the various soureces subjects obtain medicinal plants for use.

Cultivation of medicinal plants for use
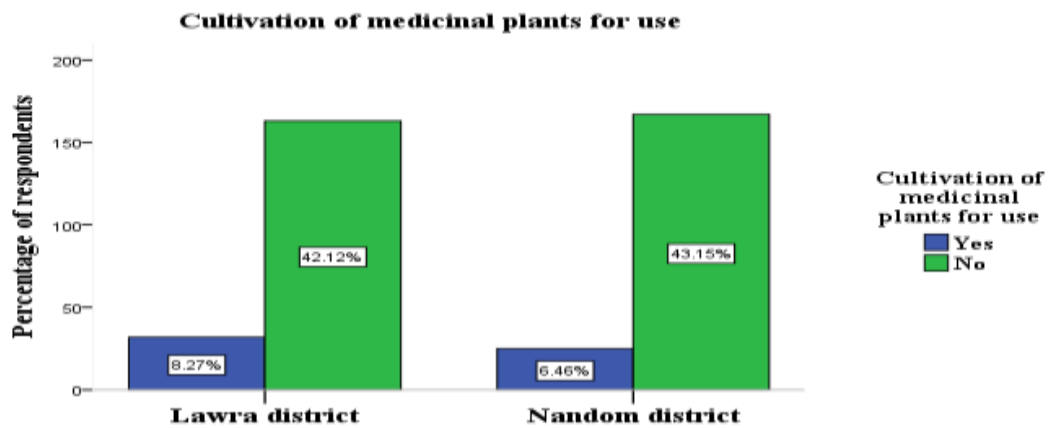
Figure 20: Cultivation of plants of medicinal value in the Lawra and Nandom districts.

The cultivation of mangoes for most locations was more predominant in the Lawra district as compared to the Nandom districts. It was revealed that 19.70% and 1.52% of respondents in the Nandom district cultivates *Mangifera indica* (Mango) respectively. This was followed by the cultivation of *Mangifera indica* (Mango) and *Carica papaya* (pawpaw) of which 18.18% of respondents in Lawra district cultivated as compared to the 3.03% in the Nandom district. Also 1.52% of respondents cultivated guava and mango, moringa, mango and gourd, mango and sweet potato, pawpaw, moringa and pawpaw.

In similar analysis respondents who harvested medicinal plants twice a month amounting to 17.79% of respondents was the most recorded in the Lawra district, while in the Nandom district, 9.43% of respondent's harvested medicinal plants twice a month. This rate was followed by 16.98% of respondents who collected medicinal plants once a month in the Lawra district as compared to 14.02% in the Nandom district.

Various plant parts were used for the preparation of medicine in both districts. About 43.04% and 19.42% of respondents in the Lawra and Nandom district respectively attested to the fact that they used leaves of plants in preparing medicines.
Less than 1%, that is 0.26% of respondents in the Lawra district indicated they use fruits as medicines and 0.26% of respondents in Nandom district used tubers as medicines. The above statistics are illustrated by clustered bar charts on Figure 24 and 25 below.
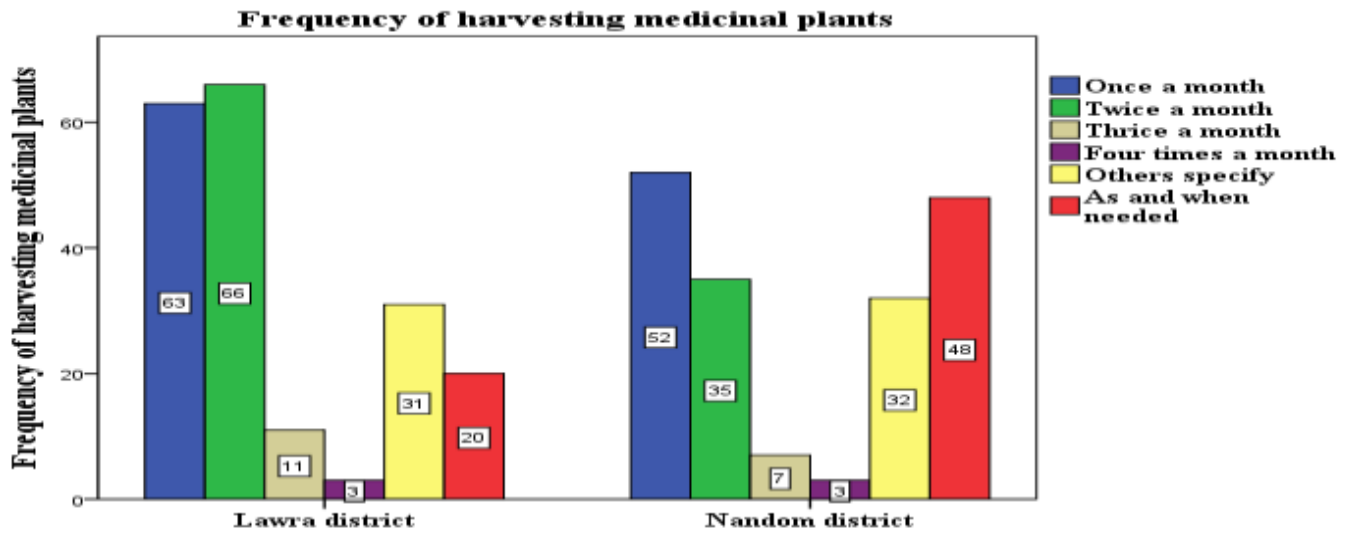
Figure 21: Clustered bar chart of the frequency of harvesting medicinal plants in the two districts.
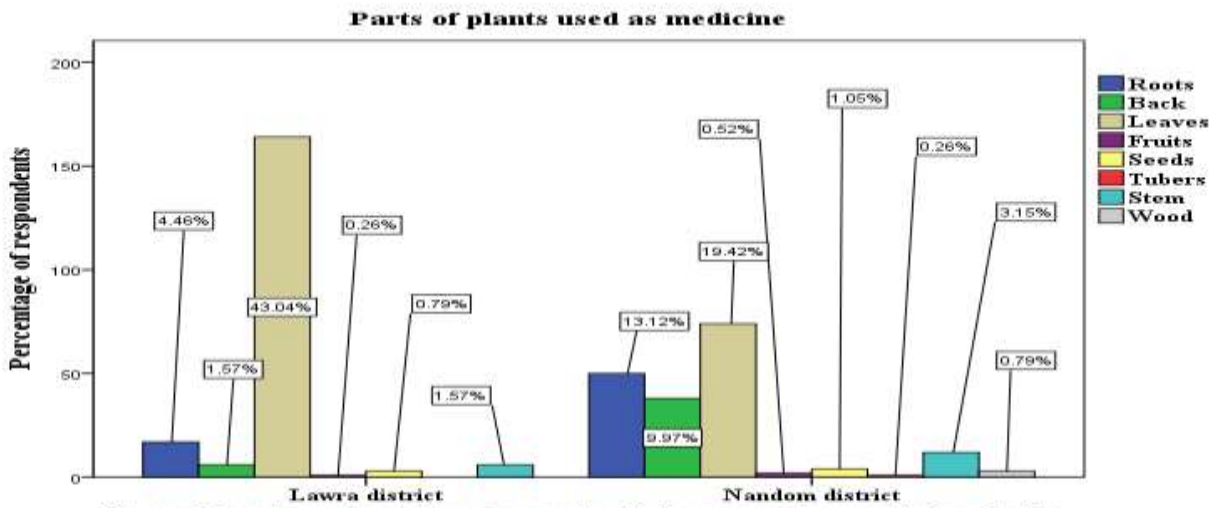
Figure 22: A bar chart showing parts of plants used as medicines in the Lawra and Nandom district.

4.1.4 **Ascertaining the impacts of medicinal plants on livelihoods and their marketability in the Lawra and Nandom district.**

As illustrated on Figure 23 and 24, 62.19% respondents indicated that they do not go to the hospital because they use medicinal plants. Others save money variously because of the use of medicinal plants. This was communicated by 30.60% respondents. The lowest benefit accrued from the use of medicinal plants was the 2.99% of respondents who demonstrated that, they have never been to the hospital because of the use of medicinal plants.

Figure 25 is also a pie chart illustrating the size of farms used for the cultivation of medicinal plants in the Lawra and Nandom districts. Of those who were involved in the cultivation of medicinal plants, 83.33% of them cultivated within the range of one to two acres of land. The remaining 16.67% of respondents cultivated five to six acres of land.

Ways medicinal plants influenced the community
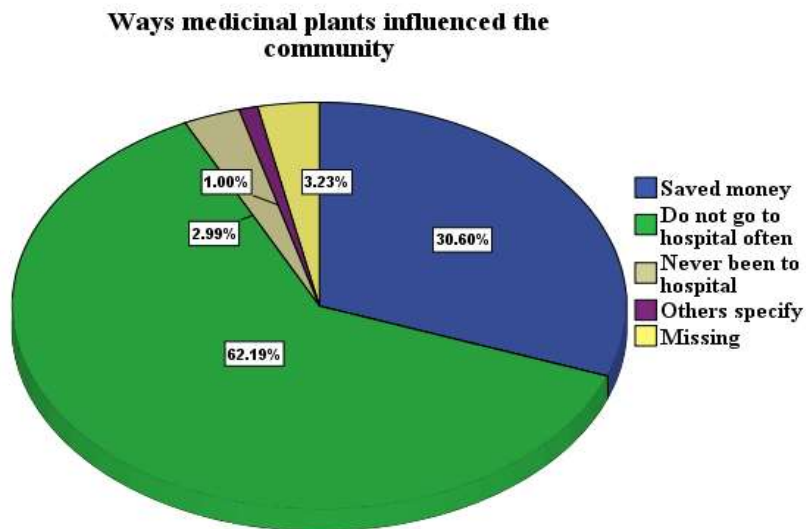
Figure 23: A pire chart illustrating the influence medicinal plants have on the people of Lawra and Nandom district.

Size of medicinal plant farm

16.67%

83.33%

1-2 acres
5-6 acres
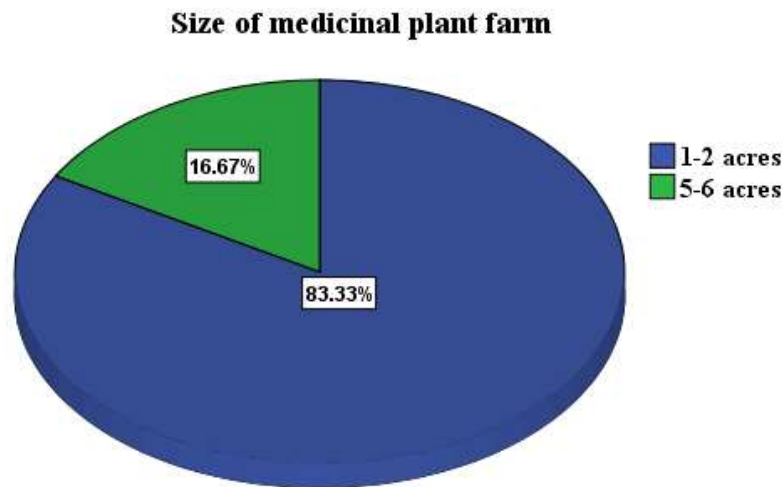
Figure 24: A pie chart illustrating the size of farms used for the cultivation of medicinal plants.

The amount of money spent by subjects in their communities when seeking orthodox treatment was analyzed as well as the amount spent on medicinal plants. As illustrated on Figure 25 and 26, 81.84% of respondents spent an equivalent of nine Ghana cedis (GH¢9) or above when seeking health care from the hospital. The lowest an individual could spend seeking health care as stipulated by 0.75% of respondents was five Ghana cedis (GH¢5) or below. This was compared to the amount spent when seeking health care by herbal treatment. Majority of respondents, that is 74.1% of respondents, spent less than five Ghana cedis (GH¢5) to get health treatment by the use medicinal plants. The amount spent when using medicinal plants as means of treatment by 0.5% of respondents was spent seven Ghana cedis.

Amount of money spent at the hospital for treatment

Legend:
- Less than five Ghana cedis
- Six Ghana cedis
- Seven Ghana cedis
- Eight Ghana cedis
- Nine Ghana cedis and above
- Missing

2.99% 8.46% 4.73% 1.24% 0.75% 81.84%
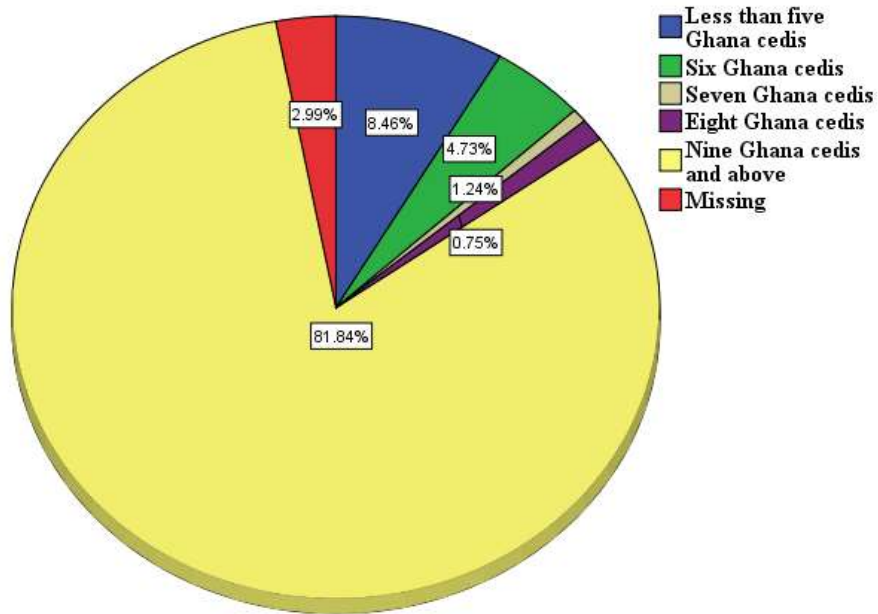
Figure 25: A pie chart illustrating the amount of money spent at the hospital for treatment.

Amount spent for herbal treatment

Legend:
- Less than five Ghana cedis
- Six Ghana cedis
- Seven Ghana cedis
- Eight Ghana cedis
- Nine Ghana cedis and above
- None of the above
- Missing

5.72% 9.45% 10.95% 0.50% 2.74% 0.75% 69.90%
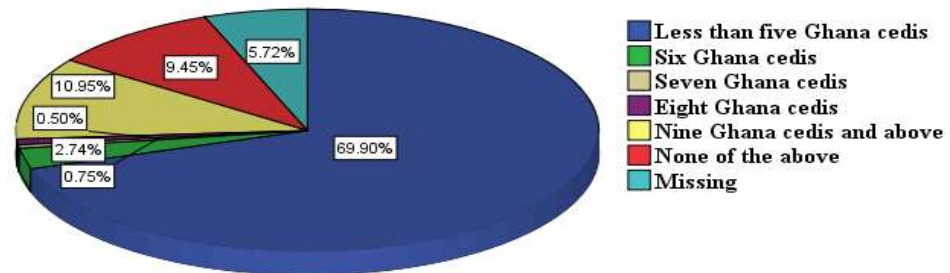
Figure 26: A pie chart illustrating the amount of money spent when seeking herbal treatment from their communities.

The purchase of medicinal plants and the least cost of plant materials were also analyzed. This is illustrated by figure 27 and 28. It was revealed that 29.4% of respondents buy medicinal plants from the community. The remaining 70.6% never purchased medicinal plants in their communities.

Purchase of medicinal plants
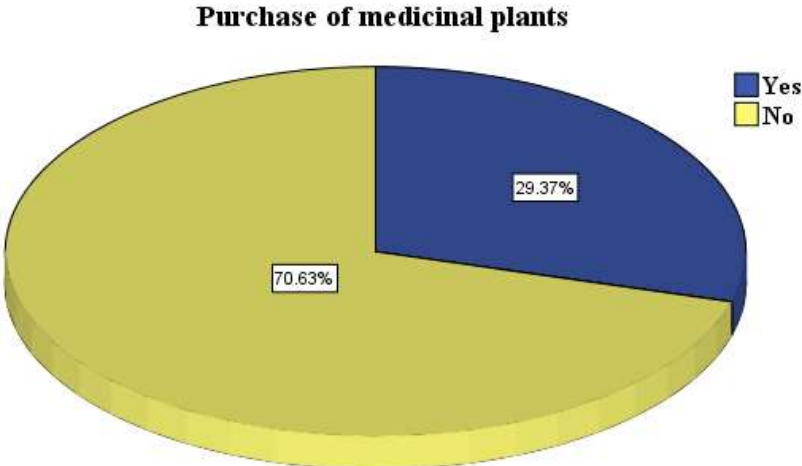
Figure 27: A pie chart showing the purchase of medicinal plants in the Lawra and Nandom district

Cost of medicinal plants
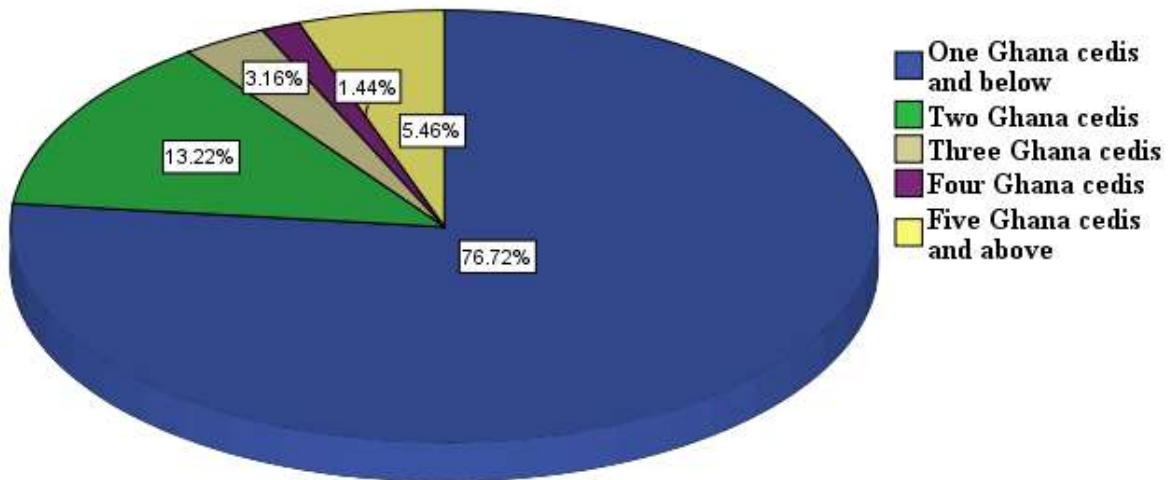
Figure 28: A pie chart showing the cost medicinal plants.

Ways in which medicinal plants influence the lives of members of communities and the purchase and sale of medicinal plants in the communities, the cultivation and size of farms used for the cultivation of medicinal plants against the Lawra and Nandom districts suggested as shown in the figures 32 and 33 that, medicinal does have lots of impact on the lives of members of communities under study.

From the Lawra district, 34.96% of respondents and 29.31% from the Nandom district indicated the greatest contribution of medicinal plants in their lives. The result indicated that 5.8% of respondents in both districts were into cultivation of medicinal plants. Of this, 33.33% and 50% of respondents

respectively in the Lawra and Nandom district all had cultivated land areas within the range of one to two acres allocated to medicinal plants. Within the range of five to six acres however there was none on the part of the Lawra districts but 16.67% in the Nandom district did indicate that they had farms within that range.
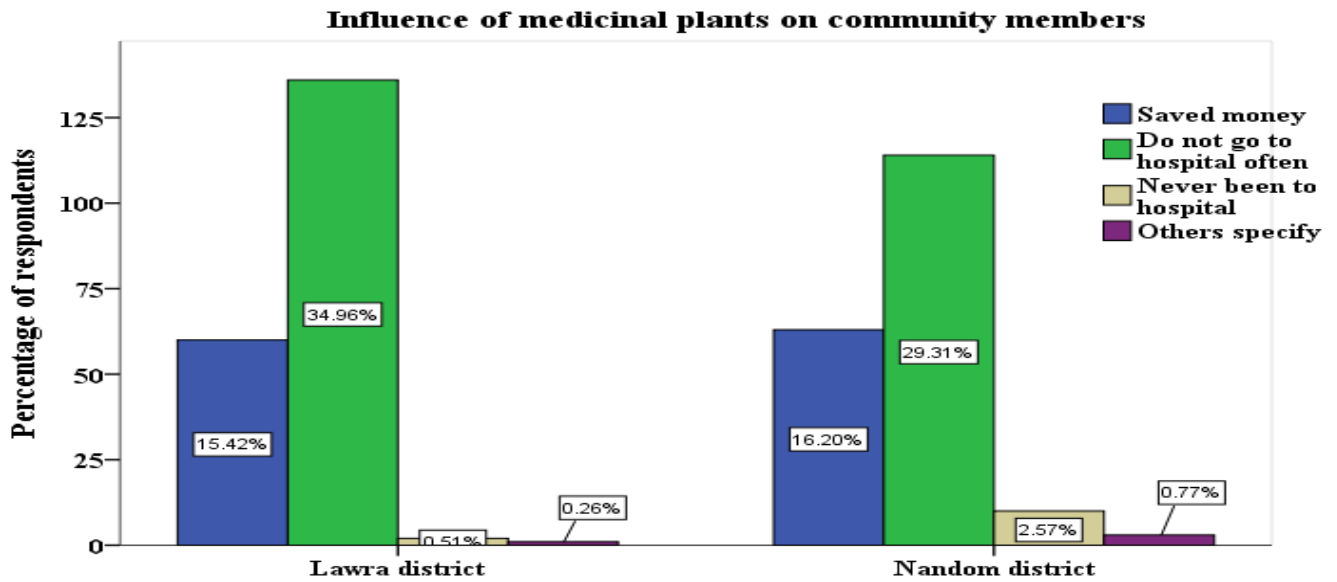
Figure 29: A clustered bar chart illustrating the influence of medicinal plants in the Lawra and Nandom district.

Size of farms
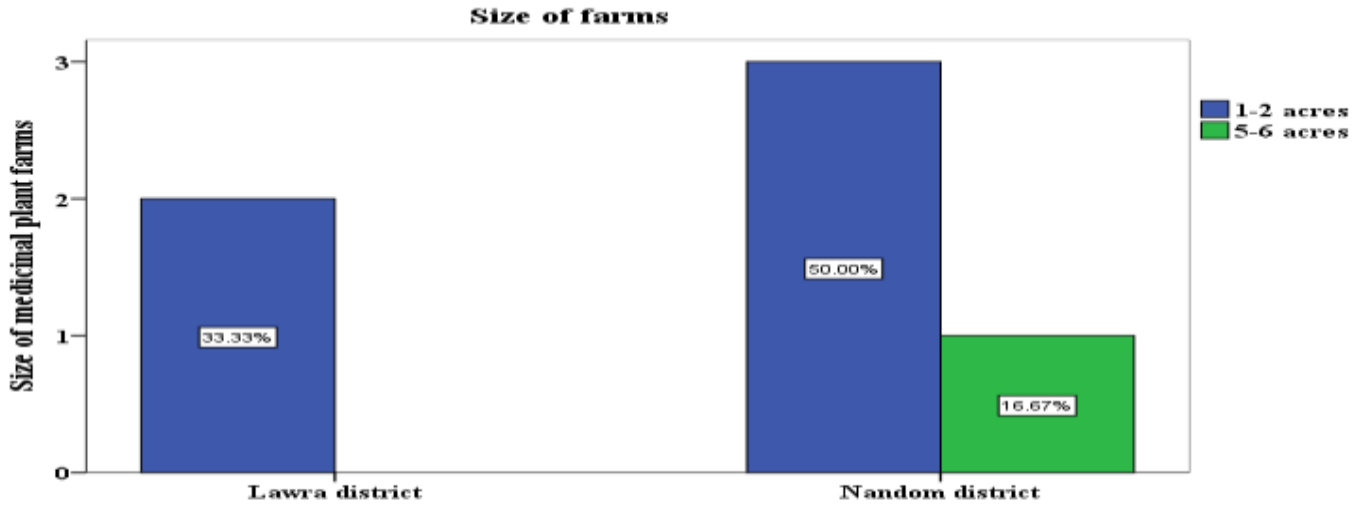
Figure 30: A clustered bar chart illustrating the sizes of medicinal plant farms of community members into medicinal plant farming.

Both districts indicated that treatment by the use of medicinal plants is far more affordable than seeking treatment from orthodox medicine. Figure 31 and 32 illustrates. The sample population indicated in both districts that, the price of orthodox treatment which stands at a maximum of nine Ghana cedis for both districts was recognized by 38.21% of respondents in the Lawra district and 46.15% of respondents in the Nandom district. With regards to herbal treatment however, 40.11% and 34.04% of respondents from Lawra and Nandom districts respectively needed less than five Ghana cedis to get treated.

Spending at the hospital
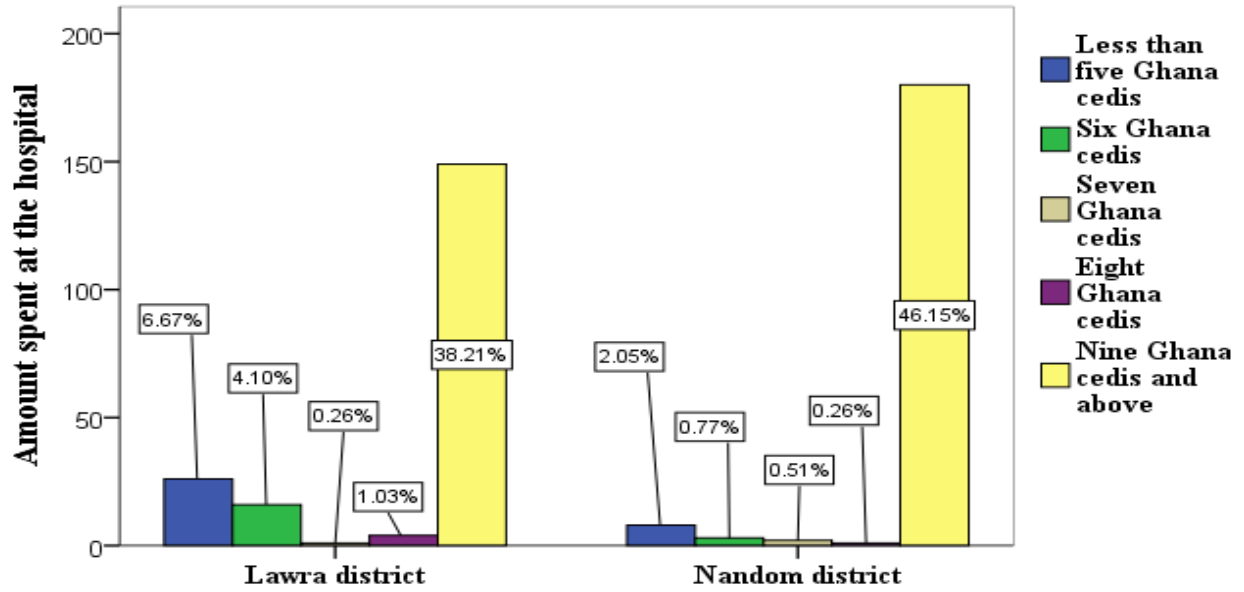
Figure 31: A clustered bar chart illustrating amount of money spent in treating ailments at the hospital.

Amount spent for herbal treatment
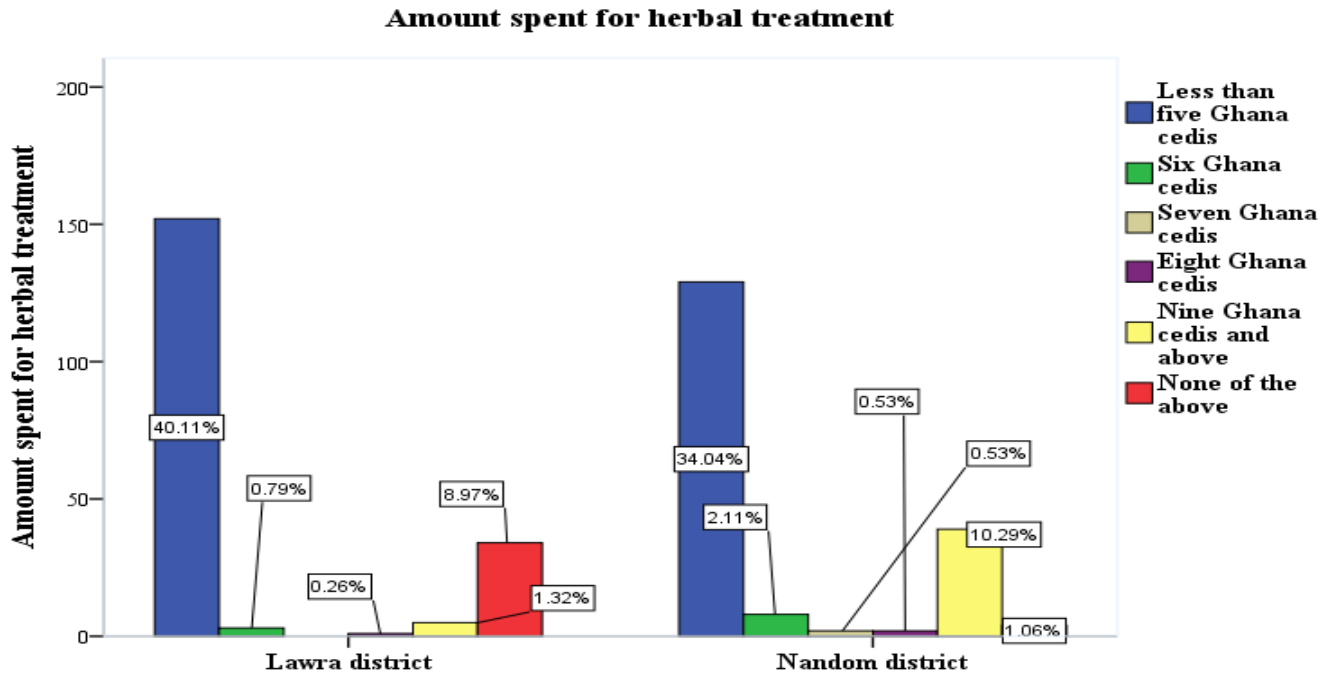
Figure 32: A clustered bar chart illustrating the amount of money spent when using medicinal plants as means of treatment.

The sale and purchase of medicinal plants was also assessed and analyzed by cross tabulation. The observation was that, majority of the sample population in Lawra and Nandom does not transact or sell medicinal plants in any way. A similar observation was made in the analysis for purchase of medicinal plants by members of the sample population.

Sale of medicinal plants
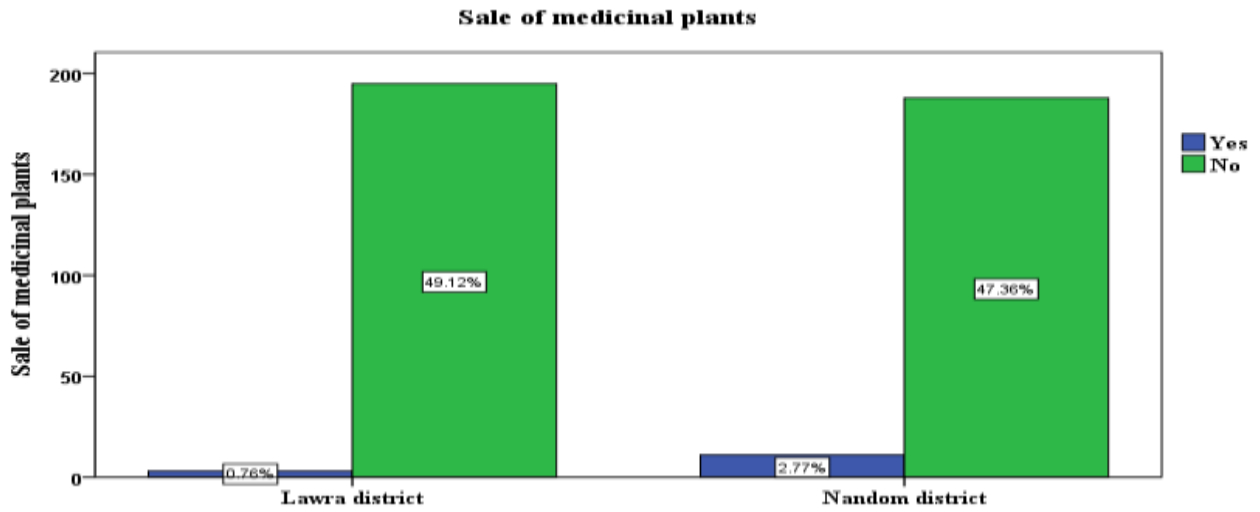
Figure 33: Is a clustered bar chart indicating the sale of medicinal plants in the Lawra and Nandome district.

Purchase of medicinal plants
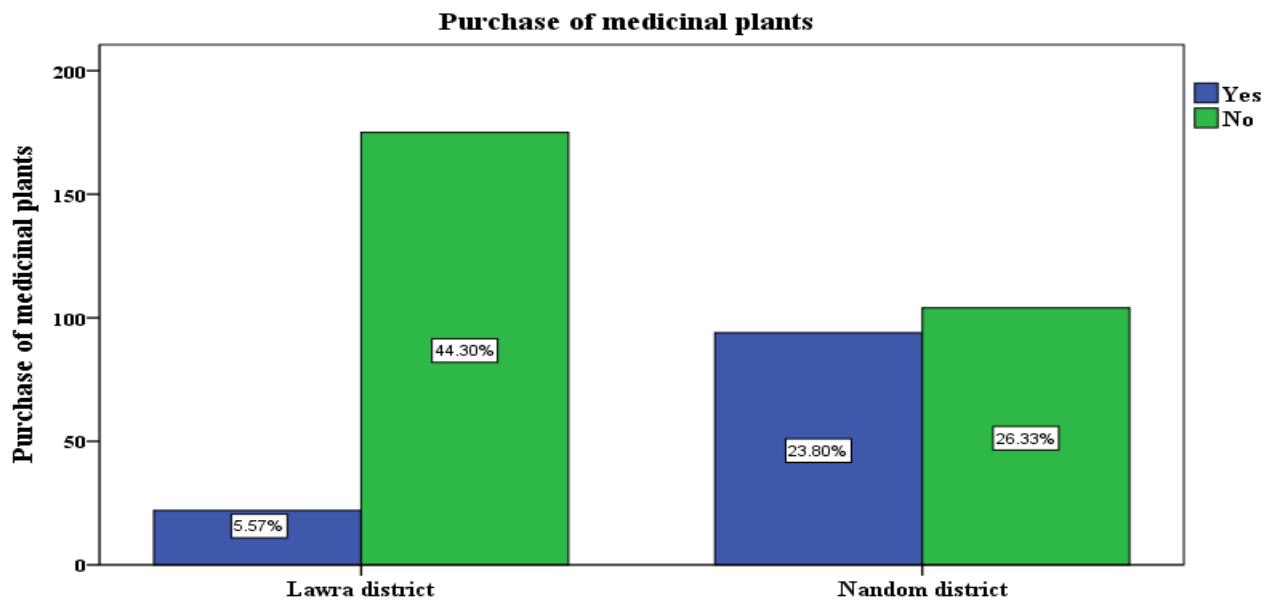
Figure 34: A clustered bar chart illustrating the purchase of medicinal plants in the two districts.
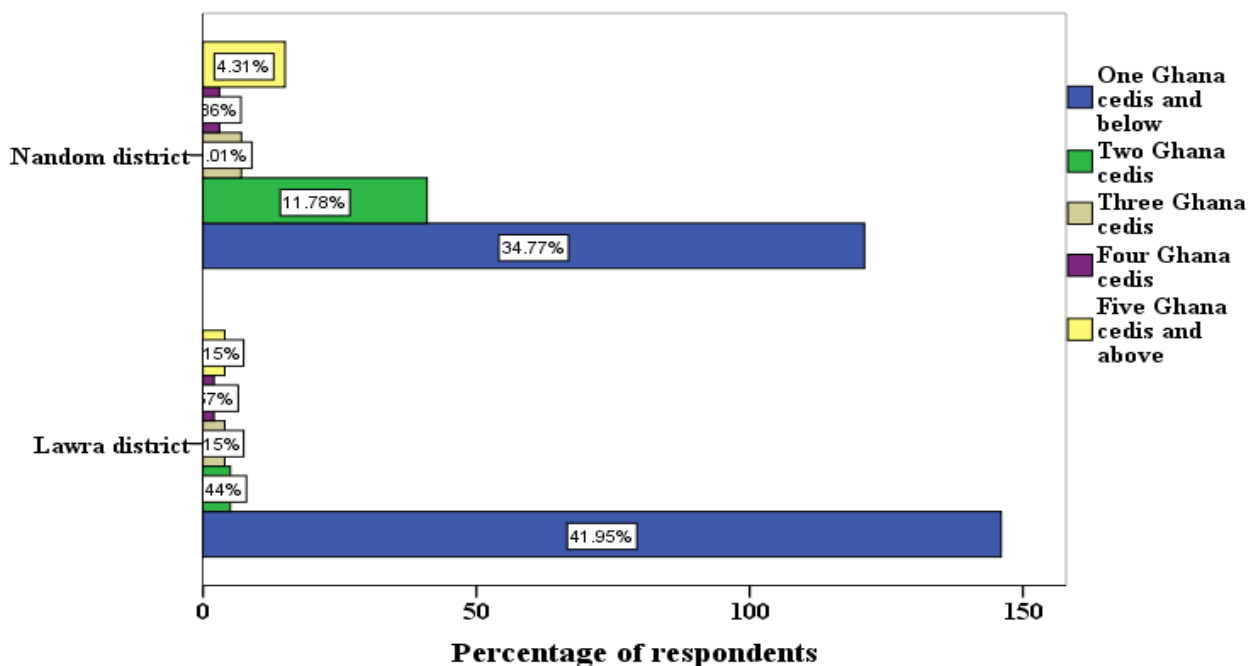
Figure 35: A clustered bar chart illustrating the least cost of medicinal plants in the Lawra and Nandom district.

4.1.5 **Determination of factors affecting the availability of medicinal plants in the Lawra and Nandom districts.**

Responses indicated as threat to the availability, access and use of medicinal plants in the Lawra and Nandom districts was presented on Figure 36 and 37. About 68.6% of respondents selected bush fire or bush burning as the major threat to medicinal plants in the Lawra and Nandom districts. The least threat in both districts was high temperatures indicated 1.8% of the respondents in communities under study. The availability of medicinal plants was selected by 55.8% of respondents. The remaining 44.2% declined.

Activities threatening medicinal plants

■	Farming
■	Drought
■	Bush fire
■	High temperatures
□	Overexploitation

5.93%
13.92%
68.56%
9.79%
1.80%
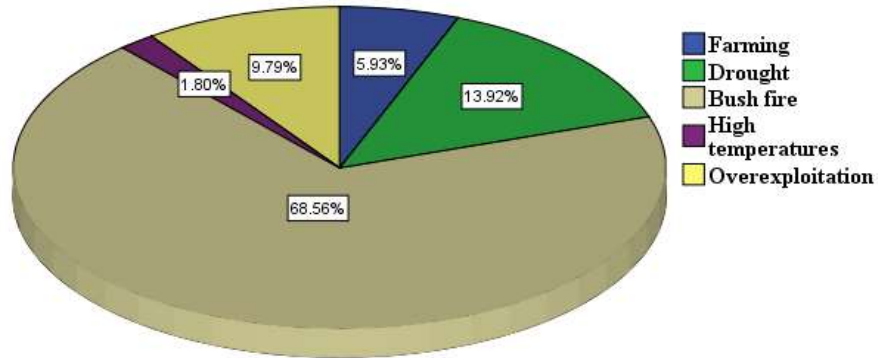
Figure 36: A pie chart illustrating the activities that threaten the availability access, access and use of medicinal plants in the Lawra and Nandom district.

Availability of medicianal plants

■	Yes
■	No

44.19%
55.81%
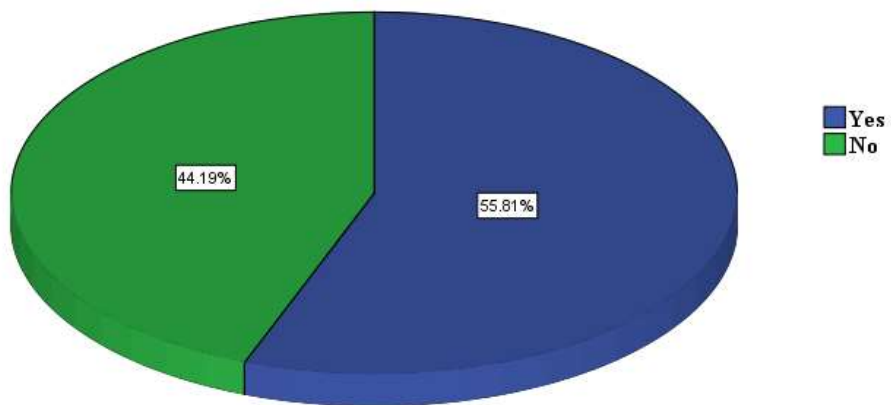
Figure 37: A pie chart illustrating medicinal plant availability from the Lawra and Nandom distrticts.

The variation of medicinal plants availability was also expressed strongly by the respondents. It was revealed by 74.9% of the respondents that medicinal plants are more accessible in the rainy season, (Figure 41). Furthermore 90.4% of respondents stated the dry season as the period where medicinal plants are hard to come by. About 41% of respondents observed that bush fire or bush burning is the biggest challenge behind getting access to medicinal plants during the dry season.

Seasons medicinal plants are available

6.39%

18.72%

74.89%

■ Dry season
■ Rainy season
□ All year round
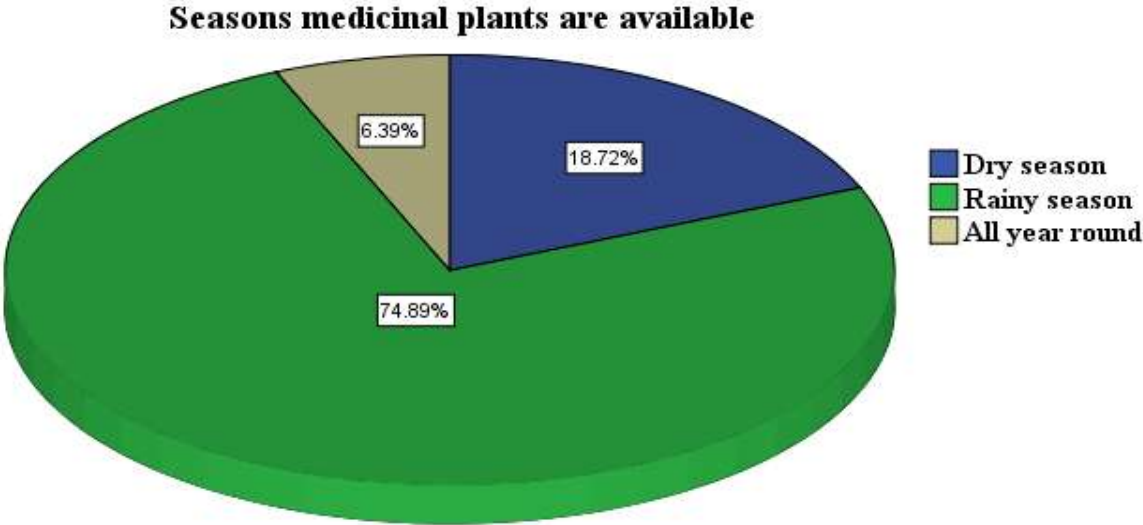
Figure 38: Is a pie chart illustrating seasonal availability of medicinal plants in the Lawra and Nandom districts.
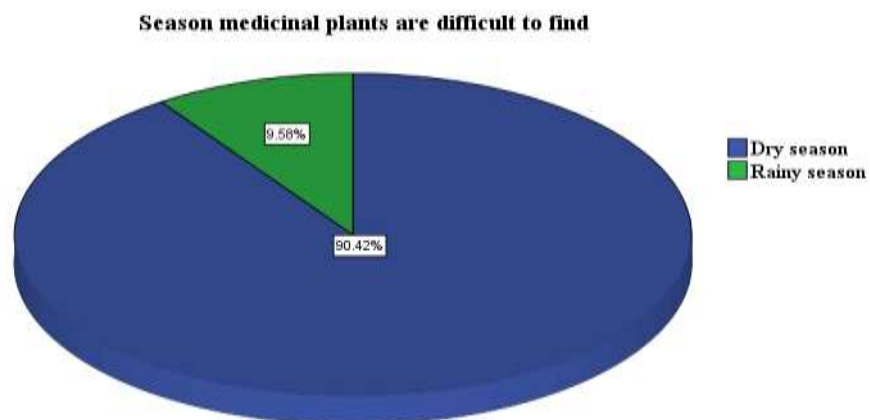
Figure 39: A pie chart illustrating seasons medicinal plants are difficult to come by.

Table 9: Reason medicinal plants are difficult to find

Reason Medicinal Plants are difficult to find	Frequency	Percent	Valid Percent
Bush fire	98	24.4	41.0
Bush fire, farming and over exploitation	49	12.2	20.5
Bush fire and deforestation	1	0.2	0.4
Drought	30	7.5	12.6
Destruction by animals	5	1.2	2.1
Drought and bush fire	11	2.7	4.6
Difficulty to dry in the raining season	1	0.2	0.4
Drought and wilting	4	1.0	1.7
Drought and farming activities	1	0.2	0.4
Over exploitation	23	5.7	9.6
Plants shedding leaves	14	3.5	5.9

Plants shedding leaves	14	3.5	5.9
Poor farming methods	1	0.2	0.4
Erratic rains	1	0.2	0.4
Total	239	59.5	100.0

Both districts recorded 53.9% of respondents with evidence that, all the communities under the two districts were protected against bush burning. In a similar manner 31% of respondents stated areas under forestry as the most protected against farming activities. About 34.3% respondents gave credence to place of traditional worship (Tingan) as the most protected against building and construction. Next was 33.6% of respondents suggesting that the forestry and the cemetery are the most protected area compared to building and construction. The figures 44, 45, 46 and 47 are pie charts vividly illustrating the information above.

Names of areas protected from bush burning

Legend:
- Gbangla
- Farms
- Whole community
- Forestry area
- Forest and along the valley areas
- Graveyard and forest
- Along the valleys
- Hilly areas
- Forest and farms
- Tangzu (Hill top)
- Tingan and forest
- Cashew and teak plantations
- Tingan
- Forest and Tangzu(Hill top)
- Around the river
- Bu Saazu (Hill top)
- Gardens

Pie chart values: 3.09%, 15.45%, 53.93%, 12.64%, 2.58%, 0.1%, 0.2%, 3.09%, 0.1%, 0.5%, 1.97%, 1.0%, 0.26%

Figure 40: A pie chart illustrating the names of areas within the Lawra and Nandom districts protected from bush burning.

Names of areas protected from farming activities

Legend:
- Tengan pari
- Groove
- Forestry area
- Tang
- Tingan and forest
- Along the valleys
- Forest and graveyard
- Forest and along rivers
- Along the river banks
- Where Gods reside
- School area
- Wawali
- Tangzu
- Forest and Tangzu(Hill top)
- Kusepane (Stone area)
- Reserved lands for grazing
- Community park

Percentages shown: 21.76%, 2.78%, 31.02%, 2.31%, 8.80%, 3.70%, 19.44%, 2.7%, 0.9%, 2.7%, 0.46%

Figure 41: A pie chart illustrating the areas protected from farming activities withing the Lawra and Nandom district.

Names of areas protected from building and construction

Legend:
- Tingan
- Farms
- Forest
- Around the river
- Forest and school
- School area
- Kusepane (Stone area)
- Forest and Cemetery
- Cemetery and around water bodies
- Forest and around water bodies
- Around the valley
- Forest and the vallies
- Around the SHS
- Community park

Percentages shown: 34.31%, 3.65%, 4.38%, 10.95%, 0.73%, 33.58%, 2., 0.73%, 4.38%, 0.73%
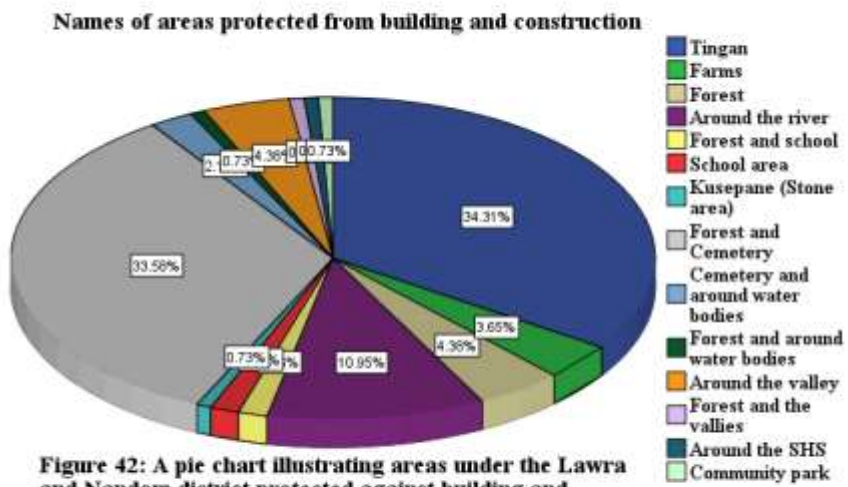
Figure 42: A pie chart illustrating areas under the Lawra and Nandom district protected against building and construction.

Traditional laws are the sole means of regulating issues concerning biodiversity and land conservation in the Lawra and Nandom district. This was confirmed by 70.5% of the respondents. Additionally punishment meted out to individuals breaking these laws ranged from cash payment to capital punishment. About 92.2% of the respondents agreed to the evidence of cash payment.

Traditional authorities protection of land and vegetation

1.28% 4.10%

24.10%

70.51%

By local watch dog committee

Traditional laws and regulations

Police

Assembly man
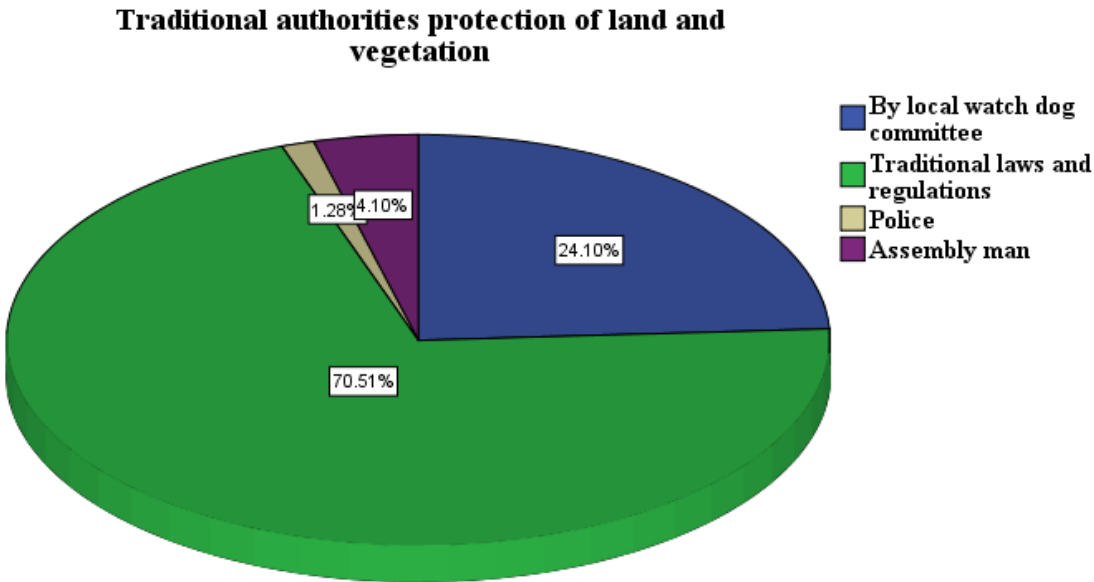
Figure 43: A pie chart illustrating traditional authoritites means of enforcing laws to protect land and vegetation.

Mode or criteria of punishment

4.32 0.2 3.24%

92.16%

Cash
Physical assets
Banisment
Number of lashes
with cane
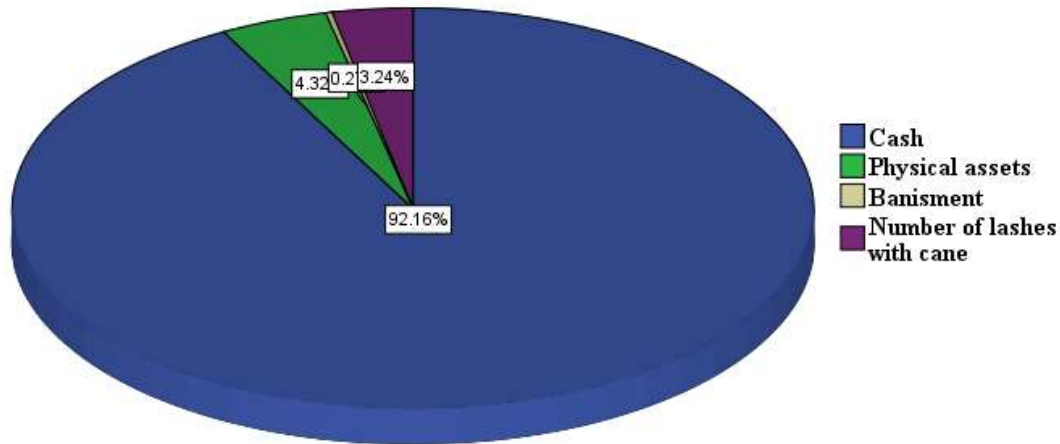
Figure 44: A pie chart illustrating the punishment meted out to individuals who flout laws meant to protect vegetation in the Lawra and Nandom district.

The availability, access and use of medicinal plants in the Lawra and Nandom district as illustrated by the analysis of the study is a matter of great concern to the rural community members. Medicinal plants of various species are available, accessible and are been used primarily for treating all kinds of ailments. The alternative uses of these plants aside curing ailments also creates tremendous benefits to the communities studied by serving as fuel in homes, food and construction materials .

CHAPTER FIVE

Discussion

The main aim of the study was to assess the availability, access and use of medicinal plants in the Lawra and Nandom districts of the Upper West Region. Therefore an effective design and efficient scoping of both districts did have great impacts on the final delivery as emphatically illustrated by Mirza (2013) that, a project scope with clearly defined goals and objectives serves as a dimension for project success.

The two districts are dominated by peasant farmers and the least occupation within the districts was those who burn charcoal for a living. The study confirmed that, in both districts 77.4% of respondents are engaged in agriculture. On the average this was relatively close to 84% projected by the Ghana Statistical Service during the population census in 2010 (Ghana Statistical Service, 2014). The majority of ages of respondents ranged between, 41 years and above, which implies that, most subjects were adequately matured to make judgments on their own.

Additionally female participation far outweighed their male counterpart in terms of active participation in the study. A greater portion of respondents, that is 75.9% had household sizes numbering five and above. This also suggests the reason for the higher reliance on medicinal plants as means of cheaper source of health provision. Furthermore majority of respondents, 29.6% of them are illiterates and have never stepped in a class room all their lives.

5.1.0 Identifying common ailments and the medicinal plants used to treat them in the traditional and orthodox medicine.

In this study majority of the respondents confirmed malaria as the commonest disease. This is in line with the Ghana Health Service (GHS) 2005 report. It was therefore no surprise to find 61.2% of

respondents attesting to malaria as the commonest disease in the Lawra and Nandom districts. The dependence on medicinal plants as an immediate primary health care measure, as touted by various studies around the globe such as that of Doughari (2009) in rural communities was specifically and emphatically revealed by 64% of respondents.

Additionally it accounts for the level of reliance of residents of the Lawra and Nandom districts on ecosystem services provided by medicinal plants, and the extent to which medicinal plants affect their livelihoods. Considering the cost distance travelled to get orthodox treatment, it's prudent for a second look at formalizing the use of medicinal and plants by the Ghana Health Service (GHS) in the treatment of diseases within the rural communities of Ghana and beyond.

Furthermore in the cause of treating an ailment, respondents that is 32.4%, used three different plant species in the treatment process. With a better understanding of the phytochemical constituents of medicinal plants, this could be reduced so as pave way for biodiversity conservation and therefore the perpetuation of medicinal plants in the two districts.

The significant Pearson's correlation coefficient of 0.85 derived between commonest diseases in Lawra and a Nandom districts and the reason for using medicinal plants shows a strong relationship between these variables. Thus as respondents submission between the two districts increases, common diseases such as malaria tend to increase because of positive relationship.

Similarly, the bivariate correlation coefficient of -0.52 between commonest ailments in the two districts and the number of medicinal plants used for treatment suggest a strong and significant relationship between the two variables. So as the number of medicinal plants used decreases the common diseases within the districts increases and the vice versa.

The cross tabulation was used to ascertain how the two districts stand alone with regards to the variables

under study. The two districts confirmed malaria as the commonest disease within the two districts. Thus 57.2% and 4.8% of respondents from Lawra and Nandom district respectively confirmed malaria as the most common disease within the two districts. The remaining ailments however were far more less in the Lawra district as compared to the Nandom district. Additionally more of the sample population in the Lawra district agreed to the affordability of the use of medicinal plants than those in the Nandom district.

In assessing the number of medicinal plants used in treating ailments within the individual districts – that is Nandom and Lawra. A significant greater portion of the respondents in the Nandom district, that is 66.7%, used more medicinal plant species, five and above in treating a particular ailment as compared to the 62.2% of the respondents in the Lawra district who used three different species of plants in treating ailments in the Lawra district. So even though lesser number of respondents in the Nandom district agreed to the use of medicinal plants because they are affordable, they actually use more plant species than their Lawra counterpart in treating a particular ailment.

5.1.1 Alternative uses of medicinal plants, their ease of access and the collection practices employed in the Lawra and Nandom district.

Medicinal plants are special for their health benefits, however they are also noted for multiple or alternative uses apart from their role in treating various ailments. In this study, medicinal plants can be used for firewood. Similarly Appiah *et al*, (2017) concluded in their study, that medicinal plants could be used for weed control. In this study 29.2% confirmed that, aside the medicinal benefits, they are also used as firewood. Very few respondents attested to it been used for ritual practices, perhaps due to the highly predominant Christian communities in the districts (Ghana Statistical Service, 2010b).

Contrary to notion that medicinal plant users have to travel long distances before access to assorted

species of plants as proposed by the study conducted by Imoro *et al.*, 2013 in northern Ghana, majority of respondents, about 42.3% in the two districts obliged that they get access to medicinal plants close their homes. Thus access should not be confirmed as problematic.

The availability of medicinal plants between now compared to thirty years ago by cross tabulation within the two districts revealed that 32.5% of respondents attested to medicinal plant available now than thirty years ago in the Lawra district, the same percentage attested to less availability in the Nandom district. The difference in availability of medicinal plants might be due to over exploitation of medicinal plants in the Nandom district as it was suggested by respondents that, they use more plants in treating common ailments as compared to those in the Lawra district.

Bush fires and other causes such as heavy rains, over grazing are also attributed to the less availability of medicinal plants. The collection practices and methods of harvesting medicinal plants is key and essential requirement to the survival of most medicinal plant species around the globe. The World Health Organization (WHO) therefore reported in their document "WHO Guidelines on Good Agricultural and Collection Practices (GACP) for medicinal plants" that, Collection practices should ensure the long-term survival of wild populations and their associated habitats ("WHO guidelines on good agricultural and collection practices (GACP) for medicinal plants," 2003).

There is no plan for collection of medicinal plants in the two districts. For the Lawra district, 71.6% of respondents harvested medicinal plants by cutting various plant parts needed. Most of the respondents in the Nandom district, represented by 87.1%, however harvested medicinal plants by peeling the plant parts needed. Both methods pose threats to biodiversity conservation as they rather threaten the survival of many species.

In this study respondents derive benefits from the alternative use of medicinal plants. Collection

practices in the two districts however is not the best as it goes contrary to the international standards set, like that of the World Health Organization (WHO). Respondents also have access to medicinal plants as and when they are needed.

5.1.2 The rate of collection and location in the two districts.

The frequency of harvesting or collecting medicinal plants was adjudged by majority of respondents, 31% to be once a month. Additionally 62.1% of respondents mostly collected the leaves of medicinal plants for treating ailments. This practically should not be a threat to biodiversity as most leaves will eventually regenerate. However the semi-arid nature of the area which is related to increased precipitation suggests that over exploitation could as well cause the depletion of most species.

The major location of medicinal plants was their farms. The next location of collecting plants was indicated as the wild, and this was confirmed by 38.5% of respondents. We could as well conclude that, majority; about 80.1% of the respondents take their source of medicinal plants from the wild. As confirmed by Malan *et al*., 2015, the major source of medicinal plants in most African countries is the wild. The market, as a source of medicinal plants was the least among choices of location of collecting medicinal plants. At the moment commercial gatherers of medicinal plants, as stated by (Malan *et al*., 2015) whether for rural, national or international trade are mostly poor people whose main aim is not resource management but to earn a living, thus the ultimate result of their activities is over exploitation of these unique ecosystem system service providers. The proposal made by Hutchings (1989) several years ago for commercial cultivation backed and enhanced by individual states is the only way to go in order to preserve biodiversity and to aid the perpetuation of medicinal plants in all nations around the globe. In this study, only 14.7% of the respondents were in some form of medicinal plant cultivation. Cultivation was however not in commercial quantities.

Most of the respondents from Lawra district acquired medicinal plants from their farms as compared to the Nandom district. On the other hand, more of the respondents from the Nandom district accessed medicinal plants from the wild, than the Lawra district. With the cultivation of medicinal plants, there were more respondents in the Nandom district than the Lawra district. The market was the least of location choices to access medicinal plants in both districts which tend to suggest a rather low marketability of medicinal plants in both districts and thus a less of lucrative avenue of earning extra income.

As stated earlier, there was no evidence of commercial cultivation of medicinal plants in both districts. Respondents understood the cultivation of medicinal plants to be planting of some few trees around their homes. In this sense mango was the most cultivated up to 19.7% for the Lawra district and 1.52% for the Nandom district. The presence of combinations of several plants was noted as well. For instance a combination of mango and pawpaw, of which 18.18% of respondents in Lawra district cultivated as compared to the 3.03% in the Nandom district. Notable too but not significant as compared to those mentioned above were cultivation of guava and mango, moringa, mango and gourd, mango and sweet potato, pawpaw, moringa and pawpaw and what have you.

The study revealed the predominant use of leaves of medicinal plants in treating ailments. Additionally plants were mainly taken from farms of respondents. Even though, there is no commercial cultivation of medicinal plants, individuals engage in planting trees with therapeutic potentials.

5.1.3 Livelihoods impacts of medicinal plants and their marketability in the Lawra and Nandom district.

The emphasis that, majority of the rural folk around the world depend on medicinal plants as their primary source of health care Ekor 2014, was captured as several respondents indicated, that they do

not go to hospital because of the use of medicinal plants. Additionally others saved money and some among other things have actually never been to the hospital because medicinal plants played a part in their livelihood.

As indicated earlier, 14.7% are involved in the cultivation of medicinal plants in the two districts. Of this percentage, 83.33% cultivated within the range of one to two acres of land and the remaining 16.67% of this cultivated five to six acres of land. It is prudent to further state here that, respondents planted various plants of medicinal value but not commercially.

Since health needs of communities is one is one great important factor in their livelihoods Ekor (2014, the study delved into the effect of seeking health care on the finances of the respondents. It was revelation that 81.84% of respondents spent an equivalent of nine Ghana cedis (GH¢9.00) or more for health services in the hospital as compared to 74.1% of respondents spending less than five Ghana cedis (GH¢5.00) to get health treatment by the use medicinal plants is a staggering revelation and this confirms subjects notion that, they save money when using medicinal plants than seeking treatment from the hospital.

On the purchase and sale of medicinal plants, 29.4% of the sample population bought or sold medicinal plants in the two districts, which confirms that, medicinal plants may not serve as an additional source of income to community members as most people can easily get access to them from the wild. It does also confirm the reason rural folks around the world are exploited and paid merger wages for gathering medicinal plants for giant pharmaceutical companies to the detriment of biodiversity.

Cross tabulating variables under this objective showed the desire of more respondents in the Nandom district in using medicinal plants to augment their livelihoods as they cultivated and put more land areas

under cultivation than the Lawra district.

5.1.4 Factors that threaten the availability of medicinal plants in the Lawra and Nandom districts.

Among factors such as: farming, drought, bush fire, high temperatures and over exploitation as threats to medicinal plant availability or access within the districts bush burning tops the list of respondents as the greatest threat to medicinal plants availability or access within the districts. As indicated by Lignule (2017), the repercussions of fire and for that matter bushfire are numerous. Bush fire destroy young plants and hinder the regeneration of woody plants, it depletes organic matter, reduces soil fertility, and ecosystem functions such as photosynthesis and nutrient water absorption, are degraded. High temperatures within the region were adjudged the least threat to medicinal plant access or availability by the respondents. There is the need for further studies to ascertain the relationship between temperature and its effects on medicinal plants availability within the two districts.

Even in the midst of this conundrum 58.5% of the respondents believes that medicinal plants are available but such availability varied seasonally, with the dry season an the issue of concern. Subjects referred to bush burning as the factor creating the decline of medicinal plants in the dry season. It is openly acknowledged that in the dry season most plants and shrubs including medicinal plants in both districts dry up and are susceptible to burning with little exposure. Livestock farmers usually burn bush for fresh grass and hunters do likewise to aid hunting. The unforeseen is the destruction of biodiversity.

The two districts in their own effort have been doing their best to protect vegetation and biodiversity. To accomplish this there are traditional laws enforced to regulate the nuance that lead to destruction of biodiversity. Indigenes that go contrary to these laws incur punishments of various kinds but the most

common is cash payment. By their efforts however, most communities in the two districts have measures for protection against bush. The forest are more protected against farming activities, place of traditional worships are more protected against building and construction but the forestry and cemetery are the most protected against building and construction.

In conclusion malaria was revealed as the predominant ailment within the two districts and the medicinal plant usually used in treatment is the neem tree (*Azadirachta indica*). The study couldn't determine the use of medicinal plants in orthodox treatment as there was no response in this regard. Additionally the alternative use of medicinal plants was determined as firewood. The access of respondents to medicinal plants was ascertained to be well and convenient. However, there were no plans for collecting medicinal plants as stipulated by international organizations like the World Health Organization (WHO).

The leaves of plants were shown to be the used for treating ailments and are usually collected from the farms of respondents. The rate and frequency of collection of plant parts depended on when they are needed. Impacts of medicinal plants on respondents ranged from saving money and time because of their affordability. The collection of medicinal plants is however not a lucrative venture and cannot serves as an alternative source of income to respondents. Therefore the cultivation of medicinal plants is limited to the planting of trees of therapeutic importance around the homes of respondents.

Bush fire was noted topmost among farming, drought, high temperatures and over exploitation as the greatest threat to access and availability of medicinal plants. Respondents also stated that medicinal plants are available in rainy season than the dry season. The Lawra and Nandom districts have traditional laws in place for the conservation and protection of biodiversity but these laws need to be assessed to determine their effectiveness.

CHAPTER SIX

Conclusion and Recommendation

a.   Conclusions

The study conducted to assess the availability, access and use of medicinal plants came up with the following conclusions.

Medicinal plants are the primary source of treatment of various ailments in the Lawra and Nandom districts. More than a single species of plant is used in treating a particular ailment in both districts. There was more reliance on medicinal plants as means of treatment in the Lawra district than the Nandom district but the Nandom district used more species of plants in treating an ailment than the Lawra district. More plants are exploited from the Nandom district than the Lawra district.

The major alternative use of medicinal plants in the Lawra and Nandom district is fire wood. The proposal that herbalist travel long distances before getting access to medicinal plants, was not observed in both districts as medicinal plants are available for use. This notion was however not very significant taking into consideration the total respondents. This however, is the view of several households and not just key informants.

The varying disparity in relationship with medicinal plant availability now as compared to thirty years ago, was encouraging for the Lawra district than the Nandom district. The signs of overexploitation expressed by respondents in the Nandom district support this claim in diverse ways.

There are no harvesting plans for collecting medicinal plants, be it the wild or farms. Harvesting of medicinal plants is not sustainable as recommended by international organizations such as the World Health Organization (WHO). This perhaps is the reasons behind signs of overexploitation identified. Other non-sustainable collection practices such as cutting and pilling plants is also high.

So far just some few individuals are into commercial gathering of medicinal plants. Their influence on biodiversity and over exploitation of medicinal plants and other ecosystem services are not certain at the moment.

The major source of acquisition of medicinal plants in the Lawra and Nandom district is their farms and the wild. Leaves of plants are the most collected for treatment purposes. When effectively controlled leaves gathering won't be so much of a problem but with overexploitation and impacts of semi-arid climate matters, this could be worsened as most plants may not survive the harsh weather conditions or could adapt by changing their phytochemical properties.

At the moment, there is no serious cultivation of medicinal plants in the Lawra and Nandom districts. A lot of tree planting seems to be happening in the Nandom district but this can't be regarded as commercial cultivation of medicinal plants.

The presence of medicinal plants as an ecosystem service has a great impact on the livelihoods of the respondents. Many rural folks save time and money due to the dependence on medicinal plants for their health needs.

Bush fire or bush burning is tops the list of threats to biodiversity and the perpetuation of medicinal plants in the Nandom and Lawra district.

b.   Recommendations

The recommendations pertaining to this study are as follows:

- It is prudent that forestry and wildlife commission, the Centre for Scientific Research on plant medicine and the Ghana Health Service educate community members on the phytochemical properties of medicinal to aid in their use and control overexploitation.

- There is the need for more in-depth studies with regards to the distance travelled before members of the community get access to medicinal plants.

- Further studies around the areas of over exploitation in the Nandom district will further clarify their claim that there is reduction in availability of medicinal plants now as compared to thirty years ago.

- The involvement of the Environmental Protection Council of Ghana, the Forestry Commission, the Plant Protection and Regulatory Services Directorate (PPRSD) and other stakeholders of concern must be encouraged to put the right collection practices in place so as to salvage and improve biodiversity.

- The collection practices of medicinal plants has diverse consequences on biodiversity, there is therefore need for further and in-depth studies by the Plant Research Department of the University of Ghana to understand collection practices of medicinal plants and thus provide best practices in this regard in Ghana.

- Members of the communities studied are already planting trees with medicinal value, this

practice needs to be encouraged and enhanced by the Plant Protection and Regulatory Services Directorate and the Forestry and wildlife commission as a means of encouraging biodiversity and the sustainable growth of these plants.

- There are traditional laws and regulation for conservation and protection of some land marks like the forest, cemetery and places ear-marked for traditional worship. These are not so much effective as many perpetrators go scot free, are not found in most cases and punishment is not detrimental enough. The communities therefore need the backing of the state and other agencies in this fight.

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APPENDIX

UNIVERSITY OF GHANA
INSTITUTE FOR ENVIRONMENT AND SANITATION STUDIES (IESS)
QUESTIONNAIRE

(Information on the assessment of the availability, access and use of medicinal plants)

This questionnaire is being administered to investigate the availability, access and use of medicinal plants in the communities under study. The study is purely for academic purposes and the information will be treated confidentially. Your genuine response is very much needed for the success of the exercise.

PART A
DEMORGRAPHIC SURVEY

1. Name of district_____

2. Name of community _____

3. What is your occupation?
   a. Farmer ▢   b. Trader ▢   c. Pito brewer ▢   d. Herbalist ▢
   e. Charcoal producer ▢
   Others specify: _____

4. How old are you?
   a. 20 yrs. and below ▢   b. 21-25 ▢   c. 26-30 ▢   d. 31- 35 ▢   e. 36-
   40 ▢   f. 41 and above ▢

5. Kindly state your sexual orientation.
   a. Male ▢   b. Female ▢

6. What is your marital status?
   a. Married ▢   b. Unmarried ▢   c. Engaged ▢   d. Separated ▢
   e. Widowed ▢

7. What is your role in the family?
   a. Family head ▢   b. Mother ▢   c. Child ▢   d. dependent ▢

8. How many people make your household?
   a. One Person ☐   b. Two people ☐   c. Three people ☐   d. Four people ☐ e. Five and above ☐

9. Which ethnic group do you belong to?
   a. Sisaala ☐   b. Waala ☐   c. Dagaaba ☐   d. Frafra ☐

10. What is your level of education?
    a. Primary level ☐   b. Junior High School ☐   c. Senior High School ☐
    d. Tertiary level ☐   e. Vocational institution ☐   f. Adult education ☐

PART B
COMMON AILMENTS AND TRADITIONAL TREATMENT USED

11. What are the commonest diseases within the community?
    a. Malaria ☐   b. Upper Resp. Tract Infection ☐   c. Rheumatism & Joint Pain ☐   d. Skin Diseases & Ulcers ☐   e. Acute Eye Infection ☐
    Others specify _____

12. Which one of the following ailments affects you?
    a. Malaria ☐ b. Upper Resp. Tract Infection ☐   c. Rheumatism & Joint Pain ☐
    d. Skin Diseases & Ulcers ☐   e. Acute Eye Infection ☐
    Others specify _____

13. How often does the ailment come each year?
    a. Once ☐   b. Twice ☐   c. Three times ☐   d. Four times ☐   e. Five and above ☐

14. Why do you use medicinal plants as means of treating ailments?
    a. It is safe ☐   b. It is affordable ☐   c. It has no side effects ☐   d. Everyone uses it ☐
    Others specify _____
    _____

15. About how many medicinal plants do you know are used in treating the ailment mentioned?
    a. One ☐ b. Two ☐ c. Three ☐ d. Four ☐ c. Five and above ☐

16. Kindly give the local names to these plants.
    1. _____   3. _____
    2. _____   4. _____

17. How do you use the plants mentioned above?
    a. Boiling ☐   b. Soaking ☐   c. Burning tissues ☐   d. Grinding ☐   e.
    Drying ☐   f. Pounding ☐   g. Drying and pounding ☐
    Others specify_____

    _____

18. How long does it take for you to get healed?
    a. Less than a week ☐   b. Two weeks ☐   c. Three weeks ☐   d. Four weeks ☐
    e. Beyond four weeks ☐

19. Do you often get herbal treatment from the hospital?
    a. Yes ☐   b. No ☐

    If yes which one of the following ailments was treated?
    a. Malaria ☐   b. Upper Resp. Tract Infection ☐   c. Rheumatism & Joint Pain ☐   d. Skin
    Diseases & Ulcers ☐   e. Acute Eye Infection ☐
    Others specify _____

PART C
ALTERNATIVE USES OF MEDICINAL PLANTS, EASE OF ACCESS AND COLLECTION PRACTICES

20. Apart from treating ailments what other uses do you put medicinal plants to?
    a. Food ☐   b. Animal feed ☐   c. Pesticides ☐   d. Cultural practices ☐
    e. Firewood ☐   f. Building houses ☐   g. Making agricultural tools ☐
    Others specify: _____

21. How far do you go before getting medicinal plants needed?
    a. Around the house ☐   b. Close to my house ☐   c. Far from my house ☐
    d. Very far from house ☐

22. Compared to thirty years ago, would you say medicinal plants are easy to come by?
    a. Yes ☐   No ☐

    If   no   why   do   you   think   they   are   hard   to   find   these
    days_____

    _____

23. How do you harvest your medicinal plants?
    a. Uprooting ☐   b. Cutting ☐   c. Plucking ☐   d. Peeling ☐

24. What do you do when medicinal plants can't be found for treating ailments?
    a. Go to hospital for treatment ☐   b. Get it from nearby village ☐   c. Plant some in the garden ☐   d. Borrow from nearby houses ☐

PART D
PLANT PARTS COLLECTED, RATE OF COLLECTION AND SOURCES OF ACQUISITION

25. Where do you get the plants used for medicine?
    a. In the wild ☐   b. Backyard ☐   c. Farm ☐   d. Market ☐

26. Do you cultivate or plant medicinal plants for use?
    a. Yes ☐   b. No ☐

    If yes kindly name those you cultivate: _____

    _____

27. How often do you go to harvest medicinal plants?
    a. Once a month ☐   b. Twice a month ☐   c. Thrice a month ☐   d. Four times a month ☐
       Others specify: _____

28. Are there any other places you get your medicines apart from the one mentioned earlier?
    a. Yes ☐   b. No ☐

    If yes name these places: _____

29. Which part of the plant do you use for the medicine?
    a. Roots ☐   b. Back ☐   c. Leaves ☐   d. Flowers ☐   e. Fruits ☐
       f. Seeds ☐   g. Tubers ☐   h. Stem ☐   i. Wood ☐

PART E
LIVELIHOOD IMPACTS OF MEDICINAL PLANTS AND MARKETABILITY

30. In which of the following ways has the use of medicinal plants influenced your lives over the years?
    a. Saved money ▭ b. Do not go to hospital often ▭   c. Never been to hospital ▭
    Others specify_____

31. Do you cultivate medicinal plants for sale?
    a. Yes   ▭   b. No   ▭

    If yes how big is your medicinal plant farm?

    a. Less than one acre ▭ b. 1-2 acres ▭   c. 3-4 ▭   d. 5-6 ▭

    Others specify _____

32. About how much do you spend to seek healthcare from the hospital?
    a. Less than GH₵ 5 ▭   b. GH₵ 6 ▭   c. GH₵ 7 ▭   d. GH₵ 8 ▭
    e. GH₵ 9 and above ▭

33. About how much do you spend seeking healthcare with the use of traditional medicine as means of treatment?
    b. Less than GH₵ 5 ▭   b. GH₵ 6 ▭   c. GH₵ 7 ▭   d. GH₵ 8 ▭
    e. GH₵ 9 and above ▭

34. Do you sell medicinal plants?
    a. Yes ▭   b. No ▭

35. Do you buy medicinal plants from the market or any other person in the community?
    a. Yes ▭   b. No ▭

    If yes, how often do you buy them from them?
    a. Once a week ▭   b. Everyday ▭   c. On market days only ▭   d. Any other day
    ▭
    Others specify: _____

36. What is the least cost of medicinal plants in the community?

a. GHℂ 1 and below ▭   b. GHℂ 2 ▭   c. GHℂ3 ▭   d. GHℂ 4
▭   e. GHℂ5 and above ▭

PART F
LAND USE LAND COVER CHANGES AND PRACTICES THAT THREATEN AVAILABILITY

37. Which of the following activities do you think serves as a threat to the availability of medicinal plants in the community?
    a. Farming ▭   b. Drought ▭   c. Bush fire ▭   d. High temperatures
    ▭   e. Over exploitation ▭

38. Do you get medicinal plants as and when you need them?
    a. Yes ▭   b. No ▭

    If yes which parts of the season are they available?
    a. Dry season ▭   b. Rainy season ▭

    If no which parts of the season are they difficult to obtain?
    a. Dry season ▭   b. Rainy season ▭

39. Why do you think medicinal plants are difficult to find in the season mentioned above?
    _____
    _____
    _____

40. Are there areas in the community that are protected from bush burning?
    a. Yes ▭   b. No ▭

    If yes kindly name those areas you have in mind.
    _____
    _____

41. Are there areas in the community protected from farming activities?
    a. Yes ▭   b. No ▭

    If yes kindly name the areas you have in mind.
    _____
    _____

42. Are there areas in the community protected from building and construction of roads and houses?
     a. Yes ☐   b. No ☐

     If yes kindly name the areas you have in mind.

     _____

     _____

43. How does the traditional authority protect land and vegetation in the community?
     a. By local watch dog committee ☐   b. Traditional laws and regulations ☐   c. Police
          ☐   d. Assembly man ☐

44. Are people punished for breaking laws?
     a. Yes ☐   b. No ☐

45. If yes, how is the punishment carried out?
     a. Cash ☐   b. Physical assets ☐   c. Banishment ☐   d. Number of lashes with
          cane ☐