

UNIVERSITY OF EDUCATION, WINNEBA

**PERCEPTION OF COMMUNITY MEMBERS ON THE IMPACT OF
LOGGING ON MEDICINAL PLANTS; A CASE ON BOBIRI FOREST
RESERVE**



EDWARD BOAMPONG

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Master of Philosophy
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JUNE, 2023

DECLARATION

Student's Declaration

I, **Boampong Edward**, declare that this thesis with the exception of quotations and references contained in published works which have been identified and duly acknowledged is entirely my original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

Signature.....

Date.....

Supervisors' Declaration

We hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of thesis as laid down by the University of Education, Winneba.

Name of Supervisor: Prof. John Kwame Boateng (Ph.D.)

Signature.....

Date.....

Name of Co-Supervisor: Felix Kwabena Donkor (Ph.D.)

Signature.....

Date.....

DEDICATION

I dedicate this work to God Almighty, my Parents, Mr. and Mrs. Boampong, my siblings (Boampong Emmanuel, Mercy Boampong, Gladys Osei, Gifty Boampong) for your support throughout my studies. This work is also dedicated to Justina Addae, whose moral and material support helped me complete this dissertation successfully.



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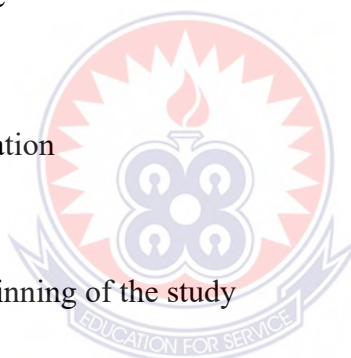
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LIST OF ABBREVIATIONS

AUPS	-	African Union Medicinal Plant Strategy
CBCP	-	Community-Based Conservation Programmes
CBD	-	Convention on Biological Diversity
CSMP	-	Certification and Standardization of Medicinal Plants
CSO	-	Civil Society Organisations
EUTR	-	European Union Timber Regulation
FLEGT	-	Forest Law Enforcement, Governance and Trade
FORIG	-	Forestry Research Institute of Ghana
FRNR	-	Faculty of Renewable Natural Resources
FSD	-	Forestry Service Division
FWG	-	Forest Watch Ghana
GFWD	-	Ghana Forest and Wildlife Policy
GIFDA	-	Ghana Institute of Foresters District Assemblies
GSPC	-	The Global Strategy for Plant Conservation
IUCN	-	International Union for Conservation of Nature
MPSG -	-	Medicinal Plant Specialist Group
NBSAP	-	National Biodiversity Strategy and Action Plan
NCCE	-	National Commission for Civic Education
NCPMH	-	National Center for the Preservation of Medicinal Herbs
RTTF	-	Regional Timber Task Force
SDG	-	Sustainable Development Goals
SHT	-	Sustainable Harvesting and Trade
TCM	-	Traditional and Complementary Medicine
TIG	-	Tropenbos International Ghana

TKDL	-	Traditional Knowledge Digital Library
TKIPR	-	Traditional Knowledge and Intellectual Property Rights
UNCTAD	-	United Nations Conference on Trade and Development
UNDP	-	United Nations Development Programme
WHO	-	World Health Organisation



ABSTRACT

Many Ghanaian rural communities depend on forest medicinal plants for health and income, but logging threatens the sustainability of these ecologically and medicinal valuable species. This research study examined community members' perceptions about the effect of logging on medicinal plants in the Bobiri Forest Reserve. The study also explored perceptions about policies and programmes for the reduction of logging on medicinal plants. The study adopted the pragmatic research philosophy and used a mixed-method approach. Questionnaire was used to collect data from household living in distant to the forest reserve. Also, interview was conducted with Ghana Forestry Commission, opinion leaders, herbalists, and loggers. Data was processed and analyzed using percentages and frequencies. Results indicated that logging has resulted in job losses in the medicinal plants' value chain, affecting negatively on the livelihoods, cultural practices and rituals, growth, distribution and availability of medicinal plants. Also, community members who rely on medicinal plants for treatment have experienced adverse health effects. The study recommends developing educational and awareness campaigns highlighting the usefulness and ecological significance of medicinal plants in Ghana as a whole and in Bobiri Forest Reserve in particular. Regulations, and policies should be established to protect endangered medicinal plant species.



CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Forests ecosystems cover approximately 30% of the world's land area and comprise complex ecological communities dominated by tree species (Brockhoff et al., 2017). Globally, forests can be categorized into ecological biomes based on climate and geographical factors, with major types including tropical rainforests, temperate forests, and boreal forests (Malhi et al., 2022). Forests provide habitat for over 80% of all terrestrial biodiversity including many rare, threatened, and endangered species (Lindenmayer & Franklin, 2002). Forest ecosystems play vital environmental roles that support all life on earth. They regulate hydrological cycles, sequester massive amounts of carbon, mitigate climate change, prevent erosion, and influence precipitation (Jiménez Cisneros et al., 2022). Recent analysis quantifies natural forests alone capturing 7.6 billion metric tons of CO₂ annually (Hubau et al., 2022). Globally, 1.6 billion people depend to varying degrees on benefits that come directly from forest ecosystems (Chao, 2012).

Forests globally face exceptional threats resulting in rapid habitat loss and degradation. Since 1990 over 420 million hectares of forests have been cleared for conversion to agricultural land, pastures, plantations, and development (Song et al., 2018). Commercial logging, mining, infrastructural expansion and fires further degrade standing forests (Barlow et al., 2016). Only about 30% of primary forests remain relatively intact today (Potapov et al., 2017). This destruction and fragmentation severely impact dependent biodiversity. Populations of forest-dwelling species specialized to native habitats have declined over 50% in the last 50 years (WWF, 2022).

Edge effects that disrupt microclimate and resources penetrate up to 1 km into fragmented forests further reducing biodiversity stability (Haddad et al., 2015). Habitat loss drives predictions of over 18% of Amazonian plants facing extinction (Hubbell et al., 2008). Rare endemic flora and fauna disappear before discovery, losing potential scientific knowledge and chemical compounds for medicine.

Deforestation also reduces climate change mitigation and exacerbates global warming. As a carbon sink, forest loss currently contributes 10-15% of all greenhouse gas emissions globally (Harris et al., 2021). In the Amazon alone where 10-15% of all terrestrial carbon is stored, clear cutting and fires emitted around 0.9 petagrams of CO₂ annually over last few decades (Walker et al., 2020).

Across the developing world, a substantial proportion of the population lacks reliable access to or resources for modern healthcare services. The World Health Organization estimates up to 80% of people in developing nations depend on traditional medicine for primary care, with medicinal plant natural remedies composing a significant component (Mukungu et al., 2016). For instance, in rural communities of countries like India, Ethiopia, and Ghana upwards of 90% of inhabitants utilize traditional herbal medicine due to efficacy, cultural familiarity, and affordability compared to Western biomedicine (Kumar & Hamza, 2022).

However, unsustainable harvesting and habitat loss now threatens numerous medicinal botanicals in developing countries. On average, developing nations lost 1.11% forest cover annually from 1990 to 2020 (FAO & UNEP, 2020), often facing deforestation rates exceeding reforestation efforts. Studies across tropical Africa, India, and Southeast Asia document declining availability wild medicinal plants linked to deforestation, agricultural expansion and overexploitation (Mukungu et al., 2016; Kumar & Hamza 2022). Simultaneously, demand rises with increasing assimilation of traditional

remedies into national healthcare systems amidst population growth outpacing scaled cultivation efforts (Kala, 2015). Shortages clinically compromise patient outcomes while undermining household economies, cultural identity, and knowledge transmission relying on threatened native species harvested from shrinking intact habitats (Cunningham, 1993). Ghana has experienced extensive deforestation and land conversion over recent decades, averaging 2.19% annual forest cover reduction from 1990-2020 (Aboagye & Gene, 2022). Habitat loss and destructive harvest of non-timber forest products threatens numerous medicinal plant populations (Williams et al., 2000), with traditional healers reporting increasing difficulty locating key species like the fever-reducing *Cincona* species or antimalarial *Cryptolepis sanguinolenta* shrub (McGregor, 2004).

The need to protect forest systems is important for the conservation of medicinal plants. Forests are the natural habitats of many medicinal plants, and deforestation and habitat loss threaten their availability and efficacy (Mukungu et al., 2016; Kumar & Hamza, 2022). Studies across tropical Africa, India, and Southeast Asia document declining availability of wild medicinal plants linked to deforestation, agricultural expansion, and overexploitation (Mukungu et al., 2016; Kumar & Hamza, 2022). The loss of forest cover in developing nations, averaging 1.11% annually from 1990 to 2020, exacerbates the problem (FAO & UNEP, 2020). The continuous utilization of medicinal plants without conservation efforts leads to species scarcity, especially for endangered species (Balick et al., 1996; Williams et al., 2000).

1.2 Problem Statement

In Ghana, the last two decades have witnessed heavy legal and illegal logging across forest reserves to meet rising timber export demand. This has led to loss of customary

medicinal plant resources (Agyeman et al., 2021). The loss of biodiversity has occurred in the Bobiri forest reserve, which was intended to be a pristine rainforest home to several medicinal plants and butterfly species (Akomaning et al., 2022).

Djagbletey et al (2018), assessed the abundance and diversity of medicinal, ectomycorrhizal tree species and macrofungi of economic importance and their relationship with the flora of the reserve.

Barima et al. (2020) assessed the scale of rosewood logging in Bobiri Forest Reserve through remote sensing and found extensive timber extraction between 2010-2015, with associated forest degradation. Moreover, Hall & Swaine (1981) an older ecological study looked at the impacts of logging disturbances on forest regeneration in Bobiri Forest Reserve. The study found low regeneration of plant species. Agyeman et al. (2021) assessed effects of illegal logging on frugivorous birds across various reserves in Ghana including Bobiri Forest Reserve, finding lower bird species richness in degraded logged zones.

These studies have looked at biodiversity, carbon storage, and regeneration in Bobiri Forest Reserve. Specifically, none seem to have examined the ecological effects of logging on medicinal plants in the Bobiri Forest. This study bridges the gap by evaluating the perception of the community members on the impact of logging on medicinal plants.

1.3 Research Objectives

The study general objective assessed the perception of community people on the impact of logging on medicinal plants in the Bobiri forest reserve. The study sought to;

1. Identify specific medicinal plants under threat of extinction due to logging in Bobiri Forest Reserve.

2. Investigate the community perspective on how logging affects medicinal plant in Bobiri Forest Reserve.
3. Analyse the perceived factors that motivate loggers to harvest medicinal plants in Bobiri Forest Reserve.
4. Explore policies and programmes that can be implemented to reduce logging of medicinal plants in Bobiri Forest Reserve.

1.4 Research Questions

The study seeks to achieve the following research questions;

1. Which specific medicinal plants are under threat of extinction due to logging in Bobiri Forest Reserve?
2. What is the community perspective on how logging affects medicinal plant resources?
3. What are the factors that motivate loggers to harvest medicinal plants?
4. How do community members perceive policies and programmes that can reduce logging of medicinal plants?

1.5 Justification of the Study

Logging and its effects on Ghanaian medicinal plants are frequently raised as an environmental concern. Without a doubt, the problem must be significant enough to warrant investigation. If a long-term solution is not found, the problem may spiral out of control, resulting in severe financial consequences for the people of the community and Ghana. This is due to the high cost of replacing lost plants. The research provided knowledge required to take appropriate action. The study's findings provided more information for academic project implementation and policy development, assisting in

halting medicinal plant logging operations and conserving Ghana's Bobiri forest for future generations.

First, in non-academic research, its applicability was used to estimate the cost of illegal logging operations to the Forestry Commission regarding lost revenue and forest conservation expenses. Second, it will assess how chainsaw activities have affected the quality of life of the community's residents. Respondents and community people became more aware of the need to collaborate with the Forest Service Division to manage and regulate the Bobiri forest reserves for sustainability and everyone's socioeconomic benefit as a result of the study. Third, the research provided the Ghana Forestry Commission the information it needed to decide whether or not to manage and suppress logging activity in the forest reserve. Finally, the study results and recommendations if taken into considerations by the responsible traditional authorities, such as chiefs and opinion leaders, to work with the Forest Services Division, would provide the information they require about the chainsaw operators, thereby protecting medicinal plants and protected areas.

1.6 Significance of the Study

Patterns of medicinal plant use documented from local and indigenous ecological knowledge can provide initial evidence of environmental change in reserves. Rural communities' observations of forest conditions and availability of key species over time offers a longitudinal perspective at the landscape scale. Understanding views of logging and forest changes establishes culturally appropriate management balancing preservation with sustainable utilization of resources that villagers depend on. The perspectives and incentives of communities living adjacent to protected areas can clarify drivers of illegal timber harvests as well as barriers to conservation behaviour.

This informs sustainable strategies balancing utilization and preservation of forest medicinal resources that communities rely upon.

Moreover, documenting community perceptions of motivators provides initial data on the prevalence and scale of this specific logging activity. Capturing local observations elucidates major drivers from an emic perspective, clarifying why current policy fails to protect medicinal plants. Findings can inform management plans curtailing unsustainable extraction while maintaining availability of forest genetic resources.

In addition, documentation of mitigation techniques directly conserves resources supporting accessible public health treatment. Capturing local perspectives on feasible interventions at extraction sites allows bottom-up policy reform that communities can support to alter norms. This maintains access while incentivizing selective harvest protecting rare medicinal species.

1.7 Scope of the Study

The research was limited to four communities in the Juaben district. The communities were Kubease, Duampopo, Nobewam and Krofofrom. It discusses the perception of community people on the impact of logging on medicinal plants.

1.8 Limitations of the study

The entire study faced some limitations, including limited involvement of key stakeholders such as opinion leaders, herbalists, forestry officials, and loggers. It took much work to reach out to stakeholders as the researcher had to postpone scheduled meetings for quite some time, delaying the entire data collection process. Also, the language barrier in translating the research instruments into the native language of the respondents. This constraint extended the duration of a sitting with respondents, making

it difficult to meet the daily schedules as pre-defined by the researcher. The perception of community members may be subjective and influenced by personal beliefs, experiences, and cultural factors, leading to potential bias in the data collected.

1.9 Organisation of the Study

This study included five chapters. Chapter One introduces the thesis, which includes a background explanation, a description of the issue, study objectives, and research questions. The research's scope, significance, and structure and the thesis' justification statement are all included in the introduction chapter. The study's second chapter includes related studies on the theoretical foundations of the research, as well as conceptual and empirical concerns highlighting the impact of logging activities on medicinal plants. The theoretical background is also provided in Chapter Two. The third chapter begins with an introduction that describes the research methodologies. The methodology section covers topics such as a review of the research paradigm, a description of the research design and technique, and a discussion of the subject area. Following this, a discussion of the study's ethical concerns, target populations, sampling techniques, data sources, instruments for data collection, instrument pre-testing, data processing and analysis, limits and delimitations is provided. Chapter four contains an analysis of the data gathered and a discussion of the findings. The fifth and final chapter's main topics are the research summary, findings, and recommendations.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Introduction

The relevant research on the perception of community people on the impact of logging on medicinal plants is reviewed in this chapter. According to Kreuger and Neuman (2006), literature reviews exhibit awareness of a body of information and reveal the connections between earlier research and the current study. Creswell (2014) claims that this provides carefully compiled and up-to-date material and separates the most pertinent research that is richly written and relevant to assist readers in learning and utilizing approaches that reduce bias and boost accuracy. Actual research on the subject backs up the offered theoretical framework.

2.1 Concept of Logging

Logging refers to the forestry industry practice of harvesting or cutting down trees for timber resources, which are then transported to mills to be processed into materials and products like paper, furniture, and housing materials. Logging is conducted through a range of practices like selective logging where only certain valuable tree species are harvested, reduced-impact logging using environmentally sustainable methods, and clearcutting which involves uniformly cutting down most or all the trees in an area (Edwards et al., 2014; Kleinschroth et al., 2019).

While tree plantations are increasingly supplemented, forestry resources remain heavily dependent on natural forest harvesting. The Food and Agriculture Organization (2020) estimates roundwood production from global forests totals about 4 billion cubic meters annually. Of this, Asia makes up the largest share at about 66% of total roundwood

production, versus 17% from Europe and 16% from North & Central America (FAO, 2020). However, there are alarming rates of net forest loss globally, calculated using satellite data on tree canopy cover. An analysis by Global Forest Watch revealed the world lost 502,000 square miles of tree cover since 2000 (Global Forest Watch, 2021). Logging makes a substantial contribution to these deforestation trends, responsible for clearing at least 20% of annual tropical forest loss (Hosonuma et al., 2012).

Illegal Logging Trends Illegal logging further drives deforestation, constituting 15-30% of total global wood trade volume as of 2016, valued up to \$100 billion USD per year (Nellemann et al., 2016). Top exporters of illegally sourced timber include key logging countries Brazil, Cameroon Indonesia, Peru and Ghana (Nellemann et al., 2016). In high-risk countries, over 90% of timber is illegally logged then laundered into supply chains (Lawson, 2014). Illegal logging causes particularly acute ecosystem instability and biodiversity loss.

Post-Logging Habitat Integrity Two major industrial harvesting methods exist: selective logging of individual commercially important trees, versus clearcutting which uniformly removes trees. Selectively logged areas made up just 36% of previously intact tropical forests by the mid-2010s, indicating extensive residual damage (Heino et al., 2015). Kalamandeen et al. (2018) found limited forest recovery even four decades after selective gold mining-related logging in the Amazon. Up to 20-25% of selective logging areas undergo fragmentation, degradation or complete deforestation during operations via logging roads, skid trails and related infrastructure creation (Bicknell et al., 2014).

2.1.1 Concept of medicinal plants

Medicinal plants have been an essential component of traditional medicinal systems around the world for thousands of years, and remain indispensable today despite advances in modern medicine. Over 9,000 species of wild vascular plants have documented medicinal properties (Chen et al., 2016). Upwards of 4 billion people over half the global population rely fully or partly on traditional plant-based medicine for their primary healthcare according to World Health Organization estimates (WHO, 2019). The vast majority resides in Africa and Asia. Moreover, 119 distinct chemical substances derived from 90 plant species contribute hugely to modern medicine as approved drugs (Atanasov et al., 2015). Global trade in medicinal plants exceeds \$100 billion annually, showing increasing demand with supply highly dependency on wild harvests (Chen et al., 2016).

Most harvests for traditional and industry use are from wild populations. Up to 90% of medicinal plant raw material derive from open vegetation outside forests rather than cultivation (Chen et al., 2016). Uncontrolled exploitative collection is causing population declines and even risking extinction of over 15,000 medicinal plant species warns the IUCN Sampled Red List Index for Plants assessment (Brummitt et al., 2015). For instance, the Himalayan yew tree has seen up to 90% loss of mature individuals from illegal wild collection for the cancer drug market (Bhattarai and Chaudary, 2020). Habitat loss also hugely impacts medicinal plant viability.

2.2 Medicinal Plants under Threat of Extinction.

2.2.1 Global

One of the most impressive applications of plant-based biodiversity is in the field of herbal medicine. Up to 90% of rural populations worldwide rely on herbal medicine as their main form of healthcare. More than 3.5 billion people in the underdeveloped world, according to current estimates by the World Health Organization (WHO), depend on plants as their primary source of healthcare (WHO, 2016).

Due to various circumstances, medicinal plants have come under growing pressure, leading to the extinction of certain species, the reduction of others, and a general fall in biodiversity in South Africa's high-use areas (Mathibela, 2013). Due to rapid agricultural growth, urbanization, indiscriminate deforestation, and unrestricted collection of plant resources, many plant species with medicinally significant chemicals are disappearing at an alarming rate (Bapat et al., 2008). Fire, wattle expansion or eradication campaigns, and grazing are other significant elements that impact the growth of medicinal plants. Due to excessive and unsustainable collection, use, overexploitation, or untrained harvesting, more than 90% of medicinal plants in India are threatened. Around 1,000 medicinal plant species may be in danger in various habitats across India, according to global rates of plant species threatened with extinction (Gowthami et al., 2021).

At current extinction rates, experts estimate that the earth loses at least one potential major drug every two years (De Baan et al., 2013). The World Conservation Union (IUCN) estimates that overharvesting may put 15,000 different medical plant species globally in danger of extinction.

The following prominent therapeutic plants are among those most in danger of going extinct:

Slippery elm (*Ulmus rubra*): In North America, particularly in Appalachia, the sticky lining of the slippery elm's bark has long been utilized as a calming remedy for coughs, gastrointestinal problems, and skin irritations. But now, slippery elm and other herbal treatments that were once only utilized locally during specific seasons are in high demand. Trees are stripped of their bark and left to wither since slippery elm wood has no marketable use. Fifty pounds of dried bark require the death of about 12 trees. Bark in 50-pound containers can sell for up to \$150. The National Center for the Preservation of Medicinal Herbs (NCPMH), the U.S. Forest Service, and the U.S. Park Service have all designated this species as "in danger" (Associated Press, 2006).

American ginseng (*Panax quinquefolius*): In North America, wild and cultivated ginseng sales total more than \$25 million annually, with wild ginseng being the more sought-after variety. Given how much more profitable wild ginseng is than cultivated ginseng, there is a significant deal of worry regarding the extinction and threatened status of the species in the wild (U.S. Forest Service, 2001).

Yew (*Taxus species*): Yew trees, including the Pacific yew (*Taxus brevifolia*) and Chinese yew (*Taxus chinensis*), are used to produce the famous, profitable, and effective cancer drug taxol (Onrubia et al., 2013).

Black cohosh (*Cimicifuga racemosa*): has been used for centuries to cure several ailments, including menopause, rheumatism, discomfort, and colds. The supply of black cohosh is derived almost entirely from wild gathering. The species has been listed as being at risk due to overharvesting and habitat degradation by the U.S. Forest Service and other organizations (U.S. Forest Service, 2001).

Hydrostis canadensis: a member of the buttercup family, has been used for centuries as a tonic to cure conditions like hemorrhoids. The NCPMH estimates that more than 60 million goldenseal plants are taken yearly without replenishment. Many states already regard goldenseal as uncommon, imperilled, or endangered (U.S. Forest Service, 2001).

2.2.2 Africa

More than 30,000 plant species may be found in Africa, many of which have a long history of using traditional medicine to treat various diseases. African culture is firmly rooted in medicinal herbs, which has been essential in ensuring that millions of people on the continent have access to affordable healthcare. However, several therapeutic plants are now in danger of extinction due to several circumstances. Millions of people in Africa's health and welfare could suffer greatly if these plants were to disappear. African medicinal plants that face extinction include;

Prunus africana, commonly known as African cherry or pygeum: is a tree species found in the highlands of East and Central Africa. Traditional Chinese medicine has treated prostate cancer, urinary tract infections, and kidney illness using the tree's bark for many years. However, due to overexploitation and the great demand for pygeum bark in the pharmaceutical business, the species is now in danger of extinction (Cunningham et al., 2002). *Prunus africana* is considered an endangered species by the International Union for Conservation of Nature (IUCN). Various nations in East and Central Africa have implemented regulations to control its collection and trade (Cunningham et al., 2002).

Salutary Warburgia East and Southern Africa are home to the *Warburgia salutaris* tree species, sometimes known as the pepper-bark tree. The tree's bark and leaves have been used in traditional medicine to cure various conditions, such as colds, flu, and coughs.

Also used as a spice and food preservative is the plant. But due to overexploitation brought on by the plant's great demand for its bark and leaves, it now faces extinction (Wasswa et al., 2019). *Warburgia salutaris* has been classified as a vulnerable species by the IUCN, and various African nations have taken action to control its collection and trade (Wasswa et al., 2019).

Erinaceous Pterocarpus, the Senegal rosewood, also known as *Pterocarpus erinaceus*, is a species of tree found in West and Central Africa. Various illnesses, such as malaria, fever, and skin conditions, have been treated with the tree's bark and leaves in traditional medicine. The tree's wood, which is highly prized in the furniture sector, is also used. The plant is in danger of going extinct due to overexploitation caused by the great demand for its bark, leaves, and lumber (Koura et al., 2019). *Pterocarpus erinaceus* has been designated as a vulnerable species by the IUCN, and several African nations have put regulations in place to control its collection and trade (Koura et al., 2019).

Petunia edulis East Africa and the Arabian Peninsula are home to the flowering plant *Catha edulis*, also called khat. The plant's leaves have been utilized in traditional medicine to cure several conditions, including obesity, weariness, and depression. The plant is also used recreationally and as a stimulant. However, the excessive exploitation brought on by the great demand for khat puts it in danger of extinction (Abdillahi et al., 2021). *Catha edulis* has been designated as a vulnerable species by the IUCN, and various African nations have taken action to control its harvest and trade (Abdillahi et al., 2021).

2.2.3 Local (Ghana)

Over 80% of the population in Ghana relies on medicinal plants for their main healthcare requirements, making traditional medicine a crucial component of the nation's healthcare system (African Union, 2009). However, several issues, including deforestation, excessive harvesting, habitat degradation, and climate change, threaten the extinction of many medicinal plants in Ghana (Kpogo-Nyamdor & Laryea, 2020). The following are a few of the unique medicinal plants in Ghana that are in danger of going extinct.

The medicinal plant *Aframomum melegueta*, sometimes referred to as grains of paradise, is indigenous to West Africa, especially Ghana (Leung & Foster, 1996). The plant belongs to the ginger family and is frequently used in traditional medicine to treat various conditions, including fever, stomachaches, and diarrhoea (Amponsah et al., 2018). However, overharvesting, habitat damage and climate change threaten the plant's extinction.

West Africa, particularly Ghana, has a medicinal shrub called African mahogany, or *Azelia africana*. The plant is frequently used to cure various conditions, including fever, diarrhoea, and respiratory infections (Owusu et al., 2020). However, the plant is in danger of extinction due to habitat loss, deforestation, and over-exploitation (Awudzi et al., 2019).

A medicinal plant in West Africa, particularly Ghana, is called *Annona senegalensis*, popularly known as the African custard apple. The plant is frequently used to cure various conditions, including fever, diarrhoea, and respiratory infections (Hazarika et al., 2012). However, habitat degradation and overharvesting have put the plant in danger of going extinct.

Senegalese grass Khaya (African mahogany). The medicinal plant *Khaya senegalensis*, also called African mahogany, is used to cure several conditions, including malaria, fever, and diarrhoea. The plant is also employed as a laxative and an analgesic. However, overexploitation and habitat degradation have put the plant in danger of going extinct.

In West Africa, particularly Ghana, there is a plant known as moabi, also known as *Baillonella toxisperma* (Zofou et al., 2013). The plant offers several medical benefits and is frequently used to treat conditions like wounds, skin infections, and respiratory infections. However, deforestation, habitat loss, and overharvesting threaten the plant's extinction at this time (Safdar et al., 2017).

In West Africa, especially Ghana, a plant known as *Buchholzia coriacea*, often called beautiful kola, is used medicinally (Izah et al., 2018). The herb is frequently used to cure various conditions, including fever, stomachaches, and malaria. The *latifolious sarcocephalus* (African peach). The medicinal plant *Sarcocephalus latifolius*, often called African peach, is used to cure several illnesses, such as fever, malaria, and diarrhoea. Additionally, it has sedative and analgesic properties. Due to overexploitation and habitat degradation, the plant is currently in danger of extinction. *Securidaca longipedunculata* (Violet tree). *Securidaca longipedunculata*, commonly known as the Violet tree, is a medicinal plant used in traditional Ghanaian medicine for various purposes. It is used to treat fever, cough, and other respiratory infections. The plant is also used to treat skin diseases and as an analgesic. However, the plant is now threatened with extinction due to overexploitation and habitat destruction.

Erinaceous Pterocarpus (African teak). The medicinal plant *Pterocarpus erinaceus*, often known as African teak, is used to cure various illnesses, such as fever, diarrhoea, and skin conditions. Additionally, the herb is utilized as an analgesic in traditional

Ghanaian medicine. However, overexploitation and habitat degradation have put the plant in danger of going extinct.

African Voacanga (African Voacanga). The medicinal plant *Voacanga africana*, also called African Voacanga, is used to cure several conditions, including fever, pain, and malaria. Additionally, it has aphrodisiac and stimulating properties. Regardless of the medicinal benefits these medicinal plants discussed above face the threat of extinction due to logging.

2.4 Effects of logging of medicinal plant resources.

2.4.1 Loss of jobs for people in medicinal plant's value chain

The medicinal plant value chain encompasses activities from the initial harvesting or collection of plants from their natural habitats to the production and sale of the final medicines or supplements to consumers (Lange, 2006). Logging and deforestation have been identified as major threats to medicinal plant resources globally, with significant impacts on associated livelihoods and jobs (Hamilton, 2004; Mander et al., 2007). Across the globe, unsustainable and unchecked logging leads to deforestation and loss of natural habitats for wild medicinal plant populations. A major report on non-timber forest products from the Center for International Forestry Research estimated that over 50,000 medicinal plant species worldwide are threatened with extinction from habitat destruction, mostly stemming from large-scale industrial logging (Hamilton, 2004). Loss of natural habitats makes plant resources scarcer over time, threatening associated jobs, livelihoods, and traditional knowledge. Mander et al. (2007) highlight disappearing markets for certain forest medicines in China and erosion of specialized ethnobotanical knowledge among South African traditional healers due to increasing scarcity of key medicinal plants. These examples illustrate the dependence of jobs in

the medicinal plant trade on the continued availability of ample plant resources from forests and other wild areas. Unsustainable logging practices fail to maintain these resources.

In many parts of Africa, medicinal plants provide raw materials to the formalized Traditional Medicine sector, comprising trained herbal medicine practitioners integrated within national healthcare systems. The scale of trade in medicinal plants and Traditional Medicine products across Africa already indicates livelihood dependence - an estimated USD \$160 million in plant materials is traded per year on the continent (Mander et al., 2007). However, growing forest loss places increasing pressure on the sector. A study modelling medicinal tree species distribution in Ghana found that potential habitat loss from logging concessions could impact 40-60% of localities where key species have been documented (Cunningham & Wehmeyer, 2016). Ultimately such loss of habitats and plant populations threatens jobs for trained Traditional Medicine providers as well as harvesters and informal traders.

Research specific to Ghana confirms that increasing scarcity of wild medicinal plant resources due to logging threatens livelihoods for harvesters, traders, transporters, manufacturers, and sellers of herbal medicines. Studies comparing protected forests to logged areas found that sensitive medicinal plants only occurred in protected areas while more hardy weedy species dominated disturbed forests (Twumasi et al., 2014; Boakye et al., 2015). Harvesters reported collecting medicinal plants mainly outside of reserves due to lower availability, reflecting habitat loss (Falconer, 1992). Such scarcity reduces security for jobs dependent on steady plant supplies. There is also evidence of declining abundance for species like *Prunus africana*, an internationally traded treatment for prostate disorders, reflecting combined pressures of legal and illegal

logging in Ghana (Stewart, 2001). In interviews, Ghanaian traditional healers and harvesters widely report decreasing availability of key medicinal plant species, raising concerns over future livelihood viability (Falconer, 1992; Sasu et al., 2010). Thus, forest loss to logging in Ghana threatens jobs across the medicinal plant value chain over the long term.

2.4.2 Change in the health of people

Across the globe, increasing population pressure and deforestation impact wild medicinal plant availability, demonstrated by well documented localized extinctions and loss of therapeutic plant species. A survey in India recorded disappearance of over 90 common medicinal plants used traditionally to treat snake bites in certain districts of the Western Ghats, indicating health vulnerability (Arora & Nair, 2018). Similarly, a study with traditional healers in Amerindian Amazon areas found over 58% of plant species commonly prescribed for malaria were no longer easily available due to deforestation, restricting treatment options for communities (Giovannini et al., 2011). Globally, medicinal plant habitat destruction clearly negatively impacts health by limiting resource access for traditional medicine practitioners as well as community members who self-treat with traditional remedies.

Traditional medicine in Africa relies heavily on wild harvesting of raw medicinal plant materials to supply national healing sectors. The volume of medicinal plant trade exceeds USD \$160 million annually on the continent, confirming extensive livelihood and health system dependence (Mander et al., 2007). However, habitat loss threatens this foundation of African traditional healthcare. Logging concessions allocated in Ghana covered 40-60% of potential habitats for multiple locally important medicinal trees modelled in one study (Cunningham & Wehmeyer, 2016). Such loss of forests

equates to loss of “natural hospital dispensaries” as described by traditional healers from Cameroon when expressing concern over disappearing plant resources (Betti et al., 2013). With formal recognition of traditional healers in many African health systems, loss of plant access ultimately becomes loss of viable treatment options for rural citizens especially.

Local research affirms Ghana’s dependence on wild medicinal plants to meet primary health demands. One nationwide survey recorded over 30% of households primarily using herbal medicine for healthcare, with higher rates up to 57% in rural areas (Gyasi et al., 2016). However, traditional healers widely report declining availability of important medicinal plants due to habitat loss from farming, firewood harvesting and timber extraction (Boakye et al., 2015). One study specifically compared forest reserves to heavily degraded landscapes, finding 75% of documented medicinal plants no longer present at degraded sites, severely reducing local access (Twumasi et al., 2014). Such scarcity of wild medicinal resources equates to scarcity of accessible treatments for diseases like malaria, typhoid and pneumonia within herbal medicine. Rural farmers in Ghana confirmed resorting to pharmaceuticals as some plants became locally extinct, despite preference for traditional remedies due to high efficacy and low cost (Agergaard & Fold, 2011). Declining health of natural ecosystems translating to declining health of human communities reflects the interdependence underlying traditional healing approaches globally.

2.4.3 Decrease in medicinal plants

Though estimates vary, the World Health Organization reports over 50,000 species worldwide hold medicinal values for traditional and modern medicine (WHO, 2019). The majority are wild harvested plants threatened as human activities drive alarming

biodiversity declines worldwide. A meta-analysis of over 800 studies found terrestrial species abundance dropped over 20% globally from 1990-2015, with tropical areas showing worst declines (IPBES, 2019). Medicinal plants follow similar trajectories when natural habitats disappear. In the Western Ghats Forest of India, over 90 medicinal plants used traditionally against snake bites faced local extinction from habitat destruction (Arora & Nair, 2018). These examples illustrate shrinking global natural ecosystems translate to shrinking natural pharmacies for herbal medicine.

Africa holds significant biodiversity riches, with up to 45,000 documented plant species, many holding medicinal properties (Ikhuoria & Maliki, 2007). However, increasing deforestation and land use pressures impact wild medicinal plant availability on the continent as well. Surveys of traditional healers and rural communities indicate increasing scarcity. In Bushbuckridge, South Africa over 20% of customarily used medicinal plant species were difficult to access due to declining wild populations from habitat loss and overharvesting (Mander, 1998). Such scenarios are driving an emerging conservation category “retreating plants” where species like the protected tree *Prunus africana* show declining abundance despite conservation status (Betti, 2011). Without interventions to preserve threatened habitats and promote sustainable harvests, wild medicinal plants will only grow scarcer in Africa.

Research from Ghana mirrors regional trends of shrinking forests and medicinal plant habitats. An 11-year study on carbon losses showed deforestation ate into protected areas despite conservation categorization (Acheampong et al., 2019). One report mapped concessions for legal timber extraction across 40-60% of documented locations for multiple threatened African cherry (*Prunus africana*) populations in Ghana, legally endangering medicinal tree habitats (Cunningham & Wehmeyer, 2016). Such landscape changes contribute to availability declines for species like the globally traded

Pausinystalia johimbe, used for erectile dysfunction. Traditional healers reported needing to travel further distances to find mature trees for quality bark harvests (Kuate et al., 2015). However, increased scarcity prompts unsustainable harvesting, exacerbating wild population threats long-term (Falconer, 1992). Without better ecosystem protections and harvest regulations, Ghana's medicinal plants face similar fates as global medicinal plant populations.

2.4 Effects on traditional healing practices

Indigenous communities worldwide possess specialized ethnobotanical knowledge identifying plant medicinal uses, preparation methods and dosages representing cumulative wisdom passed down intergenerationally (Reyes-García et al., 2019). However, traditional healing knowledge faces significant erosion threats as habitat destruction reduces encounters between communities and ancestral plant allies. In Tibetan areas of Northwest Yunnan, over 30% of documented Tibetan medicinal plant species declined locally from habitat loss linked to commercial logging, corresponding with disappearing indigenous plant names and uses (Salick et al., 2006). Parallel losses occurred in Amazonian Brazil, where forest dwelling elders displayed much lower knowledge of curative plants compared to predecessors, directly attributed to declining forests and plant availability (Case et al., 2005). Globally, disappearing plants ultimately equate to disappearing associated traditional knowledge systems.

While traditional medicine use is widespread across Africa, increasing population pressures strain wild medicinal plant resources and the cultural healing systems sustained through nature's bounty. A regional assessment compiled by the World Agroforestry Centre examined the status of 102 priority woody medicinal species, finding over half face overexploitation for medicine and fuelwood amidst increasing

scarcity (Zulu, 2010). Such declining abundance prompted conservation measures in Uganda to propagate medicinal trees like *Prunus africana* to sustain practitioner supplies. However, shortages still force traditional healers to travel farther to harvest plants (Katende et al., 2004). Scarcity also threatens the intergenerational knowledge transfer processes enabling new traditional healers to properly identify and use healing plants (Kebu, 2004). Without conservation measures securing ample plant access, the expertise foundation underlying cultural healing practices grows increasingly vulnerable across Africa.

While herbal medicine meets an estimated 75% of national public health needs (WHO, 2019), Ghanaian traditional healers face increasing difficulties acquiring preferred medicinal plants for their practices due to habitat declines. A survey of practitioner perspectives highlighted scarce availability of plants like *Griffonia simplicifolia*, posing significant threats to ongoing medicinal viability (Aziato & Antwi, 2016). Practitioners also emphasize shrines literally disappearing due to farming expansion and logging pressures, further eroding spiritual relationships with medicinal plant spirits and natural sites potentiating plant treatments (Amoah et al., 2020). Such declines in abundances of healing species and their forest habitats threaten job security for current traditional practitioners while also hampering mentorship processes for transferring plant knowledge to new trainees. Without reversing ecosystem losses, cultural healing traditions remain at risk in Ghana as across the globe.

2.4.5 Increase in price of medicinal plants

International conservation assessments reveal that over 15,000 medicinal plant species globally face threats from habitat loss while also experiencing increasing demand pressure, driving major price hikes for sourcing wild populations (Junaedi et al., 2019).

Prime examples come from Asia's *Materia Medica*. The herb Changshan sourced from *Dichroa febrifuga* as malaria and cancer treatment rose over 700% from 1960s pricing (Liu et al., 2018). Similarly, *Paris polyphylla* Smith from the Himalayas appreciated 1000% between 1980 and 2010 as habitat loss made the gastroprotective herb rarer (Pant et al., 2020). These wild species examples reflect global commodity trends for medicinal plants as natural supplies decline amidst booming consumer markets.

Multiple African medicinal herbs and products follow similar trajectories in the herbal commodity marketplace. In South Africa, the protected tree *Sclerocarya birrea*, used for infectious diseases, became so locally scarce from habitat loss and overharvesting that availability declined over 60% between 2007 and 2017. Simultaneously, seed oils tripled in price on commercial markets (Makhado et al., 2019). High pressure for species like *Harpagophytum procumbens* in the semi-arid Kalahari region similarly resulted in overharvesting given booming European demand, necessitating cultivation efforts to secure future supplies and attempt price stabilization (Stewart, 2003). With up to 60% of plant sources for Africa's traditional medicine still coming from the wild (Mander et al., 2007), rising values demonstrate unsustainability while squeezing consumer access.

Evidence for Increasing Medicinal Plant Product Values in Ghana Ghana possesses a robust herbal medicine industry, with over 200,000 estimated livelihoods involving wild medicinal plant supply chains (Kasilo & Trapsida, 2010). However, increasing national habitat pressures impact resource availability. Although Ghana prohibits wild harvesting of protected species like the roots of *Griffonia simplicifolia* for anxiety and mood disorders, scarcities still increased license prices for cultivators dramatically (Ankrah, 2019). Population pressures also drive overharvesting for species still sourced from nature like *Piper guineense* fruits, used for respiratory ailments. Actual

plant numbers recovered in the wild dropped 50-80% around key high demand areas from 2005-2015, with prices rising commensurately each season (Cunningham et al., 2016). Without interventions, ongoing habitat declines will escalate commercial values, further threatening traditionally healers and households depending on plant access.

2.4.6: Habitat Destruction

A key impact of logging operations is the clearance of original native vegetation which removes habitats medicinal plants are adapted to (Shanley & Luz, 2003). Complete habitat destruction occurs when forests are fully cleared and replaced with timber plantations or agriculture. For example, *Saraca asoca*, harvested for gynecological and inflammatory disorders, has disappeared from many protected areas in India where logging has permitted plantation establishment (Rath et al., 2012). Even selective logging which targets economically valuable tree species causes substantial collateral damage through felling, infrastructure establishment, and heavy machinery usage (Burivalova et al., 2018). Constructing roads to transport timber destroys forest habitats and fragments contiguous areas.

Medicinal plants are impacted both directly and indirectly from the destructive processes. Not all species can survive the disrupted forest conditions post-logging - remnant plants experience higher temperatures, wind exposure, fewer pollinators and seed dispersers (Jian et al., 2018). Species abundance and diversity declines with the harshest reductions amongst habitat specialists, e.g. understory herbs and vines dependent on stable forest ecosystems (Cicuzza et al., 2007). Survival is further hampered for slow-growing plants with specific nutrient and light requirements. Unsustainable harvesting further threatens recovering populations. Of India's

approximately 8,000 medicinal plants, over 400 features on conservation lists (Shankar et al., 2012). Without habitat protection, researchers warn more face similar fates.

Ultimately human health suffers from this biodiversity loss, as plant extinction directly equates to losing current and future medicines. Contemporary drugs derived from rainforest plants highlight this, including treatments for malaria, childhood leukemia and heart conditions (Pan et al., 2012). Disappearing these species cuts off productive lines of pharmaceutical research (Gurib-Fakim, 2006). Medicinal richness also protects local and indigenous health – rural forest communities utilize plants for over 80% of primary healthcare needs in developing regions (Hamilton, 2004). Habitat decline severely affects this traditional plant knowledge and associated cultures (Shanley & Luz, 2003).

2.3 Factors that Motivate Loggers to Harvest Medicinal Plants.

2.3.1 Economic incentives

Loggers frequently gather medicinal plants for economic reasons (Chen et al., 2016). These incentives might come from various sources, including pharmaceutical industry demand, traditional medicine practices, and domestic and foreign herbal medicine marketplaces (Gronde et al., 2017). The implications of such actions, however, can be disastrous for the ecosystem and the populations that rely on these plants for a living. Global demand for medicinal plants has resulted in the overexploitation of these resources in many locations, with disastrous effects on biodiversity and ecosystem functioning (Ticktin et al., 2020). The study emphasised the necessity of sustainable harvesting practices and the need for governments and conservation organizations to collaborate with local populations to preserve these resources' long-term sustainability.

Another study published in the journal *Economic Botany* looked at the economic motivations that drive the illegal trade in medicinal plants obtained from the wild in South Africa (Cunningham & Cunningham, 2017). According to the study, the strong demand for these plants, particularly from the traditional medicine market, pushed unsustainable harvesting techniques and affected residents' livelihoods. According to a report by the United Nations Conference on Trade and Development (UNCTAD), the global trade in medicinal plants was valued at over \$100 billion in 2015 and is expected to continue growing in the coming years (UNCTAD, 2016). However, this economic incentive has led to an unsustainable collection of medicinal plant species, resulting in natural resource depletion and biodiversity loss (Bhatia et al., 2011).

Economic incentives for medicinal plant harvesting have been demonstrated in studies to be influential in developing nations, where poverty and limited economic possibilities might motivate individuals to exploit natural resources for revenue (Paudel et al., 2016). For example, in Nepal's Himalayan region, medicinal plant harvesting has become a key source of income for residents. Nonetheless, unsustainable harvesting methods have resulted in falling plant populations and biodiversity loss. Economic incentives for medicinal plant harvesting have resulted in confrontations between local populations and the pharmaceutical business in several circumstances. For example, the harvest of (*Hoodia gordonii*), a succulent plant native to southern Africa, has become a profitable industry for local people. Still, global demand has resulted in over-harvesting and illegal trading (Cawthra & Styles, 2014). In addition, the pharmaceutical sector has been chastised for exploiting developing-country resources without paying adequate remuneration or guaranteeing sustainable harvesting procedures (Bodeker et al., 2011).

2.3.2 Global Market Demand

The global demand for medicinal plants has resulted in their exploitation by loggers worldwide. According to a World Health Organization report, over 80% of the world's population uses medicinal herbs for primary healthcare (WHO, 2019). Because of the strong demand for medicinal plants, loggers have been motivated to harvest these plants for profit. Harvesting Agarwood, for example, is highly sought for its use in traditional medicine and as an essential oil in the perfume business. Agarwood can be found in several countries, including India, Bangladesh, Vietnam, and Indonesia. However, overharvesting has caused the plant to become endangered in many areas, and the International Union for Conservation of Nature has categorized it as a threatened species (IUCN, 2022). Because of the high demand for Agarwood, loggers illegally harvested the plant, making it scarce in many locations.

The harvest of the Brazilian tree species pau-rosa (*Aniba rosaeodora*), which produces an essential oil used in fragrances, cosmetics, and aromatherapy, is one example of this trend. As a result, pau-rosa has been intensively logged for its valuable essential oil, prompting it to be categorized as endangered (Dias et al., 2021). Similarly, due to its usage in traditional medicine and rising global market demand, the Chinese herb Sanqi (*Panax notoginseng*) has been overharvested (Koyama, 2017). As a result, the International Union for Conservation of Nature (IUCN) has designated Sanqi as a vulnerable species (Li et al., 2017). Another example is the Himalayan yew (*Taxus wallichiana*), which is collected for its bark, which contains the cancer-fighting compound Taxol (Liu et al., 2016). Unfortunately, overharvesting of the Himalayan yew has resulted from global demand for Taxol, placing the species at risk of extinction (Chauhan et al., 2016).

Schippmann et al. (2002), the global market for medicinal plants was worth around US\$60 billion in 2000 and has grown in recent years. Population increases, ageing populations, and a growing interest in natural medicines all contribute to the demand for these plants.

2.3.3 Lack of alternative livelihoods

Globally, there is growing concern about the impact of deforestation on medicinal plants. Many of these plants are vital for local populations since they are employed in traditional medicine and have pharmacological potential. However, the demand for these plants pushes unsustainable harvesting practices that endanger their survival. One of the primary reasons for unsustainable harvesting is the need for other jobs for loggers, who rely on medicinal plant harvesting (Mehta et al., 2020). Research in Cameroon, for example, discovered that areas, where logging was the primary source of revenue, had a higher likelihood of overharvesting medicinal plants than those where other economic activities were prevalent (Tchouto et al., 2006).

Similarly, a Nepalese study discovered that when local communities had few other livelihood options, they were more inclined to overharvest medicinal plants (Paudel et al., 2015). One potential solution is the development of sustainable medicinal plant harvesting practices that prioritize the long-term survival of these plants. This could include the establishment of community-led harvesting initiatives, where local communities are empowered to manage the harvesting of medicinal plants in a sustainable way (Mander et al., 2014). Additionally, there is a need for investment in local infrastructure and economic development, which can create new opportunities for income generation beyond logging and medicinal plant harvesting.

According to a study by Pandey et al. (2018), poverty and limited income-generating opportunities are critical drivers of the illegal harvesting of medicinal plants in Nepal. The study found that loggers, previously engaged in timber harvesting, have shifted to collecting and trading medicinal plants due to the declining availability of timber resources. In addition, the lack of alternative livelihoods in the region has forced these individuals to exploit medicinal plants to make a living (Astutik et al., 2019). Similarly, Lama et al. (2018) discovered that loggers' unlawful collection of medicinal plants was linked to a lack of other livelihood alternatives in Bhutan. Many individuals are compelled to rely on natural resources, particularly medicinal plants, to maintain their families without viable livelihood options.

The correlation between a lack of alternative livelihoods and medicinal plant gathering is more robust than in Nepal and Bhutan. In Pakistan, Kamal et al. (2021) discovered that poverty and a lack of alternative income-generating options drove illegal medicinal plant gathering. The study emphasized the necessity for developing sustainable livelihood options to lessen the impact on natural resources, especially medicinal plants. Due to a lack of alternative livelihood options, loggers in Ghana have begun to pick therapeutic herbs. The demand for these plants has expanded in recent years, both locally and internationally, boosting their commercial value (Ferreira et al., 2020). As a result, logging communities have turned to medicinal plant collecting to supplement their income. According to Kpelle et al. (2019), most people engaging in Ghana's medicinal plant trade are small-scale harvesters who are largely loggers, hunters, and farmers. Because these people have limited access to alternative livelihood alternatives, they must rely on medicinal plant collecting to make ends meet. This is especially true in communities where the forest is the primary source of income.

2.3.4 Limited Regulations and Enforcement

Evidence shows limited rules and enforcement have led loggers worldwide to harvest medicinal plants (Astutik et al., 2019). Country's lack of regulations and enforcement was cited as a significant factor contributing to the illegal harvesting of medicinal plants. Similarly, a study conducted in Brazil found that the country's lack of regulations and enforcement has led to the illegal harvesting of several species of medicinal plants, including Catuaba and Pau d'Arco (de Oliveira et al., 2019). The study's authors noted that the illegal harvesting of these plants had negative impacts on the environment and the communities that rely on them for their livelihoods.

Lack of regulations and enforcement is a significant factor in the illegal harvesting of medicinal plants (Hoang & Dang, 2020). Harvesting medicinal plants in Africa is a lucrative business, and the lack of adequate regulations and enforcement measures has led to unsustainable harvesting practices. This has resulted in the depletion of medicinal plant populations, negatively impacting the environment and local communities relying on these plants for their traditional medicine practices. Many African countries lack the necessary regulations to protect their medicinal plants from overharvesting and unsustainable practices. This has led to the loss of important medicinal plant species, negatively impacting human health and the environment (De Caluwe et al., 2010).

Furthermore, a lack of enforcement of existing regulations has allowed illegal harvesting and trade of medicinal plants to flourish. This was highlighted in a study published in the *African Journal of Traditional, Complementary and Alternative Medicines*, which found that illegal harvesting and trade of medicinal plants was a significant problem in many African countries, including South Africa, Kenya, and Nigeria (Wanzala et al., 2013). Exploiting medicinal plants in Africa is not limited to

illegal harvesting and trade. In some cases, the lack of regulations has led to the unsustainable harvesting of plant populations, which has negative implications for the environment and local communities. For example, harvesting the African cherry (*Prunus africana*) for its medicinal properties has led to a decline in its population, which has negative implications for the environment and local communities that rely on this plant for their traditional medicine practices (Kamau et al., 2018).

Ghana is one of the countries in West Africa where the exploitation of medicinal plants is widespread, and the lack of regulations and enforcement measures has allowed for unsustainable harvesting practices (Appiah et al., 2019). The study also found that illegal harvesting and trade of medicinal plants was a major problem in Ghana, with some of the most commonly traded species being threatened with extinction. In addition, the lack of enforcement of existing regulations has allowed this illegal trade to continue, leading to the further depletion of medicinal plant populations (Appiah et al., 2019). Furthermore, lack of regulations and enforcement measures has also led to the unsustainable harvesting of baobab (*Adansonia digitata*) bark in Ghana. The bark is used for medicinal purposes, and the unsustainable harvesting practices have led to a decline in the baobab population, which has negative implications for the environment and local communities relying on this plant for their traditional medicine practices (Gyawali et al., 2018).

2.3.5 Health Needs

The global demand for medicinal plants is driven by the health needs of people seeking alternative and traditional medicine (Cseke et al., 2016). However, this demand has also led to unsustainable harvesting practices, negatively impacting the environment and local communities that rely on these plants for their traditional medicine practices.

Global demand for medicinal plants has led to unsustainable harvesting practices in many countries, including China, India, and South Africa. The lack of regulations and enforcement measures has allowed for the overharvesting of medicinal plants, which has led to the loss of important medicinal plant species (Shen et al., 2015).

The demand for medicinal plants in Africa is driven by the health needs of local communities that rely on traditional medicine (Cseke et al., 2016). The lack of access to modern healthcare services and the high cost of Western medicine has led to the increased use of traditional medicine, which has led to unsustainable harvesting practices of medicinal plants (Tchatchoua et al., 2016). The overexploitation of medicinal plants in Africa has negative implications for human health and the environment. Depletion of medicinal plant populations in Africa has led to a decline in the availability and quality of traditional medicine, which has negative impacts on the health and well-being of local communities (Ezeja et al., 2017).

2.3.6 Preservation of Cultural Heritage

Preservation of cultural heritage is another factor that motivates loggers to harvest medicinal plants globally. Many cultures worldwide have relied on traditional medicine for centuries, and medicinal plants are essential to their cultural heritage. However, the lack of regulations and enforcement measures has led to unsustainable harvesting practices, which has resulted in the depletion of medicinal plant populations and the loss of cultural heritage. Traditional medicine is an integral part of many cultures, and the use of medicinal plants is often deeply rooted in the traditions and beliefs of local communities. The study found that the loss of traditional knowledge and practices related to medicinal plants can negatively impact local communities' cultural heritage (Cruz-García & Price, 2015). The depletion of medicinal plant populations due to

unsustainable harvesting practices has negatively affect preserving cultural heritage. Loss of medicinal plant species can result in the loss of cultural knowledge and practices related to traditional medicine, which negatively impacts the cultural heritage of local communities (Tchatchoua et al., 2016).

Unsustainable harvesting of medicinal plants in Ghana is leading to the loss of traditional knowledge and practices related to traditional medicine, which negatively impacts the cultural heritage of local communities (Addae-Mensah & Agyeman, 2013). The depletion of medicinal plant populations due to unsustainable harvesting practices can also have negative implications for the livelihoods of local communities in Ghana. Loss of medicinal plant species in Ghana is leading to a decline in the availability of traditional medicine, which negatively impacts the health and well-being of local communities (Odonne et al., 2012).

2.5 Policies and Programmes Implemented to Facilitate the Reduction of Medicinal Plants through Logging.

2.5.1 Global

The regeneration of medicinal plants is an important issue. Many plant species used for medicinal purposes are at risk of extinction or threatened due to various factors, such as overharvesting, habitat loss, and climate change. In response, different global policies and programmes have been implemented to facilitate the regeneration of medicinal plants. Some of the policies and programmes include;

- 1. Convention on Biological Diversity (CBD):** CBD is an international treaty that aims to conserve biodiversity, promote sustainable use of its components, and ensure the fair and equitable sharing of the benefits of using genetic resources. The CBD has

several provisions relevant to the conservation and sustainable use of medicinal plants. For example, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization, a supplementary agreement to the CBD, aims to ensure the fair and equitable sharing of benefits arising from the use of genetic resources, including medicinal plants. The CBD also has a program on sustainable use and management of biodiversity, including medicinal plant use (CBD, 2011).

2. The Global Strategy for Plant Conservation (GSPC): The GSPC is a global framework for conserving and using plant diversity. It has 16 targets, one of which is ensuring that 60% of threatened plant species are preserved in situ, and their populations are viable by 2020. The GSPC is relevant to conserving and regenerating medicinal plants because many medicinal plant species are threatened with extinction. The GSPC also emphasises the need to involve local communities in the conservation and sustainable use of plant diversity, which is essential for regenerating medicinal plants (CBD, 2011).

3. Sustainable Development Goals (SDGs): The SDGs are 17 goals adopted by the United Nations in 2015 to promote sustainable development worldwide. SDG 15 explicitly addresses the conservation and sustainable use of terrestrial ecosystems, including forests and biodiversity, which are crucial for regenerating medicinal plants (UN, 2015).

4. Medicinal Plant Specialist Group (MPSG): The MPSG is a global network of medicinal plant experts established by the International Union for Conservation of Nature (IUCN). The MPSG promotes the conservation and sustainable use of medicinal plants through research, advocacy, and policy development and guides policymakers and practitioners on best practices for medicinal plant management (IUCN, 2019).

5. Traditional Knowledge Digital Library (TKDL): The TKDL is a global initiative led by India to document and digitise traditional knowledge related to medicinal plants and other areas. The TKDL provides a platform for sharing traditional knowledge with the broader scientific community and helps to ensure that traditional knowledge is recognised and protected in policy and legal frameworks.

6. Traditional and Complementary Medicine (TCM): The TCM program is a program of the World Health Organization (WHO) that aims to promote the integration of traditional and complementary medicine into national health systems. The TCM program is relevant to regenerating medicinal plants because it recognises the importance of traditional medicine, including traditional medicinal plants, in healthcare. The TCM program also promotes research and development of traditional medicine, which can help to identify medicinal plant species that have the potential to be regenerated (WHO, 2019).

7. International Union for Conservation of Nature (IUCN): The IUCN is a global organisation that aims to conserve biodiversity and ensure the sustainable use of natural resources. The IUCN has developed several initiatives to promote the conservation and sustainable use of medicinal plants, including the Medicinal Plant Specialist Group, which provides scientific and technical support for the conservation and sustainable use of medicinal plants.

8. United Nations Development Programme (UNDP): The UNDP has implemented several programmes to promote the sustainable use of medicinal plants and to support the livelihoods of communities that rely on these plants for their health and well-being. For example, the UNDP's Biodiversity and Ecosystems Global Programme supports countries in developing and implementing policies and strategies for the sustainable use

of biodiversity, including medicinal plants. The UNDP also supports community-based approaches to the conservation and sustainable use of medicinal plants.

The WHO has developed several policies and programmes to promote the use and conservation of medicinal plants. For example, in 2002, the WHO launched the Global Strategy for Traditional Medicine to promote the safe and effective use of traditional medicine, including medicinal plants. The WHO also established the International Agency for Research on Cancer (IARC), which studies plants' carcinogenic properties and helps identify potential new drugs from plant sources.

2.5.2 Africa

Africa is home to a rich biodiversity of medicinal plants used for centuries to treat various ailments. However, the overexploitation of these plants has led to a decline in their population, making them endangered species. To address this issue, several policies and programmes have been implemented in Africa to facilitate the regeneration of medicinal plants. Some of the policies and programmes implemented in Africa to facilitate the regeneration of medicinal plants include;

1. The African Union Medicinal Plant Strategy: The AU has developed a comprehensive strategy to promote the sustainable use and conservation of medicinal plants in Africa. The plan aims to strengthen the capacity of African countries to manage and sustainably use medicinal plants, promote research and development of medicinal plants, and enhance regional and international cooperation in the management of medicinal plants. The strategy also aims to encourage the development of national policies and legal frameworks that support the conservation and sustainable use of medicinal plants in Africa. (African Union, 2020).

2. Traditional Knowledge and Intellectual Property Rights: Several African countries have developed policies and programmes to protect traditional knowledge and intellectual property rights related to medicinal plants. These policies and programmes aim to ensure that the benefits derived from the use of medicinal plants are shared equitably among all stakeholders, including local communities. For example, the South African government enacted the Traditional Knowledge and Intellectual Property Rights Act in 2013, which protects and promotes traditional knowledge related to medicinal plants (South Africa, 2013).

3. National Medicinal Plant Conservation and Development Programmes: Many African countries have established national medicinal plant conservation and development programmes to ensure the sustainable use and management of medicinal plant resources. For instance, Nigeria's National Institute for Pharmaceutical Research and Development (NIPRD) has established a National Medicinal Plants Development Program to promote the sustainable cultivation, harvesting, and processing of medicinal plants.

4. Community-Based Conservation Programmes: Several community-based conservation programmes have been implemented across Africa to involve local communities in the conservation and sustainable use of medicinal plants. For instance, the Community-Based Natural Resource Management Program in Namibia has facilitated the conservation and management of medicinal plants by empowering local communities to take charge of their natural resources.

5. Certification and Standardization of Medicinal Plants: Certification and standardisation programmes have been implemented in several African countries to promote the safety and efficacy of medicinal plants. For instance, the African Union

has developed the African Herbal Pharmacopoeia to standardise the quality and safety of medicinal plants across the continent.

6. Sustainable harvesting and trade: Sustainable harvesting and marketing of medicinal plants are crucial for their regeneration and conservation. Several African countries have developed policies and programmes to promote sustainable harvesting and trade of medicinal plants. For instance, the Community Herb Gardens programme in Ghana aims to promote the sustainable harvesting and marketing of medicinal plants by empowering local communities (Opoku-Agyemang et al., 2015).

7. Ex-situ conservation: It conserves plant species outside their natural habitats, typically, in botanical gardens or seed banks. For example, ex-situ conservation is used in Africa to regenerate and save endangered medicinal plants. For instance, the National Botanical Research Institute in Nigeria has an active ex-situ conservation programme for medicinal plants (Okezie, 2014).

2.5.3 Local (Ghana)

Ghana has implemented various policies and programmes to facilitate the regeneration of medicinal plants. These efforts are aimed at conserving and sustaining the country's rich biodiversity and ensuring the continued availability of medicinal plants for traditional medicine and modern pharmaceutical industries. Some of the policies and programmes implemented in Ghana are:

National Biodiversity Strategy and Action Plan (NBSAP): The NBSAP was developed in 2012 to provide a framework for the conservation and sustainable use of Ghana's biodiversity. The plan includes strategies for the protection and regeneration of medicinal plants, as well as the development of sustainable harvesting practices. The plan is implemented by the Environmental Protection Agency (EPA) and the Forestry

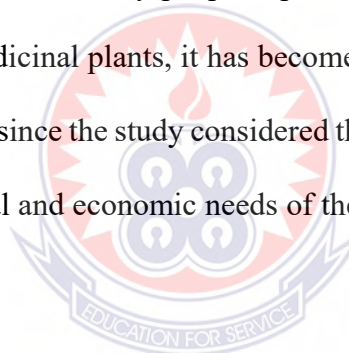
Commission (FC) in collaboration with other stakeholders (Government of Ghana, 2012).

2.6 Theoretical Background

Understanding the world around us is aided by theories. It enables us to describe what we observe and decide how to affect change. In the end, theories direct research. It makes it easier to predict human behaviour and explains how various features of human behaviour are structured. As a result, a few theories are reviewed to inform this study.

2.8 Sustainability Theory

As we attempt to clarify community people's perceptions and misconceptions on the effects of logging on medicinal plants, it has become helpful to examine sustainability theory to guide the study since the study considered the Bobiri Forest Reserve to sustain the: social, environmental and economic needs of the people in the community around the forest.



The 1987 Report of the Brundtland Commission, *Our Common Future*, defined sustainable development as "meeting the needs of the present generation without compromising the ability of future generations to meet their own needs." The issue of sustainability is one of resource scarcity, either at present or at some projected time in future. Sustainability concerns manifest as resource depletion, resource degradation, the deliberate or accidental damage of resources for short-term gain, or a misunderstanding of the complex interrelationships between resources. For most of human history, the population size was sufficiently small that we either did not experience significant resource loss, where there were resource limitations, we could relocate, or resources could regenerate naturally. More recently, the resource limitations

and resultant disruptions to natural cycles have led to severe human tragedies such as negative impacts on human health and well-being poverty and malnutrition (Hecht et al., 2012)

Theories of sustainability attempt to prioritise and integrate social responses to environmental and cultural problems. An economic model looks to sustain natural and financial capital. Sustainability means a capacity to maintain some entity, outcome, or process over time. For example, agriculture, forest management, or financial investment might be deemed sustainable, meaning the activity does not exhaust the material resources it depends on. An analogous use of the term “sustainability” refers to dependent social conditions; for example, a peace treaty, an economic policy, or a cultural practice may be called sustainable if it does not exhaust a political community's support. In its increasingly common use, the concept of sustainability frames how the environment jeopardizes the conditions of healthy economic, ecological, and social systems. The most widely known model of sustainable development is the “three pillars model” (United Nations World Summit, 2005). The “pillar” names change with different versions of the models, and the most common include:

- Economic, Social, and Environmental (United Nations World Summit, 2005).
- Economic, Social, and Natural Capital (Dyllick & Hockerts, 2002).
- Economic growth, Social Progress, and Environmental protection (Kates et al., 2005).
- Business, Society, and Nature (Dyllick & Hockerts, 2002).

Generally, the three pillars model considers “environmental, economic, and social resources” (WCED, 1987). This model achieves sustainable development once all three pillars work in unison. When discussing sustainable development, the environment or the economy is usually prioritised (Giddings et al., 2002). Although the Local Agenda

21 agreements at the Rio Conference included issues to do with social and economic development, strengthening participation and ways of implementation (Grubb, 1993), most LA 21 plans in Britain pay attention primarily to environmental issues (Durham, 1997; Northumberland, 2000). This focus of LA 21 on the environment can be a weakness, as this often means it is considered peripheral by both local and national governments, who usually concentrate on economic issues. According to Giddings et al. (2002), many English and American environmentalists prioritise the countryside, wild animals and wilderness with the aim of preservation from people, with less concern about the urban environment. This outlook has its roots in a view that sees the environment as independent from humans and an anti-urban tradition.

2.9 Conceptual Framework for the Study

The framework depicts various factors, impacts, and policies related to logging medicinal plants in Bobiri forest reserve. The variables in the framework are related to the perception of the community on the impact of logging of medicinal plants in Bobiri forest reserve. Motivating factors are the driving forces behind logging of medicinal plants in Bobiri forest reserve. Medicinal properties of the plants make them valuable for use in traditional medicine, while economic incentives and alternative sources of income motivate people to log the plants. Market demand for medicinal plants also plays a role in driving logging. These logging activities leads to the extinction of specific medicinal plants including, *Morinda lucida* *Tetrapleura tetraptera*, *Bridelia atrovirides*, *Amphimas pterocarpoides*, *Entandrophragma utile* putting them under the risk of extinction. In ensuring the regeneration of medicinal plants, education and awareness campaigns, protection of endangered species, and medicinal plants conservation are all part of the policies for medicinal plants regeneration. These policies

aim to regenerate medicinal plants that have been lost due to logging. Development of ecotourism initiatives can provide an alternative source of income for local communities while also promoting the conservation of medicinal plants. Protection of endangered medicinal plants can also help to ensure their survival for future generations

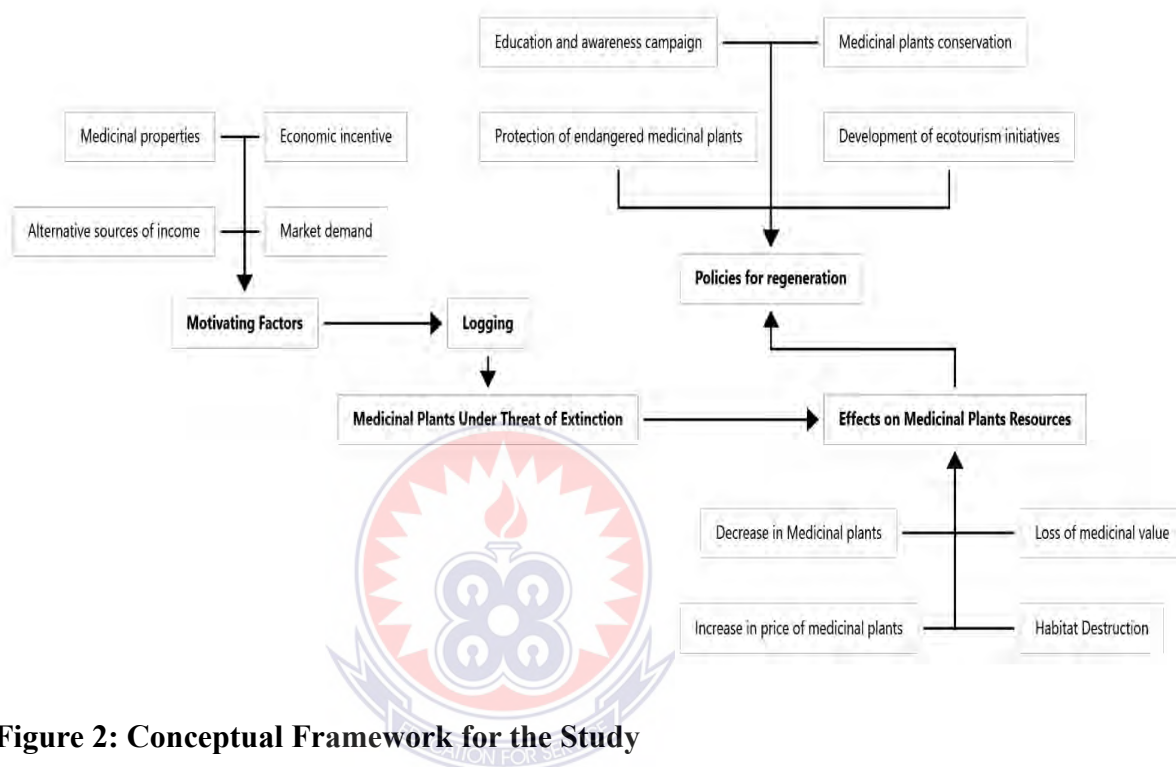


Figure 2: Conceptual Framework for the Study

Source: Author’s Construct, 2023

2.10 Chapter Summary

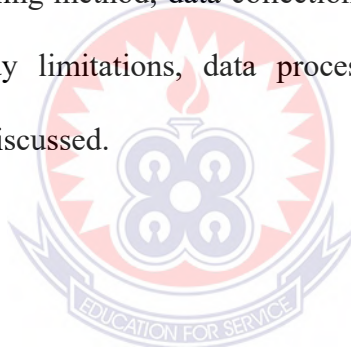
The chapter reviewed the literature on; community peoples’ perceptions of the specific impacts of logging on medicinal plants, specific medicinal plants under threat of extinction due to logging, perception of the community on the factors that motivate loggers to harvest medicinal plants, strategies that can be employed to minimise damage to medicinal plants through logging and perceptions about policies and programmes that can be implemented to facilitate the regeneration of medicinal plants.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

Creswell (2002) defines research technique as "the distinct procedures or approaches utilized to discover, select, process, and analyze data regarding a specific issue." According to Willmott (2020), research methodology provides conceptual frameworks for assertions made in acquiring knowledge and employing specific methodologies. As a result, this chapter discusses the study's research technique, beginning with a description of the study's research design and philosophical foundations. The research's target populations, sampling method, data collection tools, data collection procedure, study delimitation, study limitations, data processing and analysis, and ethical considerations are then discussed.



3.1 Study Area

3.1.1 Background

The adjoining communities that surround the forest reserve is located within Juuaben Municipality. Juaben Municipal Assembly is one of 43 districts in Ghana's Ashanti Region. It was formerly part of the then-larger Ejisu-Juaben Municipal District in 1988, which was formed from the former Ejisu-Juaben-Bosomtwe District Council, until the northeast part of the district was split off to form Juaben Municipal District on 15 March 2018; thus, the remaining part has been renamed Ejisu Municipal District. The municipality is located in the center section of the Ashanti Region, with Juaben as its capital city.

3.1.2 Physical features

3.1.3 Location and Size

Juaben Municipal is located between latitudes 1o 15'N and 1o 45'N and longitudes 6o 15'W and 7o 00 W. It has a total land area of 364,674 hectares (365 sq. km.). The Municipality is located in the heart of the Ashanti Region and shares boundaries with six (6) districts. They are Sekyere East to the northeast and Afigya Kwabre to the north, respectively; Ejisu to the west, Bosomtwi to the south, Asante Akim South to the southeast, and Kumasi Metropolitan Assembly to the north. The Municipality's central location in the region and its size in terms of land area explain the numerous neighbouring districts. This positions the Municipality well if it embarks on a combined district development project (Ghana Statistical Service, 2021).

3.1.4 Climate and Vegetation

Like most of Ghana's middle belts, the municipality has tropical rainfall with a bimodal rainfall pattern and a moist semi-equatorial climate. It is distinguished by twice maximum rainfall that lasts from March to July and then again from September to the end of November. The average annual rainfall is 1200mm, making it suited for short-season agriculture. Temperatures range from 20 degrees Celsius in August to 32 degrees Celsius in March. The relative humidity is moderately high during the rainy season and early mornings. The Municipality's fair distribution of temperature and rainfall patterns promotes the development of several food and cash crops, making it a food-sufficiency case in Ghana. The municipality is located in a semi-deciduous forest zone, which resembles the rain forest in appearance. Most trees drop their leaves during the dry season, although not all trees are of the same species at the same time. The native vegetation cover had been degraded into a secondary forest due to

environmentally unfavourable farming methods, stone quarrying activities, and illegal chainsaw operations. Massive deforestation has occurred in locations such as Adadientem, Achiase, and Peminase, gradually transforming the forest into savanna conditions (GSS, 2021).

3.1.5 Relief and Drainage

The municipality is located on a forest-dissected plateau topography. Pre-Cambrian rocks of the Birimian and Tarkwaian formations underlie this region. It reaches between 240 and 300 meters above sea level. The terrain is mainly hilly, and various rivers drain the area, including the Oda, Anum, Bankro, Hwere, and Baffoe. Flooding occurs in the inland valleys along the river basins during the rainy season. The construction of an irrigation dam on the Anum River at Nobewam offers tremendous possibilities for agricultural development in the municipality (GSS, 2021).

3.1.6 Soils

The geology and soil types in the municipality provide a wide range of opportunities for producing traditional and non-traditional cash crops and other staple foods, positioning the municipality as one of Ghana's food basket cases. The municipality's geology and soil types include the Kumasi-Offin Compound Association, the Bomso-Offin Compound Association, the Swedru-Nsuba Simple Association, and the Boamang-Suko Simple Association. Kobeda-Eschiam-Sobenso-Oda Compound Association, Atunkrom-Asikuma Association, Bekwai-Oda Compound Association (GSS, 2021).

3.1.7 Political Administration

The Assembly connects with the various hierarchies vertically and receives expert advice or recommendations from entities at the same level. The Municipal Assembly is the highest level of government, followed by the Executive Committee, which has fifteen (15) members. The Municipal Chief Executive chairs the Executive Committee, which performs the Assembly's political, administrative, and coordinating tasks. At the same time, Sub-committees are convened to debate on subjects related to their functional areas.

Among other things, the subcommittees collect and deliberate on topics referred to them by the Executive Committee. The Assembly's basic values are consistent with Service Delivery Standards (SDS), which ensure openness, accountability, and mutual confidence between duty-bearers and right-holder citizens in service delivery. The Municipal Chief Executive (MCE) is aided by a Central Administration secretariat led by the Municipal Co-ordinating Director, who reports to the MCE. The Municipal Assembly's Central Administration office includes the General Administration and Finance (GAF) and Municipal Planning Co-ordinating Unit (MPCU), all of which operate to coordinate, monitor, and assess development operations for budgetary purposes. The Municipal Health Management Team, Social Welfare and Community Development, Education, Science, Sports, Ministry of Food and Agriculture, Works Department, Budget, Urban Roads, National Resource Conservation, Trade and Industry, and Disaster Prevention units assist these two offices (GSS, 2021).

3.1.9 Economy

The Juaben Municipality's local economy can be divided into four basic categories: agriculture, industry, trading, and services. Despite the Municipality's apparent peri-

urban status, agriculture remains the dominating industry. In the Municipality, agriculture employs approximately 47 percent of the total households. Crop cultivation employs most of the Municipality's agricultural resident's 96 percent, with livestock husbandry, fish farming, and tree planting accounting for the remaining 20 percent. The majority of these crops are grown on a small scale. Only a few people engage in medium to large-scale farming. Some farmers, on the other hand, appear to be taking advantage of the vast potential market in Ejisu and the Kumasi Metropolis to cultivate food (maize, plantain, rice, cocoyam,) tree crops, and vegetables such as pepper, tomatoes, garden eggs, cabbage, carrots, cucumber, green pepper, and okra on a relatively large scale. Compared to the national average of 5 acres, the average farm size is as low as 1.9 acres per farmer. Juaben has a vast oil palm plantation that feeds the Juaben oil mills. Only a small part of agricultural goods, such as cassava and maize, are processed into gari and cornbread, respectively. The second most important agricultural industry in the municipality is livestock rearing. Over 100,000 animals were raised, including 15,200 sheep, 12,370 goats, and 3,746 piglets. 105,075 hens, 404 guinea fowls, 901 ducks, and 277 doves were in the poultry category. Other animals (non-traditional livestock) included 197 grass-cutters and 440 rabbits, respectively.

Retailing, paltry dealing, wholesaling manufactured goods, and agricultural produce are all part of the commerce sector. This sector employs approximately 7.2 percent of the municipality's total labour force. Foodstuffs, provisions, spare parts, alcoholic and soft drinks, building materials, prepared food, wood and wood products, plastic products, chemicals/drugs, gasoline, and so on are examples of trading/commercial operations in the municipality. The majority of shops get their start-up funding from personal savings. Their business is modest, with low turnover and earnings. The most significant aspect is that they rely on it for survival. These expanding activities impact

our environment, particularly in terms of sanitation. As traders trade along these routes, there is also the risk of being hit by passing vehicles. The Municipality's existing markets need to be in better condition and adequate. The service industry, which includes civil and public officials and banking and financial services, employs around 40% of the entire labour force in the Municipality. Other famous occupations include housekeeping, driving, nursing, and teaching. Hairdressing/barbering, traditional catering (chop bar), automotive, radio/TV, fridge/air-conditioning, and mobile phone repairs are all accessible in the district.

Juaben Municipality is involved in both primary and secondary industries. The Juaben's major industries are small and medium-sized manufacturing businesses. The industrial sector employs approximately 5.8 percent of the Municipality's workforce. Most industrial owners operate on a small scale, employing less than 20 people. The largest industrial concentrations are the oil palm plant in Juaben, which employs about 23% of the labour force involved in the industry. Wood processing employs about 29%, and kente-weaving employs 36%. Metal-based manufacturing accounts for 5%, while other manufacturing activities account for 7%. The majority of industrialists (85%) are self-employed. The Municipality has three markets; thus, markets are always available, especially on market days. The degree of productivity in an industry is determined by technology, innovation, and capital. The key issues affecting industry require greater money and new advanced technologies to increase production methods and output productivity (GSS, 2021).

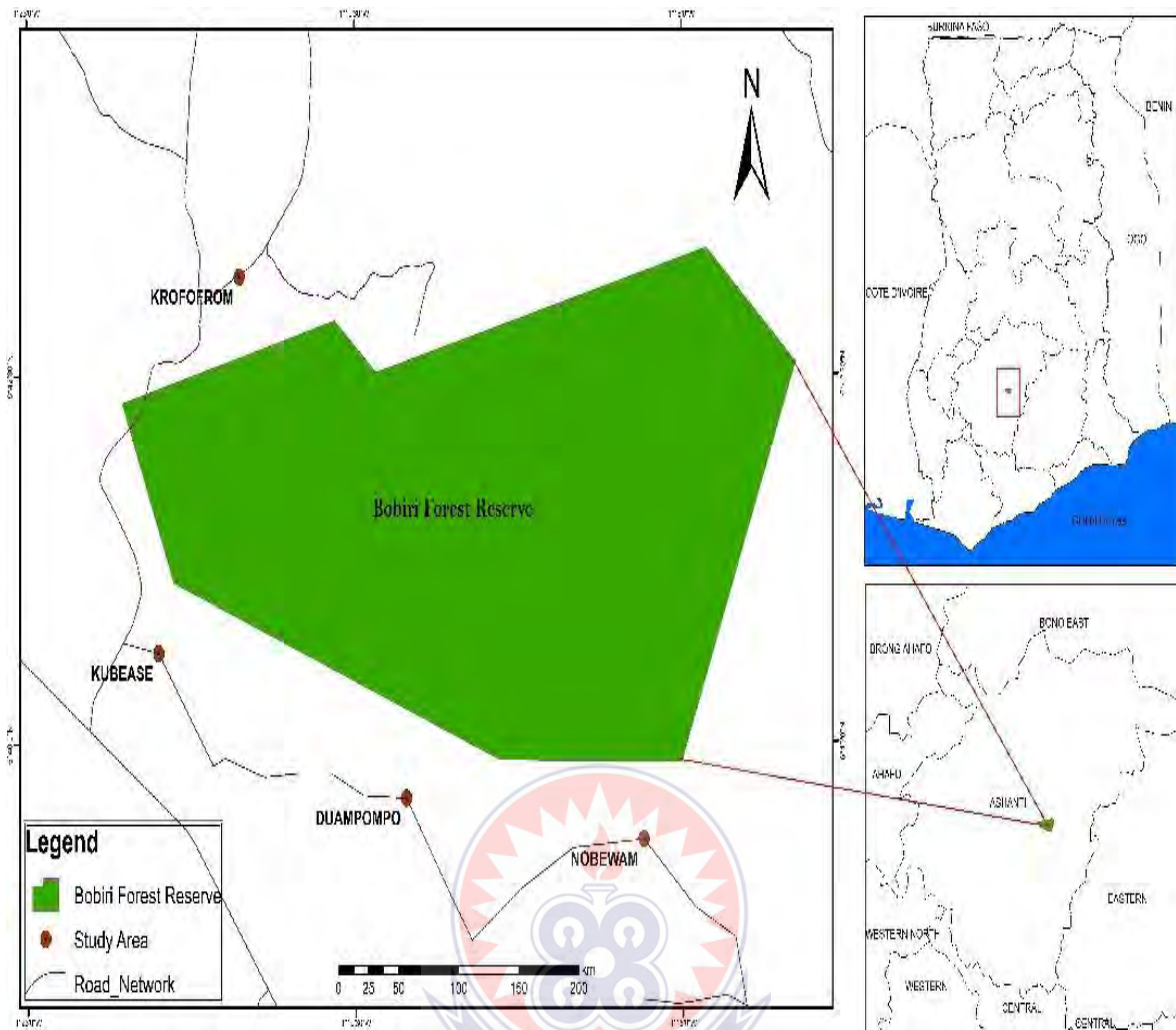


Figure 1 Map of Juaben Municipal Assembly

Source: Author's Construct, 2023

3.2 Philosophical underpinning of the study

The Study's guiding research philosophy was pragmatism. The pragmatic method assumes that a worldview evolves from conditions, events, and outcomes rather than preceding circumstances (Creswell, 2010). Concerns have been raised about applications, functionality, and problem-solving techniques (Tesch, 2013). Instead of focusing on procedures, researchers emphasize the research topic and employ every methodology available to solve it. (Punch, 2014). All competing systems of reality and philosophy are welcome in pragmatism philosophy. This refers to mixed methods research since researchers heavily use quantitative and qualitative assumptions when conducting their research (Creswell, 2014). Mixed methods research is a research strategy that comprises acquiring both quantitative and qualitative data, merging the two forms of data, and applying diverse designs that may contain philosophical assumptions and theoretical frameworks (Cameroon, 2011). Pragmatists believed in an external universe that was both independent of and embedded in the mind. They believe, however, that we should stop asking questions about reality and natural laws (Cherryholmes, 1992). Thus, pragmatism opens the door to diverse methodologies, distinct worldviews, assumptions, and other types of data collection and analysis for the mixed methods researcher (Creswell, 2014).

3.3 Research Approach

A mixed-method approach was used in this study. Mixed methods research is an approach to an inquiry involving collecting both quantitative and qualitative data, integrating the two forms of data, and using distinct designs that may involve philosophical assumptions and theoretical frameworks (Creswell, 2012). The core assumption of this form of inquiry is that combining qualitative and quantitative

approaches provides a more complete understanding of a research problem than either approach alone. Mixed methods involve combining or integrating qualitative and quantitative research and data in a research study. Qualitative data tends to be open-ended without predetermined responses, while quantitative data usually includes closed-ended responses such as those found on questionnaires or psychological instruments (Creswell, 2014).

3.4 Research Design

The study relied on an explanatory sequential design. The explanatory type of research design basically tries to understand and explain the current nature, situation or the relationship that exist between phenomena. It is defined as an attempt to connect ideas to help understand the causes and effects of a phenomena. According to Yin (2003), explanatory research is an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used.

This design seeks to answer question of “why” phenomena occur the way they do as well as explain what is going on. The explanatory research usually involves the use of exploratory research to explore something and the use of descriptive research to gain more knowledge about it before seeking to explain the situation. Explanatory research looks at how things come together and interact. It was adopted for the research to help explore and explain the impact of logging of medicinal plants and the strategies to minimise the damage to medicinal plants through logging.

3.5 Study Population

Avoke (2005) refers to the population as the centre of interest group to the researcher. It is that group that the researcher is interested in learning more about to make inferences. People who reside in the four communities (Kubease, Nobewam, Duampopo, Krofofrom) made up the study's population. These communities serve as a gateway to the forest reserve. Natives from the communities, including forestry officials, opinion leaders, herbalists, and loggers, constitute the research area's population.

3.6 Target population

The target population for the study included community residents aged 18 years and above who have been living in the area for a minimum of five years. This age group is often associated with legal adulthood and independent decision-making and also have long-term familiarity with the community and its dynamics. Various stakeholders were also involved in the study to acquire a holistic understanding of the effects of logging on medicinal plants in Bobiri Forest Reserve. These stakeholders included Ghana Forestry Commission, opinion leaders (chiefs and elders), herbalists, and loggers. Their contributions were integral in comprehending the community's perspective on the impact of logging on medicinal plants.

3.7 Sample Size

The population elements are also referred to as the study's sample size (Kothari, 2009). According to Bryman and Bell (2007), a sample is a population slice chosen for the investigation. The sample size for the study was 400 respondents. Four hundred (400) members in the four communities make up the sample size.

The sample size was determined using Yamane's (1967) formula.

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

Where n is the sample size, N is the total population, which is 63929 in this study, and e is the confidence level, in this case using an error margin of 10%.

$$\text{Therefore; } n = \frac{63929}{1 + 63929(0.05)^2} = 399.9$$

$$n = 400$$

3.8 Sampling Technique

Sampling is one of the pivotal mechanisms in gathering data for a study. By choosing a smaller set of participants. Alan et al. (2017) defined sampling techniques as determining what a more significant population would reveal if we asked every member of the larger population the same question. Each study's sampling techniques are based on the population, sample size, and analytic method (Rao et al., 2016).

Muti-stage sampling and purposive sampling was used for the study. Multi-stage sampling is well-suited for incorporating into a mixed methods research design intending to gather data from a large geographic area. As Creswell and Creswell (2018) discuss, multistage clustering leverages multiple steps to narrow in on a target sample both randomly and strategically. When paired with mixed methodology, it provides strengths in balancing quantitative breadth through surveys with qualitative depth from focused subgroups (Shorten & Smith, 2017). A multi-stage sampling technique was appropriate for this study because the population being studied was very large and spread out over a wide geographic area.

The first stage used simple random sampling to select four (4) towns from the Juaben district. With this, the lottery method was used. The names of towns in the district were

written on pieces of paper and put in a container. The towns were randomly selected. The selected towns were Kubease, Duampopo, Krofofrom and Nobewam. Collins et al. (2006) discusses that, selecting a smaller number of clusters allows investing more resources into gathering richer within-cluster data rather than thinner datasets across many towns. Prioritizing depth over breadth is suitable for certain research aims.

The second stage used controlled quota sampling to assigned 100 respondents to each of the four towns. When employing multistage sampling for a stratified population of unknown sizes across sampling units, El-Badry (1961) recommends assuming equal fractions to determine proportional allocations: "In the absence of reliable data on the actual distribution of a population characteristic among the strata, an unbiased assignment is made by the method of equal fractions" (p. 110).

The final stage used simple random sampling to select respondents from the four communities namely, Kubease (100), Duampopo (100), Krofofrom, (100), Nobewam (100) to answer the survey questions.

Purposive sampling was used to select loggers (4), opinion leaders (4), herbalists (4), and Ghana Forestry Commission (1) considered vital informants. In all 13 participants were purposively sampled for the qualitative study. The reason for opting for purposive sampling in this scenario is because the chosen groups of individuals possess specific knowledge and expertise that is relevant to the research topic. For instance, loggers have direct experience extracting forest resources, while Ghana Forestry Commission have regulatory and managerial responsibilities linked to forest resources. Opinion leaders are influential members of the community and are capable of providing insights into social and cultural attitudes towards forest resources. Similarly, herbalists have traditional knowledge concerning the medicinal properties of plants and their significance in the local culture. Hence, these groups of individuals are vital informants

to understand the intricate social, economic, and cultural factors that influence the management and use of forest resources in the study area.

3.9 Data Source

This research work made use of primary sources of data. The primary data was collected from key respondents, including members of the communities, Ghana Forestry Commission, opinion leaders, herbalists, and loggers. The instruments used to collect primary data for this study included questionnaires and an in-depth interview guide.

3.10.1 Questionnaires

Questionnaires are tools used to collect quantitative data. Questionnaires are simple to analyze and can be processed by most statistical software. It also ensures accuracy and authenticity. The questionnaire was selected because its well-known benefits of establishing a solid rapport, generating a pleasant and healthy environment in which respondents easily collaborate, answer questions, and demonstrate clear anxiety about any aspect of a study (Kumekpor, 2002). The questionnaire approach was chosen because, according to Cresswell (2010), it best suits the collecting of quantitative data and ensures respondents' confidentiality, anonymity, and convenience. The questionnaires were in six (6) sections. Section A contained the demographic characteristics of respondents; Section B contained community people's perception of the specific impacts of logging on medicinal plants, Section C, Specific Medicinal plants under threat of extinction due to logging, Section D contains factors that motivate loggers to harvest medicinal plants, Section E strategies to be employed to reduce damage to medicinal plants and Section E contains perceptions about policies and programmes that can be implemented to facilitate the regeneration of medicinal plants.

3.10.2 In-depth interview (IDI) guide

Another tool utilized in the study was the IDI guide (Appendix 2). In-depth interviews with forestry officials, opinion leaders, herbalists, and loggers were conducted using this guide. The major qualitative research method, developing an interview guide, was more beneficial. The open-ended questions gave us additional flexibility during data collecting on the field. As such, obtaining more detailed information where necessary with the interview was possible. To ensure validity and reliability, the responses provided by the interviewees were repeated by the interviewers for the interviewees to confirm or modify. This ensured that the interviewees understood the issues well and that the interviewers or the recorders did not misrepresent their responses. Also, in addition to the recorder, a note taker was present to take note of the essential points derived from the interviews. Using an unstructured interview guide, the respondents had the opportunity to control the direction of the questions. However, the researcher insisted that all relevant questions in the interview guide were answered. The time taken for each interview session ranged from 30 to 45 minutes.

3.11 Pre-test of research instruments.

Pre-testing is frequently regarded as necessary for the development of survey questionnaires, as well as for improving data collection for quality-of-life research. It employs many techniques or combinations of procedures (Bassili, 1996). According to Draisma (2004), it is usual procedure in a social science survey to pre-test attitudinal material to guarantee that questions that respondents cannot meaningfully answer are eliminated. This is one of the reasons why research tools must be pre-tested.

The instruments were subjected to a pretest during a reconnaissance study, and improvements were made to meet the requirements for the field survey. The

reconnaissance study was conducted to test the instruments and familiarise the study area. According to Sarantakos (1997), the reconnaissance stage of the study gives the researcher familiarity with the environment. Also, it offers the opportunity to practice research in an actual situation before the main study begins. For this research, the reconnaissance survey was done in Boankra, a 10-minute drive from the forest reserve. This location was chosen due to its proximity to the forest reserve and its similar characteristics of logging activities to the actual study areas.

3.12 Data Collection Procedure

This study employed two main data collection methods: questionnaires and in-depth interviews. The questionnaires were distributed to the respondents via in-person delivery, based on the convenience of the respondents. The questionnaire was designed to elicit responses on different aspects related to the research question. To ensure the validity of the questionnaire, a pilot test was conducted to assess its clarity and comprehensibility. This testing helped to identify ambiguities in the questions, which were later revised to improve their clarity and readability.

In-depth interviews were held with key informants with specialized knowledge and expertise relevant to the research topic. The key informants were selected using purposive sampling, where individuals were chosen based on specific criteria. The interviews were conducted face-to-face, and the questions were open-ended to allow for detailed responses. The participants were given informed consent and assured of the confidentiality of their responses. The interviews were audio recorded with the consent of the participants, and later transcribed verbatim for analysis.

3.13 Data Processing and Analysis

After collecting the data, the data was coded and imputed in SPSS for data cleaning. The dataset was scrutinized to identify missing values, outliers, and inconsistencies. The missing values were either imputed or removed, depending on the extent of the missingness. Outliers were detected using statistical techniques and eliminated if necessary. Inconsistencies were rectified by cross-checking the data against the original questionnaires. SPSS was used to test the reliability of the data. The Cronbach's alpha coefficient was used to evaluate the internal consistency of the data. A Cronbach's alpha coefficient of 0.968 was achieved after testing the internal consistency of all 45 scaled items used for the study. The Alpha value revealed a very high internal consistency hence the items were considered suitable for data analysis. Quantitative data were analysed in percentages and frequencies. The results were displayed using tables and graphs, which aided the interpretation of the results. Qualitative data was analysed using direct content analysis. Upholding this pragmatic tenant in mixed methodology research is particularly important after access has been conferred through proportional quota assignments. As Shorten and Smith (2017) discuss, sidelining grounded inputs from qualify-selected populations risks compromising integrated validity. Therefore, prioritizing emic manifestations over etic interpretations through direct content analysis of verbatim transcripts, field notes and other qualitative outputs helps reconcile the structured sampling with the subjective nature of subsequent ethnographic data gathering.

3.14 Ethical Considerations and Community Entry Protocol.

Throughout the whole period of data collection, this study took into account and upheld ethical principles, including informed consent, anonymity, and confidentiality. This

was done to refrain from forcing anyone to participate in a study (Neuman, 2007). Therefore, before conducting the survey, informed consent from the respondents were sought. Furthermore, the aim of the study was made clear to respondents when they were approached. They were then asked for permission to take part in the survey. Those who chose not to participate in the study were not under any duress, but those who did were given questionnaires and an interview guide to fill out.

The study's respondents were also assured of the anonymity of their responses and identities. To do this, no personal information such as telephone number, name, or address was gathered as part of the socio-demographic information of the respondents. Moreover, respondents were assured that any information provided towards the study is kept confidential (Neuman, 2007), such that on no account will another person have access to the data collected from them, except for the researcher and the supervisor of this academic study. The respondents were further assured that the study was a purely academic exercise and under no circumstances would their background information be associated with specific responses given or disclosed to a third party. The forestry commission served the researcher with a copy of clearance, making it easy to conduct one-on-one interview sessions with the director in charge of the Bobiri Forest Reserve.

3.15 Chapter Summary

This chapter discussed the methodology used in the study. The chapter discussed issues relating to the study area. The study used the Pragmatic research approach and used the mixed data collection and analysis method. The chapter indicated the study's data sources, target population, sample size and sampling procedures. The instrument for data collection and how the data was processed and analysed were also considered. The study upheld ethical issues.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.0 Introduction

This chapter covered the results and discussion of the survey data collected on community people's perception of the impact of logging on medicinal plants in Bobiri Forest Reserve in Juabeng Municipality. The chapter presented the results in five sections. Due to the nature of the study's objectives, the first section integrated the demographic characteristics of the respondents into the first objective; the second section identified specific medicinal plants under threat of extinction due to logging. The third section explored effects of logging on medicinal plants resources. The fourth section determined the perception of the community on the factors that motivate loggers to harvest medicinal plants. The fifth section explored perceptions about policies and programmes that can be implemented to facilitate the regeneration of medicinal plants.

4.1 Demographic Characteristics of Respondents

The study asked respondents background information such as gender, age, level of education, employment status, community, origin and duration for living in the community. These are presented in Table 4.1 below.

Table 4.1: Demographic Characteristics of Respondents

Variables	Frequency (f)	Percentage (%)
Gender of Respondents		
Male	234	58.5
Female	166	41.5
Age Group of Respondents		
18-28	84	21.0
29-39	143	35.8
40-49	79	19.8
50 and above	94	23.5
Level of Education		
No formal education	159	39.8
Basic	92	23.0
SHS/Voc/Tec	98	24.5
Tertiary	51	12.8
Employment Status		
Employed	152	38.0
Unemployed	248	62.0
Community		
Kubease	100	25.0
Nobewam	100	25.0
Krofofrom	100	25.0
Duampompo	100	25.0
Origin		
Native	263	65.8
Migrant	57	14.3
Settler	80	20.0
Duration for living in the community		
Less than 5 years	37	9.3
5-10 years	40	10.0
11-15 years	35	8.8
16-20 years	95	23.8
More than 20 years	193	48.3
Total	400	100.0

Source: Field survey, 2023

Table 4.1 provides a comprehensive overview of the characteristics of 400 respondents surveyed in four different communities. It is evident that the survey had a higher proportion of male respondents (58.5%) than female respondents (41.5%). In terms of age groups, the largest group was those aged 30-39 (35.8%), followed by those aged 50

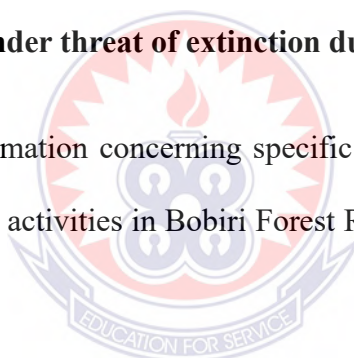
and above (23.5%). This indicates that a sizeable proportion of middle-aged and older people were included in the survey.

Regarding the level of education, the highest proportion of respondents (39.8%) had no formal education, while (24.5%) had SHS/Voc/Tec education. In terms of employment status, (62%) of the respondents were unemployed, while (38%) were employed.

Four communities were included in the survey, with equal numbers of respondents. Kubease (25.0%), followed by Nobewam (25%), Krofofrom (25%), and Duampompo (25%). In terms of origin, most of the respondents were natives (65.8%), while only (14.3%) were migrants. Finally, the duration of living in the community varied among the respondents, with (48.3%) of them living in the community for more than 20 years.

4.2: Medicinal plants under threat of extinction due to logging.

The study solicited information concerning specific medicinal plants under threat of extinction due to logging activities in Bobiri Forest Reserve. The results are presented in the figure below.



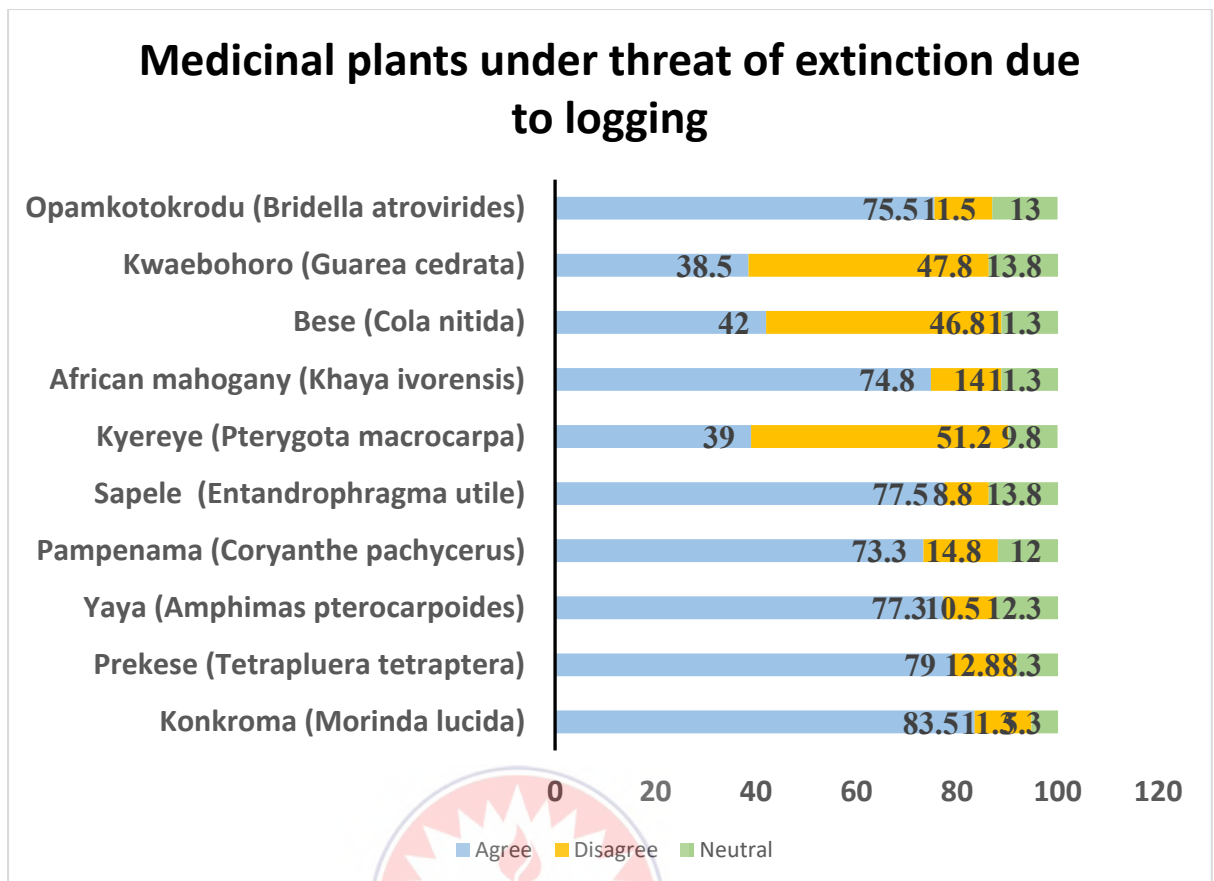


Figure 3: Medicinal plants under threat of extinction due to logging

Source: International Union for Conservation of Nature report (2019)

The figure above gives insight into respondents' opinions regarding the extinction rate of ten medicinal plant species due to logging. Each respondent was asked to rate their agreement or disagreement on a scale of agree, disagree, or neutral.

The survey results indicate that respondents generally believe that logging is one of the main causes of the extinction of certain species of plants. The highest level of agreement with this statement was found for “Konkroma” (*Monrinda lucida*), with 83.5% of respondents agreeing that logging is causing the plant to become extinct. “Prekese” (*Tetrapluera tetraptera*) and Yaya (*Amphimas pterocarpoides*) also had high levels of agreement, with 79% and 77.3% of respondents agreeing that logging is a factor in their extinction. Sapele had a slightly lower level of agreement at 77.5%.

“African mahogany” (*Khaya ivorensis*) had a slightly lower level of agreement at 74.8%, while “Pampenama” (*Coryanthe pachycerus*) and “Opamkotokrudu” (*Bridella atrovirides*) had levels of agreement of around 75%. This suggests that respondents are more likely to believe that logging is causing the extinction of some plants than others, although this is by no means a unanimous opinion.

However, the levels of agreement for “Kyereye” (*Pterygota macrocarpa*) and “Bese” (*Cola nitida*) were much lower, at 39% and 42%, respectively. This suggests that respondents believed that logging had less impact on these species than the other species. The lowest level of agreement was for “Kwaebohoro” (*Guarea cedrata*) at 38.5%, indicating that respondents did not think that logging was causing this plant to become extinct at a high rate.

It emerged that some opinion leaders, especially herbalists find it difficult to obtain medicinal plants to cure various ailments because these plants have gone extinct in the forest reserve. They enter into the forest reserve without getting the medicinal plants due to the activities of the loggers harvesting the plants.

“Konkroma” (Morinda lucida), “Kyereye” (Ptyerygota macrocarpa), “Kwaebohoro” (Guarea cedrata) these plants are used in the treatment of all kinds of diseases, but due to logging, they have gone extinct. Sometimes, I have to travel to other forest areas to search for these kinds of plants. This has really affected my work as a herbalist” (Herbalist, Duampompo; March, 2023).

My people's health is intricately connected with the health of the forests. As protecting trees like the magnificent African Mahogany and the humble Pampenama becomes a losing battle, we herbalists

struggle to procure the natural medicines necessary to treat common ailments. Depriving us of our forest's ancient herbal wisdom jeopardizes community wellbeing and severs cultural links to time-honored therapeutic traditions. I implore the authorities to curb excessive logging immediately through sustainability initiatives, before it's too late. We must safeguard Kyereye, Bese and Kwaebohoro from joining the scores of plants already critically endangered by human activities. The future vitality of both the forest and folk medicine now hangs in the balance - but with wise interventions, we can still secure a thriving coexistence." (Herbalist Kubease: March, 2023)



4.3: Community's perspective on how logging affects medicinal plant resources.

The study sought perceptions of the respondents on how logging affects medicinal plant resources. The results are presented in the table below.

Table 4.2: Community's perspective on how logging affects medicinal plant resources

Community's perspective on how logging affects medicinal plant resources	SD %	D %	N %	A %	SA %
1. Loss of jobs for people in the medicinal plant's value chain	13	12.3	14.5	22.8	37.4
2. Logging has affected the cultural practice or rituals that rely on the use of medicinal plants in your community	9.3	8.5	13	25.4	43.8
3. Logging has affected the growth and distribution of medicinal plants	9	5.3	5.8	34.8	45.2
4. Logging activities has caused a great change in the health of members of your community	6	6.8	9.8	29	48.4
5. Displacement of herbal practitioners	6.8	7.4	11	20.8	54
6. Logging has a significant impact on the availability of medicinal plants	4.4	7	6.8	32.8	49
7. The loss of medicinal plants has affected the traditional healing practice in your community	6	8.8	5.8	23.2	56.3
8. There has been an increase in the price of medicinal plants due to logging activities	8.3	2.3	6.8	21.4	61.3
9. There has been a decrease in medicinal plants as a result of logging	3.2	6	7.8	22.8	60.2

Source: fieldwork, 2023

From Table 4.2, most of the community members, (60.2%), agrees that logging leads to a loss of jobs in the medicinal plant value chain. A significant percentage (25.3%) disagrees, possibly suggesting a divergence of opinion on this issue, while (14.5%) remain neutral. Also, a substantial (69.2%) of the community members agrees that logging has impacted cultural practices or rituals tied to medicinal plant use. A smaller proportion (17.8%) disagrees, while (13%) express a neutral stance on this matter.

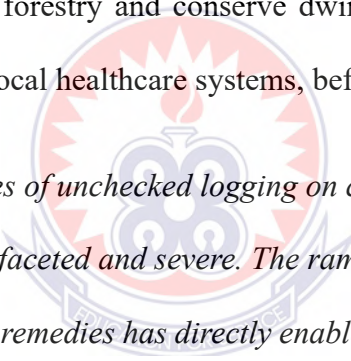
Moreover, a striking 79.9% of respondents believe that logging has had a negative impact on the growth and distribution of medicinal plants. Only a small percentage (5.8%) disagrees, and 14.3% remain neutral, indicating a strong consensus on this issue. Moreso, most of the respondents (77.4%) agrees that logging activities have caused a significant change in community members' health. A smaller percentage (9.8%) disagrees, while (12.8%) express neutrality.

Furthermore, considerable (74.8%) of the community members feels that logging has led to the displacement of herbal practitioners. Only (11%) disagree, and (14.2%) remain neutral, highlighting a widespread concern about the impact on traditional healers. In addition, an overwhelming (81%) of respondents believe that logging significantly affects the availability of medicinal plants. A minimal percentage (6.8%) disagrees, while (11.4%) remain neutral, underlining a strong consensus on the perceived impact.

To add to, a significant (79.5%) of the community members agrees that the loss of medicinal plants has affected traditional healing practices. A small percentage (5.8%) disagrees, and (14.7%) remain neutral, indicating widespread concern for the cultural and healing implications. Last but not least, a substantial (82.7%) of respondents believe that logging has led to an increase in the price of medicinal plants. A small percentage (6.8%) disagrees, while (10.5%) express a neutral stance, suggesting broad agreement on the economic impact.

Finally, a large majority (83%) agrees that logging has resulted in a decrease in medicinal plants. A smaller percentage (7.8%) disagrees, and (9.2%) remain neutral, highlighting a strong consensus on the perceived decline in medicinal plant resources.

The data paints a concerning picture of logging's perceived impacts on medicinal plants and traditional healing practices within the community. There is strong agreement that logging activities have led to job losses in the medicinal plant value chain, negatively affected growth and availability of key plant resources, driven up prices due to scarcity, and disrupted the cultural heritage of herbal medicine. Further, majority of the respondents believe health and wellbeing have declined due to this threat to traditional treatment options. The loss of biodiversity and displacement of practitioner guardians of generations-old healing wisdom also raises alarm. With such an overwhelming consensus on logging's extensive damage across economic, ecological, sociocultural, and health dimensions, urgent action is imperative. Authorities must implement policies that promote sustainable forestry and conserve dwindling flora vital for community livelihoods and resilient local healthcare systems, before reversibility is lost.



“The consequences of unchecked logging on community health and wellness are multifaceted and severe. The rampant removal of trees crucial for herbal remedies has directly enabled the proliferation of illnesses once treated by now impossible-to-find forest cures. Bereft of these natural disease-fighting resources, people suffer from maladies that had been managed for generations by traditional healers using plant-based medicines. Simultaneously, the erosion of river banks and water contamination resulting from logging means hydration and hygiene sources are compromised too. These medicinal plants are not just ingredients for tinctures and salves but part of a disappearing botanical wisdom. As deforestation robs the community of ancient trees, it also uproots knowledge, culture, and care practices uniquely adapted to surrounding ecology. The forest

canopy felling unravels tapestries of plants, people, and time-honored healing techniques intricately interwoven. It is this tremendous diversity that has secured community health for centuries, providing a cornucopia of curative flowers, barks, saps, and fungi as complex as the web of life itself. But logging-driven extinction now unravels these connections strand by irreplaceable strand” (Opinion leader, Duampompo; March, 2023)

“There have been changes in the number or variety of medicinal plants. There used to be abundant medicinal plants, but their number has reduced due to logging. These trees are going extinct because they are not replaced after being harvested. The logging of these plants has really affected our cultural practice. We have sacred days where entry into the forest is prohibited, but these loggers harvest trees anytime they want, all because they have a license from the government. Since time immemorial, we have relied on these herbs from plants to treat disease. Still, since loggers harvest these plants anytime, especially on sacred days, it has reduced their medicinal power, affecting my work as a herbalist” (Herbalist, Kubease; March, 2023).

4.4: Factors that motivate loggers to harvest medicinal plants.

The study sought perceptions of the respondents on the factors motivating loggers to harvest medicinal plants. The results are presented in the table below.

Table 4.1: Factors that motivate loggers to harvest medicinal plants

Factors that motivate loggers to harvest medicinal plants	SD %	D %	N %	A %	SA %
1. The demand for medicinal plants in local and international markets motivates loggers to harvest them.	11	6.8	4.5	39.3	38.4
2. Loggers harvest medicinal plants to preserve their cultural heritage.	44	23	15.8	8.2	9
3. The need for alternative sources of income motivates loggers to harvest medicinal plants.	7	6	13.3	33.7	40
4. The medicinal properties of the plants motivate loggers to harvest them.	8.2	7	20	25.8	39
5. The primary motivation for loggers to harvest medicinal plants is to make money.	6	9.5	9	25.5	50
6. The need to share distraction.	15.2	14	20.8	23.8	26.2
7. Harvesting medicinal plants is important for the economic development of the community.	40	33.5	21	3.5	2

Source: Field survey, 2023

The Table 4.3 above provides data on the motivation of loggers to harvest medicinal plants. The motivation of loggers to harvest medicinal plants is influenced by various factors, as evidenced by the survey results. The demand for medicinal plants in local and international markets emerged as a significant driver, with (77.7%) of respondents agreeing, (4.5%) remained neutral while (17.8%) disagreed that this factor motivates them. Furthermore, the preservation of cultural heritage was identified as a motivating factor for loggers, with (17.2%) agreeing, (15.8%) remained neutral and most of the respondents (67%) disagreed that they harvest medicinal plants for preservation of cultural heritage. The need for alternative sources of income also emerged as a strong motivator, with (73.7%) of respondents agreeing, (13.3%) remained neutral and (13%) disagree that this factor drives them to harvest medicinal plants.

Moreover, the medicinal properties of the plants themselves were found to be a motivating factor, as (64.8%) respondents agreed, (20%) of the respondents remained neutral and (15.2%) disagreed that medicinal properties of the plants motivate them to harvest the plants. Also, the survey results revealed that the economic incentive that is the need to make money motivates loggers to harvest medicinal plants with (75.5%) of the respondents agreeing, (9%) of the respondents remained neutral and (15.5%) disagreed.

Additionally, the need to share destruction motivates loggers to harvest medicinal plants with most of the respondents (50%) agreeing, (20.8%) remained neutral and (19.2%) disagreeing to the statement. Finally, the survey results revealed that the economic development of the community is an important consideration, with (73.5%) of respondents disagreeing, (21%) of the respondents remained neutral and (5.5%) agreed that harvesting medicinal plants is vital for the community's economic development.

The data reveals economic incentives as the predominant drive behind medicinal plant harvesting by loggers. The vast majority are compelled by lucrative domestic and international market demand, indicating commercialization pressures. Seeking alternative income streams also factors hugely, underscoring underlying financial motives.

“I harvest these plants as a source of livelihood for my family and me. The money I get from selling these plants to traders has been the main reason why I enter the forest reserve to harvest these plants. Sometimes people in the community demand these trees for building and construction purposes. Normally, traders demand that certain trees like Odum, Wawa, Mahogany and other medicinal trees be

harvested for them since they are most in demand at the local market. I have no choice but to search and harvest these plants for them” (Logger, Nobewam; March, 2023).

“I understand why many condemn us loggers for driving medicinal plants to extinction. But they must comprehend our predicament too. Most of us have logged timber here for generations - these forests are intrinsic to our livelihood. With contracting jobs and few alternatives, harvesting herbs, roots and barks for the booming herbal market helps us survive. Do some not care about preserving nature's gifts that kept our people healthy for ages? I won't deny the motives are mainly profit-driven today. With families to feed and bank loans to repay, incomes matter most. But we too value the profound plant wisdom fading as the logging drone on. We too feel the pain as sacred trees that protected our ancestors' villages from evil spirits are felled for functional furniture in the forest reserve. But they must understand why we log like there's no tomorrow - because for us, without these forests resources (Trees), we might not survive.” (Logger, Kubease: March, 2023).

4.5 Perceptions about policies and programmes to reduce logging of medicinal plants.

This study explored the perceptions regarding policies and programs aimed at reducing logging of medicinal plants. A survey was conducted to gather opinions on various proposed measures. The results are presented in the table below.

Table 4.4: Perceptions about policies and programmes to reduce logging of medicinal plants

Perceptions about policies and programmes to reduce logging of medicinal plants	SD %	D %	N %	A %	SA %
1. Education and awareness campaigns should be developed to promote the importance of medicinal plants in health care and economy	7	3.5	11	36.7	41.8
2. Policies should be established to protect endangered medicinal plant species from overharvesting and habitat destruction	3.3	7.2	8.2	31.5	49.8
3. Policies should be established to ensure that traditional knowledge of medicinal plants is properly documented and preserved	3.5	14	6.8	29.7	46
4. Policies should encourage the development of medicinal plant-based agroforestry systems that promote sustainable land use and biodiversity conservation	6.3	6.5	11.3	26.5	49.7
5. Policies should be established to ensure that traditional knowledge of medicinal plant use is respected and protected	8.3	5.6	10.3	33.4	42.5
6. Policies should encourage the development of medicinal plant gardens and conservatories for public education and conservation purposes	3.3	6.8	14.8	27.7	47.4
7. Policies should incentivize companies to use sustainable and ethical sourcing practices for medicinal plants	6.5	8	12	30.3	43.2
8. Policies should encourage the development of medicinal plants trade networks that are transparent and accountable	3.3	7.5	10	33.7	45.5
9. Policies should encourage the development of eco-tourism initiatives centred around medicinal plant conservation and education	1.8	5.8	12.5	30.2	49.7

Source: Field Survey, 2023

The table below provides percentages of respondents' perceptions about policies and programmes to reduce logging of medicinal plants. The results showed strong agreement for most initiatives proposed. First and foremost, there is strong support for greater public education and awareness campaigns that promote the importance of medicinal plants in healthcare and the economy. (78.5%) of respondents agreed such initiatives should be developed, pointing to recognition that wider understanding of medicinal plants' value could aid conservation efforts, (10.5%) of the respondents disagreed, while (11%) of the respondents remained neutral. Additionally, there was very high agreement (81.3%) that protective policies are needed to shield endangered medicinal plant species from threats like overharvesting and habitat destruction, (10.5%) of the respondents disagreed, while (8.2%) of the respondents remained neutral to the statement.

Beyond protection, policies should be established to ensure that traditional knowledge of medicinal plants is properly documented and preserved received (75.7%) agreement from respondents, (17.5%) disagreement and (6.8%) remained neutral. Similarly, Policies should encourage the development of medicinal plant-based agroforestry systems that promote sustainable land use and biodiversity conservation received (76.2%) agreement from respondents, (12.8%) disagreement and (11.3%) neutrality.

While (75.9) % agreed that traditional knowledge of medicinal plant use is respected and protected, (13.9) % disagreed and (10.3%) remained neutral to the statement. More consensus emerged around encouraging the development of medicinal plant gardens and conservatories for public education and conservation purposes, with (75.1%) agreement, (10.1%) disagreement and (14.8%) remained neutral to the statement. Moreover, policies should incentivize companies to use sustainable and ethical sourcing

practices for medicinal plants had (73.5%) agreement from respondents, (14.5%) disagreement and (12%) of the respondents remained neutral.

Furthermore, most of the respondents (79.2%) agreed that policies should encourage the development of medicinal plants trade networks that are transparent and accountable, (10.8%) of the respondents disagreed, while (10%) of the respondents remained neutral. Finally, most of the respondents, (79.9%) of the respondents agreed to policies should encourage the development of eco-tourism initiatives centred around medicinal plant conservation and education, (7.6%) of the respondents disagreed while (7.6%) of the respondents remained neutral.

The data reveals a clear mandate from respondents for decisive policy action to curtail threats facing medicinal plants. There is strong consensus on the need for multi-pronged strategies encompassing awareness campaigns, habitat/species protection policies, codifying traditional knowledge, and sustainable management plans. Encouragingly, while urgency on conservation is expressed, balancing these ecological imperatives with safeguarding local livelihoods and medicinal plant-based microenterprises also features prominently. This underscores recognition that the fates of human communities and plant biodiversity facing shared threats are interlinked. As such, policies centered on public education, ethical sourcing incentives, medicinal plant trade transparency, and promoting alternative sustainable land-use systems are widely supported.

While promoting greater public awareness through environmental education campaigns seems virtuous, focusing solely on enlightening people should not distract from enacting and enforcing deterrent protections for endangered medicinal plants. Education alone cannot transform behaviors without corresponding legal disincentives and

penalties for violations. And ironically, evidence shows that elite and educated social strata are often most complicit in perpetuating the lucrative underground trade in rare floral medicines, fully aware of the ecological consequences but largely immune to moral suasion. These are not crimes of ignorance by the poor and marginalized with no other options. On the contrary, the wealthy and influential mastermind the plundering of ever more rare wild herbs and barks to satisfy booming global market demand and reap profits. And they leverage their privilege to evade accountability. So while grassroots consciousness building has merits, the urgent priority must be imposing rigorous protections for threatened medicinal vegetation backed by prosecution, not just potential social opprobrium. Those financing and enabling the harvesting understand only the language of deterrence imprinted in law books, not school books” (Opinion leader, Nobewam; March 2023)

“I think the local people need to be educated on the need to protect the forest reserve from logging. They should therefore be enlightened on the need to conserve the forest reserve to meet the needs of the future generation. Also, most people rely on the forest reserve as a source of livelihood. The government should therefore create job opportunities that will help the rural dwellers engage as a source of livelihood to care for them and their families” (Officer in Charge of Bobiri Forest; March 2023).

Discussion of Results

4.1 Medicinal plants under threat of extinction due to logging.

The survey results in Figure 4.1 indicate that respondents generally believe that logging is one of the leading causes of the extinction of certain species of plants. The highest level of agreement with this statement was found for “Konkroma” (*Morinda lucuada*), with (83.5%) of respondents agreeing that logging is causing the plant to become extinct. “Prekese” (*Tetrapluera*) and “Yaya” (*Amphimas pterocarpoides*) also had high levels of agreement, with 79% and (77.3%) of respondents agreeing that logging is a factor in their extinction. Sapele had a slightly lower level of agreement at (77.5%). In West Africa, especially Ghana, a plant known as *Buchholzia coriacea*, often called beautiful kola, is used medicinally (Izah et al., 2018). The herb is frequently used to cure various conditions, including fever, stomachaches, and malaria (Omobuwajo et al., 2015). However, overharvesting and habitat degradation threaten the plant's extinction right now (Adomako et al., 2019).

Dubini (*Khaya ivorensis*) had a slightly lower level of agreement at (74.8%), while Pampenama (*Corynanthe pachycerus*) and Opamkotokrudu (*Bridella atrovirides*) had levels of agreement of around (75%). The plant is frequently used to cure various conditions, including fever, diarrhoea, and respiratory infections. However, the plant is in danger of extinction due to habitat loss, deforestation, and over-exploitation (Awudzi et al., 2019).

Kpogo-Nyamdor and Laryea (2020) assert that several issues, including deforestation, excessive harvesting, habitat degradation, and climate change, threaten the extinction of many medicinal plants in Ghana.

In the view of Fongzossie et al. (2020), the medicinal plant (*Khaya senegalensis*), also called “African mahogany”, is used to cure several conditions, including malaria, fever, and diarrhoea. The plant is also employed as a laxative and an analgesic. However, overexploitation and habitat degradation have put the plant in danger of going extinct. It is clear from the survey results that logging is viewed as a major factor in the extinction of certain species of plants and that this view is widely held among respondents. Pimm et al. (2014) suggest that if logging continues at its current rate, it is likely that more plants will become extinct in the future. This is concerning, as plants are essential for the environment’s health and human life. It is important to take action to reduce the negative impact of logging on plants and other species. This includes introducing more sustainable logging practices, increasing penalties for illegal logging, and increasing public awareness of the issue.

Jones and Solomon (2013) add that it is important to ensure that those responsible for logging are held accountable for the impact of their actions. Taking these measures makes it possible to reduce the number of plants that are becoming extinct due to human activity.

However, the levels of agreement for “Kyereye” (*Ptyerygota macrocarpa*) and “Bese” (*Cola nitida*) were much lower, at (39%) and (42%), respectively. This suggests that respondents believed that logging had less impact on these species than the other species. The lowest level of agreement was for “Kwaebohoro” (*Guarea cedrata*), at (38.5%), indicating that respondents did not think that logging was causing this plant to become extinct at a high rate.

Due to various circumstances, medicinal plants have come under growing pressure, leading to the extinction of certain species, the reduction of others, and a general fall in biodiversity in South Africa's high-use areas (Mathibela, 2013).

According to Bapat et al. (2008), many plant species with medicinally significant chemicals are disappearing alarmingly due to rapid agricultural growth, urbanization, indiscriminate deforestation, and unrestricted collection of plant resources. The findings of this survey are consistent with previous studies that have highlighted the negative impacts of logging on biodiversity. For example, a study conducted in the Democratic Republic of Congo found that logging was a major driver of forest degradation and biodiversity loss (Chuyong et al., 2006). Another study conducted in Cameroon found that logging had a negative impact on the survival of many plant species, including those that are important for medicinal purposes (Fujita et al., 2006). This finding is also consistent with the tragedy of the commons, a concept in environmental economics that describes how shared resources can be overused and depleted due to individual self-interest. The tragedy of the commons suggests that when everyone owns a resource, it is in nobody's interest to take care of it, leading to its eventual depletion. In the case of logging, individual loggers are incentivised to cut down as many trees as possible to maximize their profits, even if it means destroying entire ecosystems and contributing to the extinction of certain plant species.

4.2 Community's perspective on how logging affects medicinal plant.

Logging negatively impacts livelihoods and local economies through lost jobs and incomes related to medicinal plants. As Table 4.2 indicates, (60.2%) of surveyed community members believe logging leads to job losses in medicinal plant value chains. This aligns with studies finding logging displaces harvesters and traditional healers

depending on these resources (Leacock & Warrican, 2007; Shanley et al., 2016), reducing incomes and medicinal plant access (Laird et al., 2010). In a Guatemalan community, over 90 indigenous healers reported decreasing client numbers after nearby forest clearance (Cruz Garcia, 2006). Harvesters also indicate livelihood challenges from declining resources (Leonti & Casu, 2013). However, some studies suggest limited livelihood impacts (25.3%) disagreed logging affects jobs. Sustainable logging may support certain harvesters (Ingram et al., 2012), and some adapt by cultivating or purchasing medicinal plants (Leonti & Casu, 2013). But a meta-analysis found livelihood impacts still overall negative, with forest dependence and overharvesting risks (Newton et al., 2013).

The vast majority (79.9%–83%) of surveyed community members believe logging substantially reduces medicinal plant growth, availability and access. Research affirms this perception. Up to 70% decreases in yield and survival rates of numerous species like chamomile and ginseng occur in logged over shade-intolerant plants (Cunningham et al., 2002; Hokkanen et al., 2009). Harvesters travel greater distances as supplies decline regionally over 80% in Guatemala (Cruz Garcia 2006) and by 98% in India (Uniyal et al., 2000). As resources become scarce, prices also increase. A 210% price increase occurred for American ginseng due to habitat loss (Bailey 1999), aligning with 82.7% of survey respondents reporting cost impacts. Higher prices and distance barriers reduce medicinal plant access and traditional medicine affordability for rural and indigenous communities with already limited healthcare choices (Hamilton, 2004; Leonti & Casu 2013).

Moreover, logging impacts on health, healers and traditional practices. These access limitations help explain why (77.4%) of community members observe health impacts

from logging decreasing medicinal resources. Medicinal plants treat an estimated (75-90%) of the developing world's healthcare needs (Leonti & Casu, 2013; Saslis-Lagoudakis et al., 2014). Reduced access thus heavily affects community health and traditional healing capacity, as noted by (74.8%) reporting healer displacement. In Peru, depleted forest resources displaced over 28 herbal specialists, with few successors arising (Shanley et al., 2016). Younger generations possessing little traditional ecological knowledge further threaten cultural continuity (Cruz Garcia, 2006). Subsequently, 79.5% of survey respondents feel traditional healing practices are themselves endangered from this cultural erosion and environmental damage. Indigenous groups emphasize deep ties between forest ecosystems, medicinal resources and holistic health beliefs (Laird et al., 2010), with degradation disrupting these interconnected relationships and belief systems.

4.3 Factors that motivate loggers to harvest medicinal plants.

The survey and interviews from respondents revealed a lot of factors that motivate loggers to harvest medicinal plants. The factors were, economic incentive associated with local and international, preservation of cultural heritage, need for alternative sources of income, medicinal properties of the plants, the need to make money, community's economic development and health-related factors, such as the desire to obtain medicinal plants for personal use.

It was revealed that variety of factors drive loggers to harvest medicinal plants. The economic incentive associated with local and international markets was the most significant motivating factor. Loggers are strongly motivated by the potential to earn income. The economic benefits of medicinal plant harvesting have been extensively studied, and it is widely recognized that many loggers are motivated by the potential

for high profits (Fernández-Llamazares et al., 2018). The global trade in medicinal plants is worth an estimated \$60 billion annually (WHO, 2018), and the high prices of some medicinal plant species can be a significant incentive for loggers. For example, the high demand for Asian ginseng (*Panax ginseng*) has increased wild-sourced roots' price to \$700-\$900 per pound in some markets (Foster et al., 2012). Economic incentives which drive loggers to harvest medicinal plants are consistent with the concept of the tragedy of the commons. The tragedy of the commons is a phenomenon that occurs when a shared resource is exploited by individuals for their own gain without regard for the long-term consequences. In the case of logging of medicinal plants, the resource is being overexploited for economic gain, potentially leading to the depletion of the resource.

This finding is supported by previous studies highlighting the economic importance of medicinal plant trade in developing countries. For example, a WHO (2013) study estimated that the global market for herbal medicines was worth over \$80 billion in 2011, with the potential to grow to \$7 trillion by 2050. The study highlighted the economic potential of the herbal medicine trade, particularly for countries rich in biodiversity.

The second highest motivating factor is the preservation of cultural heritage. According to UNESCO (2016), cultural heritage significantly promotes sustainable development, social cohesion, and economic growth. Laven and Brouder (2017) found that cultural heritage is crucial in tourism, as tourists prefer destinations that offer unique cultural experiences. Additionally, Bortolotto and Zacarias (2018) noted that cultural heritage contributes to people's well-being by providing a sense of belonging, identity, and continuity and fostering social cohesion and intercultural dialogue.

Sharma et al. (2021) argues that loggers harvesting medicinal plants threaten the preservation of cultural heritage. Medicinal plants have been crucial in human culture since ancient times, with indigenous communities often relying on traditional knowledge and practices for their medicinal properties. Over-harvesting of medicinal plants by loggers can lead to the depletion of these plants, which can have significant cultural, economic, and ecological impacts. In addition to the loss of traditional knowledge and practices associated with medicinal plants, the loss of these plants can also lead to the loss of biodiversity and ecosystem services (Bussmann et al., 2020).

Moreover, the need for alternative sources of income is a strong motivating factor for loggers to harvest medicinal plants. Loggers are engaging in harvesting medicinal plants as a means to supplement their income. In some areas, logging may be the only source of livelihood for local communities. In such cases, loggers may have no alternative but to harvest medicinal plants to generate income. Ghorbani et al. (2016) in Iran found that loggers harvested medicinal plants due to the lack of alternative livelihood options. For instance, in the Amazon region of Brazil, the harvest of acai (*Euterpe oleracea*) and other fruits is an important source of income for many rural communities (Albuquerque et al., 2012). This finding is consistent with the literature on the economic motivations for logging activities, which highlights the role of poverty and lack of alternative income opportunities (Fisher et al., 2018; Ruiz-Mallén et al., 2019). Moreover, the depletion of medicinal plant populations can result in the loss of cultural and traditional knowledge, which can have significant implications for intergenerational learning and social cohesion (Gebremedhin et al., 2020).

Also, the medicinal properties of the plants are a factor that drives loggers to harvest them. This indicates that loggers recognize the potential health benefits of these plants

and are motivated to collect them. The medicinal properties of the plants can make them highly valuable, both for local use and for trade in national and international markets (Nijman & Shepherd, 2015). This had led to over-harvesting, particularly when the demand for medicinal plants exceeds their natural regeneration rates (Gebremedhin et al., 2020). Over-harvesting of medicinal plants have significant ecological impacts, such as biodiversity loss and ecosystem services disruption (Nijman & Shepherd, 2015). Moreover, the depletion of medicinal plant populations can have socio-economic impacts, particularly for local communities that rely on them for their livelihoods (Huang et al., 2019). The unsustainable harvesting of medicinal plants can also lead to losing traditional knowledge and cultural heritage (Gebremedhin et al., 2020). For example, a study conducted by Adnan et al. (2014) found that certain plants in Pakistan have medicinal properties and, therefore, are harvested by loggers. Similarly, another study by Tardío and Pardo-de-Santayana (2008) found that using plants for medicinal purposes is common in many countries, which may contribute to their overexploitation.

Furthermore, it was revealed that the main motivation for harvesting medicinal plants is to make money. This reinforces the economic incentive as the primary driver for this activity. A study conducted by Bhagwat et al. (2005) in the Western Ghats of India found that the income generated from the sale of medicinal plants was higher than that from the sale of timber, which motivated loggers to harvest medicinal plants. The harvesting of medicinal plants is an important source of income for many rural communities, particularly in developing countries. However, the unsustainable harvesting of medicinal plants can have severe ecological and socio-economic impacts. The theory of the tragedy of the commons explains how the overuse of shared resources, such as forests and fisheries, can lead to their depletion and eventual collapse. The unsustainable harvesting of medicinal plants can be seen as an example of the tragedy

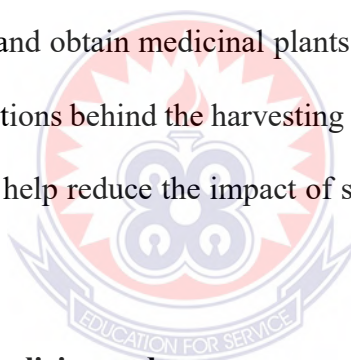
of the commons, where individual loggers pursue their self-interest without regard for the resource's long-term sustainability (Ostrom, 1990).

Additionally, the community's economic development was also seen as a major factor. Collecting non-timber forest products (NTFPs), including medicinal plants, can be an important source of income for local communities. The study found that loggers and other forest users could earn significant income from collecting NTFPs. This income contributed to poverty reduction and improved livelihoods. The contribution of medicinal plant harvesting to local economic development has been studied in various contexts. For example, a study conducted in Nepal found that the trade of medicinal plants generated significant income for local communities and contributed to their economic development (Adhikari et al., 2016). Another study conducted in Ethiopia found that the trade of medicinal plants had the potential to contribute to poverty alleviation and food security (Abiyu et al., 2020). However, the contribution of medicinal plant harvesting to local economic development must be balanced against the need for sustainable harvesting practices. The over-harvesting of medicinal plants can have significant ecological impacts, such as the loss of biodiversity and disruption of ecosystem services, undermining the resource's long-term sustainability. Khan et al. (2017) asserts that the overexploitation of medicinal plants by loggers in the Himalayan region of Pakistan had led to the depletion of these plants and the loss of biodiversity in the area.

lastly, health-related factors, such as the desire to obtain medicinal plants for personal use, motivated loggers to harvest medicinal plants. Many traditional healers rely on medicinal plants to treat various illnesses and conditions. In many rural communities, traditional medicine is the primary source of healthcare, and medicinal plants are an

important part of traditional medicine. Therefore, traditional healers' demand for medicinal plants can significantly incentivize loggers to harvest them. For instance, the bark of the cinchona tree (*Cinchona* spp.) is used to produce quinine, a medication used to treat malaria. The bark of this tree is in high demand in many parts of the world, especially in Africa and South America, where malaria is prevalent (Willcox et al., 2011). A study conducted by Shankar et al. (2012) revealed that more than 80% of the rural population in India depends on traditional medicine for their healthcare needs.

Overall, the data suggests that economic factors are the primary motivators for loggers to harvest medicinal plants, followed by cultural and health-related factors. Loggers are driven by the economic incentive to harvest medicinal plants and a desire to contribute to their local economies and obtain medicinal plants for personal and familial use. By understanding the motivations behind the harvesting of medicinal plants, policymakers can develop strategies to help reduce the impact of such activities on the environment (Bhagwat et al., 2005).



4.4 Perceptions about policies and programmes to reduce logging of medicinal plants.

In Table 4.4, the study explored community people's perceptions about policies and programmes that can be implemented to facilitate the regeneration of medicinal plants.

The highest-rated policy or program was "Education and awareness campaigns should be developed to promote the importance of medicinal plants in healthcare and the economy". People in the communities believe that promoting the importance of medicinal plants through education and awareness campaigns is crucial for regenerating medicinal plants (Uprety et al., 2010).

The survey results in Table 4.4 indicate that respondents are keen to raise awareness about the importance of medicinal plants. Chen and Sun (2018) add that as medicinal plants are becoming increasingly rare due to over-harvesting, habitat destruction and climate change, it is essential to raise public awareness of the importance of preserving them. Education and awareness campaigns can help to make people aware of the importance of medicinal plants and encourage conservation efforts. Creating awareness campaigns can help to make people aware of the potential benefits of medicinal plants. Educating people about the medicinal uses of plants can encourage them to use them in healthcare, which can help reduce the cost of healthcare in the long run (Sofowora et al., 2013). Similarly, raising awareness of medicinal plants' economic benefits can help create more job opportunities in the medicinal plant industry (Jia et al., 2016).

The second-highest-rated policy or program in Table 4.4 was "Policies should be established to protect endangered medicinal plant species from overharvesting and habitat destruction". The community believe preserving these species is important to ensure their continued availability and that they are not exploited due to overharvesting (Van Wyk & Prinsloo, 2018). The policy of establishing protective measures for endangered medicinal plant species from overharvesting and habitat destruction received a high rating in the survey. This aligns with the theory of sustainability, which involves conserving natural resources for future generations. Individuals are taking steps towards sustainable management and conservation by recognising the need to protect these resources. Numerous studies have emphasized the importance of sustainability in managing medicinal plants.

For instance, Poudel et al. (2021) found that sustainable harvesting practices are crucial for the long-term survival of medicinal plant species. Similarly, Hamilton et al. (2018)

highlighted the importance of incorporating sustainability principles in managing medicinal plant resources. Therefore, the high rating for the policy of establishing protective measures for endangered medicinal plant species is a positive step towards achieving sustainability in managing and conserving medicinal plant resources. This aligns with the United Nations' Sustainable Development Goals, particularly SDG 15, which focuses on protecting, restoring and promoting the sustainable use of terrestrial ecosystems, including forests (United Nations, 2015)

Similarly, the third-highest-rated policy or program in Table 4.4 was "Policies should be established to ensure that traditional knowledge of medicinal plant is properly documented and preserved". There is a need for policies that prioritize the protection of traditional knowledge, particularly concerning medicinal plants. This knowledge is extremely valuable, as it can provide important insight into natural remedies, herbal treatments and other traditional healing practices. By documenting and preserving this knowledge, we can ensure that it is not lost and can be used to benefit future generations. Sarkhel (2017) explained that traditional knowledge of medicinal plants could contribute to advances in modern science, as it can be used to discover new treatments and uncover new uses for existing plants. By documenting and preserving these plants, we can ensure that this knowledge is accessible to researchers and can be used to inform future studies. Establishing policies to document and preserve traditional knowledge of medicinal plants are consistent with the principles of sustainability theory. This theory highlights the need to manage resources in a way that meets the needs of the present without compromising the ability of future generations to meet their own needs (World Commission on Environment and Development, 1987).

By documenting and preserving traditional knowledge of medicinal plants, individuals and communities can contribute to sustainable resource management by ensuring that these resources are available for future generations. Recognizing and respecting traditional knowledge can improve people's understanding of medicinal plants' ecological and cultural significance, leading to the development of sustainable harvesting practices and the identification of threatened species (Berkes, 2018).

According to the survey results in Table 4.4, the policy with the fourth-highest rating was "Policies should encourage the development of medicinal plant-based agroforestry systems that promote sustainable land use and biodiversity conservation (Smith et al., 2021). This indicates that respondents believe encouraging the development of agroforestry systems incorporating medicinal plants can promote sustainable land use and biodiversity conservation.

Agroforestry systems, which combine the cultivation of trees and crops, have been identified as a sustainable land-use option providing economic, environmental, and social benefits (FAO, 2014). These systems can help to improve soil fertility, regulate water resources, increase biodiversity, and provide alternative income sources for farmers. Furthermore, incorporating medicinal plants into agroforestry systems can provide additional income for farmers and contribute to the conservation of medicinal plant species. A study conducted in India found that incorporating medicinal plants into agroforestry systems helped to conserve these species by reducing the reliance on wild harvesting and creating a sustainable source of income for farmers (Maikhuri et al., 2011). Another study conducted in Nepal found that agroforestry systems incorporating medicinal plants had higher biodiversity and soil fertility than traditional farming systems (Rai et al., 2018).

The survey results in Table 4.4 revealed that the policy with the fifth-highest rating was "Policies should be established to ensure that traditional knowledge of medicinal plant use is respected and protected. The policy of respecting and protecting traditional knowledge of medicinal plant use can be linked to the tragedy of the commons. This theory describes how shared resources can deplete due to individual users seeking to maximize their benefits (Ostrom, 1990). In the case of medicinal plants, the traditional knowledge of their use is often passed down through generations within local communities (Byg & Salick, 2009). However, as these communities are often marginalized and lack legal recognition, their knowledge can be exploited by outsiders who may seek to profit from the plants without proper compensation or consideration for the sustainability of the resource (Cámara-Leret & Paniagua-Zambrana, 2019). Establishing policies that respect and protect traditional knowledge can reduce the potential for overexploitation and depletion of medicinal plant resources. This can be achieved through community-based conservation programmes involving local communities in decision-making processes and incentivising them to conserve medicinal plants (Ticktin et al., 2012). Additionally, policies can be implemented to ensure that outsiders seeking to profit from medicinal plants must obtain permission from local communities and appropriately compensate them (Rao & Geetha, 2017).

The survey results in Table 4.4 further showed that, the policy with the sixth-highest rating was "Policies should encourage the development of medicinal plant gardens and conservatories for public education and conservation purposes. This indicates that while respondents believe such policies are important, they are not as highly prioritized as other policies related to medicinal plant conservation. Encouraging the development of gardens and conservatories for medicinal plants is an effective approach to promoting their conservation and sustainable use (Sharma et al., 2016). These sites can serve as

living museums, allowing visitors to learn about medicinal plants' traditional uses and importance and their role in modern medicine. They also provide opportunities for research and experimentation with the cultivation and propagation of medicinal plants, which can contribute to developing new medicines and plant-based products. Such gardens and conservatories have been found to contribute to the conservation of endangered medicinal plant species (Sharma et al., 2016). For instance, the Indian government has established several botanical gardens and conservatories to conserve endangered medicinal plant species, including Himalayan yew, *Asparagus racemosus*, and *Rauvolfia serpentina*. Similarly, the United States Botanic Garden in Washington, D.C., features over 400 species of plants used for medicinal purposes.

Besides their conservation value, medicinal plant gardens and conservatories can benefit local communities economically. For instance, the Kwara State Medicinal Plants Project in Nigeria established a botanical garden for the cultivation of medicinal plants, which provided employment opportunities and income for local farmers (Olawuyi et al., 2017).

Moreso, in Table 4.4, the policy of incentivizing companies to use sustainable and ethical sourcing practices for medicinal plants is essential for promoting the conservation of these resources and ensuring that their use does not lead to environmental degradation or exploitation of local communities. Encouraging companies to adopt sustainable and ethical sourcing practices for medicinal plants has been suggested as a policy to promote their conservation and sustainable use (Khan et al., 2018). Incentivizing companies to adopt such practices can lead to developing sustainable supply chains for medicinal plants, which can benefit both the environment and local communities. Sustainable sourcing practices can include measures such as

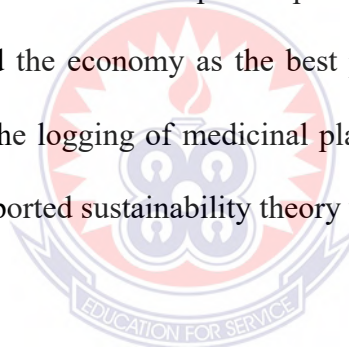
using organic farming techniques, avoiding overharvesting, and respecting local communities' traditional knowledge and rights. According to Nag et al. (2017), sustainable sourcing practices can contribute to conserving medicinal plant species and promote their long-term availability. For example, the FairWild certification scheme has been established to promote the sustainable and ethical harvesting of wild medicinal plants (Khan et al., 2018). The scheme provides a mechanism for companies to demonstrate their commitment to sustainable sourcing practices while ensuring that local communities receive fair compensation for their traditional knowledge and labour.

Lastly, policies should encourage the development of medicinal plants trade networks that are transparent and accountable for the development of eco-tourism initiatives centred around medicinal plant conservation and education was the least perception of perceptions about policies and programmes that can be implemented to facilitate the regeneration of medicinal plants. This could be due to a need to understand the potential benefits of such initiatives or a lack of interest in investing in them. It could also be due to a need for more resources or commitment to make them successful (Schwienbacher & Larralde, 2010). Marunda and Chaneta (2014) suggest that to ensure that eco-tourism initiatives are effective in regenerating medicinal plants, it is important to ensure that respondents are aware of the potential benefits. This can be done through outreach and education and incentivising people to participate in eco-tourism initiatives. Once people understand the importance of eco-tourism initiatives for regenerating medicinal plants, they will be more likely to invest in them (Banerjee & Shiva, 2014). Ultimately, eco-tourism initiatives can be an important part of regenerating medicinal plants. Still, ensuring that respondents understand and are willing to invest in the potential benefits is important. Without this understanding and commitment, the efforts to regenerate

medicinal plants through eco-tourism initiatives will be fruitless (Goodwin & Santilli, 2009).

4.5 Chapter Summary

This chapter discussed specific medicinal plants under threat of extinction in Bobiri Forest Reserve due to logging, the study revealed that, Konkroma (*Morinda luciada*) (83.5%) was the medicinal plant that had gone extinct. Moreover, the study revealed that there has been a decrease in medicinal plants as a result of logging. It was established that demand for medicinal plants in local and international markets motivates loggers to harvest them. Finally, the study suggests that education and awareness campaigns should be developed to promote the importance of medicinal plants in health care and the economy as the best policy or programme that can be implemented to reduce the logging of medicinal plants in the Bobiri Forest Reserve. Most of the findings supported sustainability theory used for the study.



CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter summarised the thesis and the study's key findings. The first section summarised the study and presents the key findings. It also includes the findings and recommendations. Finally, recommendations for future research are presented for consideration.

5.1 Summary of the Study

Medicinal plants face growing threats from logging despite their vital cultural purpose in Ghana's forests. Logging has led to the disappearance of Medicinal plants in Bobiri Forest Reserve. The general purpose of the study was to examine community people's perception of the impact of logging on medicinal plants in Bobiri Forest Reserve in Juabeng Municipality of Ghana. Specifically, the study explored specific medicinal plants under threat of extinction due to logging, perception of the community on how logging affects medicinal plant resources, factors that motivate loggers to harvest medicinal plants, and perceptions about policies and programmes that can be implemented to facilitate the regeneration of medicinal plants. The study used a mixed method approach, comprising a survey of 400 respondents and key informant interviews. A multi-stage and purposive sampling technique was used to get to respondents in the study areas. Interview guides were used for the key informant interviews. Statistical Package for Social Sciences (SPSS) and Microsoft Excel was used to perform descriptive statistics (Percentages and frequencies), while interviews with key informants were transcribed and analysed qualitatively.

5.2 Key Findings

The first objective of the study focused on medicinal plants under threat of extinction.

The key findings were that:

Konkroma (Morinda luciada), *Kyereye (Ptyerygota macrocarpa)*, *Kwaebohoro (Guarea cedrata)* were medicinal plants under threat of extinction.

The second objective focused on perception of the community members on how logging affects medicinal plant resources. The key findings were that:

- Logging has affected the growth and distribution of medicinal plants.
- Cultural practice or rituals that rely on the use of medicinal plants in the community has been affected.
- There is loss of jobs for people in the medicinal plant's value chain.

The third objective focused on factors motivating loggers to harvest medicinal plants the key findings were that:

- Economic incentive motivates loggers to harvest medicinal plants.
- The need of alternative source of income motivates loggers to harvest medicinal plants.
- Demand for medicinal plants in local and international market motivates loggers to harvest medicinal plants.

The final objective focused on perceptions about policies and programmes for medicinal plant regeneration. The key findings were as follows:

- Education and awareness campaigns promoting the importance of medicinal plants.

- Policies protecting endangered medicinal plant species from overharvesting and habitat destruction.
- The documentation and preservation of traditional knowledge related to medicinal plants were considered essential.
- Encouraging eco-tourism initiatives centered around medicinal plant conservation and education.

5.3 Conclusion

- It was revealed that medicinal plants, such as Konkroma (*Morinda lucuada*), Kyereye (*Ptyerygota macrocarpa*), and Kwaebohoro (*Guarea cedrata*) are under threat of extinction. These findings highlight the need for conservation efforts to protect these species and prevent the loss of their medicinal value.
- The study found that logging activities have negatively impacted medicinal plant in Bobiri forest reserve. Specifically, logging was perceived to affect medicinal plant growth and distribution, with community members observing declines in plant availability. Additionally, cultural practices and rituals in the community that utilize medicinal plants have been disrupted by having less access to key species. Together, these findings demonstrate that logging takes a toll on community medicinal traditions, ecology, and employment that depends on intact forest ecosystems. Protecting remaining medicinal plants require policy changes that promote sustainable forestry over conventional logging, allowing forests and the cultural practices intertwined with them to persist for future generations.
- The study found that there are several driving factors motivating loggers to harvest medicinal plants, predominantly economic incentives. These findings indicate that overharvesting medicinal plants is largely driven by livelihood and financial

considerations from actors within the logging industry. To prevent unsustainable harvesting from the sector, conservation efforts should account for these economic motivations. If the medicinal plant sector remains financially incentivized for loggers without these supplemental interventions, plant extinction threats and ecosystem damage will likely continue mounting over time.

- The study found that multiple types of interventions are perceived as important for supporting medicinal plant regeneration and conservation. These findings highlight that a multifaceted strategy is likely necessary, incorporating education programs, policy reform, cultural preservation efforts, and sustainable development initiatives. Adopting such a comprehensive approach with involvement from government agencies, local communities, conservation groups and other stakeholders provides the greatest promise for safeguarding threatened medicinal plant species and associated knowledge.
- By considering the perspectives and concerns of the community, it is possible to develop effective strategies and programmes that mitigate the negative impacts of logging and ensure the preservation and availability of medicinal plants for future generations.

5.4 Recommendations

From the findings and the conclusions, the following recommendations have been put forward for minimizing the impact of logging on medicinal plants

- The Forestry Commission of Ghana should identify populations of threatened medicinal plant species and designate protected areas in regions where they are endemic.

- The Ghana Forestry Commission should implement stricter sustainable harvesting regulations for the logging industry enforced through increased field monitoring.
- District Assemblies in forested areas should identify key medicinal plants threatened by overharvesting and apply for geographical indication status for these species, including standardized harvesting protocols that loggers must follow.
- Government through the Forestry Commission should strengthen their initiative through education and awareness campaign.

Contribution to Knowledge

Prior to this study, there was no known research conducted on the perception of the local community regarding the impact of logging on medicinal plants in the Bobiri Forest Reserve. This study has made significant contribution to new knowledge to the field through its findings. Now, we know the evidence from community people and other stakeholders that logging of medicinal plants in the Bobori forest has led to a loss of employment opportunities for herbalists and has also negatively affected the health of community members who rely on these plants for treatment. Also, we now know that, there is alarming rate of disappearance of highly valued medicinal plant and if not checked will lead to the extinction of specific species such as: “Konkroma” (*Monrinda lucida*), “Prekese” (*Tetrapluera tetraptera*), “Yaya” (*Amphimas pterocarpoides*), “African mahogany” (*Khaya ivorensis*), “Pampenama” (*Coryanthe pachycerus*), “Opamkotokrudu” (*Bridella atrovirides*), “Kyereye” (*Pterygota macrocarpa*), “Bese” (*Cola nitida*) and “Kwaebohoro” (*Guarea cedrata*).

Furthermore, we now know that, illegal loggers make significant economic gains from logging certain tree species such as “Odum”, “Sapele” and “African mahogany”, and

also there are other sources of income generating ventures from the forest serving as key motivating factors for loggers engaged in harvesting medicinal plants. These observations make it very difficult for the authorities to stop the illegal logging operations. This calls for the authorities to assume an entrenched position to fight off the operations of the illegal loggers.

Additionally, we have known that, the majority of community members believe education and training programmes, along with the provision of alternative sources of income, would be effective action to reduce the logging of medicinal plants. Also, we know now that, the promotion of education and awareness campaigns emphasizing the importance of medicinal plants would help address the problem.

5.5 Suggestions for further studies

The study explored the perception of community people on the impact of logging on medicinal plants in the case of the Bobiri Forest Reserve. A further study can focus on existing policies and governance frameworks related to logging and medicinal plants in the Bobiri Forest Reserve. Also, studies should focus on community engagement strategies to raise awareness about the impact of logging on medicinal plants in Bobiri Forest Reserve.

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APPENDICES

UNIVERSITY OF EDUCATION, WINNEBA

SCHOOL OF GRADUATE STUDIES

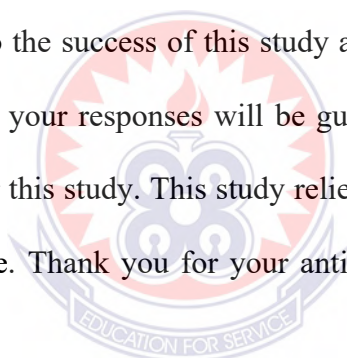
FACULTY OF SOCIAL SCIENCES

DEPARTMENT OF GEOGRAPHY EDUCATION

QUESTIONNAIRE

Dear Respondents,

This research is an academic exercise, and it intends to assess the community's perception of the effects of illegal logging on medicinal plants in partial fulfilment of an MPhil. Geography Education at the University of Education, Winneba. Your responses are valuable to the success of this study and are based on your experience. Kindly be reminded that your responses will be guarded with utmost confidentiality and will be used only for this study. This study relies on your response. In most cases tick [√] where applicable. Thank you for your anticipated interest to partake in this research.



APPENDIX A

Demographic Characteristics of Respondents

1. Gender

Male

Female

2. Age group

18-29

30-39

40-49

50 and above

3. Level of Education

No Formal Education

Basic

SHS /Voc. /Tec.

Tertiary



4. Employment Status

Employed

Unemployed

5. Community

Kubease

Nobewam

Krofofrom

Duampompo

6. Origin

Native

Migrant

Settler



7. Duration for living in the community

less than 5 years

5-10 years

11-15 years

16-20 years

more than 20 years

Please read the following statement carefully and tick [✓] the appropriate responses [as they apply to you] to indicate your level of agreement or disagreement. Please use the scale below: 1 Strongly Agreed 2 Agreed 3 neutral 4 Strongly Disagreed 5 Disagreed

APPENDIX B

Medicinal plants under threat of extinction

	Medicinal plants under threat of extinction	1	2	3	4	5
1.	Konkroma (<i>Morinda lucida</i>)					
2.	Prekese (<i>Tetrapluera tetraptera</i>)					
3.	Yaya (<i>Amphimas pterocarpoides</i>)					
4.	Pampenama (<i>Coryanthe pachycerus</i>)					
5.	Sapele (<i>Entandrophragma utile</i>)					
6.	Kyereye (<i>Pterygota macrocarpa</i>)					
7.	African mahogany (<i>Khaya ivorensis</i>)					
8.	Bese (<i>Cola nitida</i>)					
9.	Kwaebohoro (<i>Guarea cedrata</i>)					
10.	Opamkotokrodu (<i>Bridella atrovirides</i>)					

APPENDIX C

Community people's perception of the specific impact of logging on medicinal plants

	Community People's Perception of the Specific Impact of Logging on Medicinal Plants	1	2	3	4	5
1.	Loss of jobs for people in the medicinal plant's value chain					
2.	Logging has affected the cultural practice or rituals that rely on the use of medicinal plants in your community					
3.	Logging has affected the growth and distribution of medicinal plants					
4.	Logging activities has caused a great change in the health of members of your community					
5.	Medicinal plants practitioners move to other work sectors					
6.	Logging has a significant impact on the availability of medicinal plants					
7.	The loss of medicinal plants has affected the traditional healing practice in your community					
8.	There has been an increase in the price of medicinal plants due to logging activities					
9.	There has been a decrease in medicinal plants as a result of logging					

APPENDIX D**Factors that motivate loggers to harvest medicinal plants**

	Factors that motivate loggers to harvest medicinal plants	1	2	3	4	5
1.	The primary motivation for loggers to harvest medicinal plants is to make money.					
2.	The demand for medicinal plants drives loggers to harvest them.					
3.	The medicinal properties of the plants motivate loggers to harvest them.					
4.	Loggers harvest medicinal plants to preserve their cultural heritage.					
5.	Harvesting medicinal plants is important for the economic development of the community.					
6.	The lack of alternative sources of income motivates loggers to harvest medicinal plants.					
7.	The demand for medicinal plants in local and international markets motivates loggers to harvest them.					
8.	The belief that medicinal plants are abundant in the forest motivates loggers to harvest them.					

APPENDIX E

**Perceptions about policies and programmes that can be implemented to facilitate
the regeneration of medicinal plants.**

	Perceptions about policies and programmes that can be implemented to facilitate the regeneration of medicinal plants.	1	2	3	4	5
1.	Policies should be established to protect endangered medicinal plant species from overharvesting and habitat destruction.					
2.	Education and awareness campaigns should be developed to promote the importance of medicinal plants in healthcare and the economy.					
3.	Policies should incentivize companies to use sustainable and ethical sourcing practices for medicinal plants.					
4.	Policies should be established to ensure that traditional knowledge of medicinal plant use is respected and protected.					
5.	Policies should encourage the development of medicinal plant gardens and conservatories for public education and conservation purposes.					
6.	Policies should encourage the development of medicinal plant-based agroforestry systems that promote sustainable land use and biodiversity conservation.					
7.	Policies should encourage the development of medicinal plant trade networks that are transparent and accountable.					
8.	Policies should encourage the development of eco-tourism initiatives centered around medicinal plant conservation and education.					
9.	Policies should be established to ensure that traditional knowledge of medicinal plant use is properly documented and preserved.					
10.	Policies should encourage the development of medicinal plant trade networks that are transparent and accountable.					

INTERVIEW GUIDE FOR LOGGERS, FOREST OFFICIALS, OPINION LEADERS AND HERBALISTS

Loggers

1. How do you perceive the impact of logging on the availability and accessibility of medicinal plants in Bobiri forest reserve?
2. In your opinion, what effect does logging have on the quality and potency of medicinal plants found in the Bobiri forest reserve?
3. Have you noticed any changes in the demand and use of medicinal plants by the community following logging activities in Bobiri forest reserve?
4. What measures do you think can be put in place to mitigate the negative impact of logging on the availability and accessibility of medicinal plants in Bobiri forest reserve?
5. Do you think that the community has a role to play in protecting and conserving medicinal plants in Bobiri forest reserve, and if so, what actions can they take to ensure sustainability?

Forest Officials

1. What is the perception of the local community on the impact of logging on the availability of medicinal plants in Bobiri forest reserve?
2. Have there been any changes in the usage of medicinal plants by the community since logging activities began in Bobiri forest reserve?

3. How do the local community members perceive the impact of logging on the quality of medicinal plants in Bobiri forest reserve?
4. Have there been any efforts by the forest officials to mitigate the impact of logging on the availability of medicinal plants in Bobiri forest reserve? If yes, how effective have these measures been in addressing the concerns of the community?
5. In the opinion of the local community members, what measures can forest officials take to ensure sustainable logging practices that do not negatively impact the availability and quality of medicinal plants in Bobiri forest reserve?

Opinion Leaders

1. Have you noticed any changes in the area's number or variety of medicinal plants?
2. Have you engaged with the authorities responsible for the management of the forest reserve, or have you implemented any community-level initiatives to address this issue?
3. What do you think are the long-term consequences of logging on the availability of medicinal plants within the Bobiri forest reserve?
4. Do you think that the depletion of medicinal plants will have a negative impact on the health and well-being of the community?
5. How do you think the community can work together to address the issue of logging and its impact on medicinal plants in the Bobiri forest reserve?

6. Do you think that education and awareness-raising initiatives can play a role in promoting the conservation of medicinal plants?

Herbalist

1. As a herbalist, how do you perceive the impact of logging on the availability of medicinal plants in the Bobiri forest reserve?
2. In your opinion, what are the most commonly used medicinal plants in the Bobiri forest reserve and how has the logging activity affected their availability?
3. Have you noticed any changes in the quality of medicinal plants obtained from the Bobiri forest reserve since logging activities began? If so, what changes have you observed?
4. How do you think the depletion of medicinal plants due to logging activities can affect the health of the local community who rely on these plants for healthcare purposes?
5. From your interactions with community members, what is the general perception of the impact of logging on medicinal plants in the Bobiri forest reserve?

