

**FACTORS INFLUENCING SUSTAINABILITY OF MEDICINAL PLANTS: A CASE OF  
LAIKIPIA EAST DISTRICT, KENYA.**

**BY**

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## DECLARATION

This research project report is my original work and has not been presented for award of a degree in any other university

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## **DEDICATION**

I dedicate this research Project proposal to my beloved parents, Mr. and Mrs. Kipchoge for their inspiration throughout my study time. Also, special dedications are to my workmates at Kenya Wildlife Service.

I will not forget my brothers and sisters, as you mean a lot to me.

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## **ABBREVIATIONS AND ACRONYMS**

<b>EU</b>	European Union
<b>HIV</b>	Human Immunodeficiency Virus
<b>KFS</b>	Kenya Forest Service
<b>KWS</b>	Kenya Wildlife Service
<b>NEMA</b>	National Environment Management Authority
<b>UNEP</b>	United Nations Environmental Programme
<b>UN</b>	United Nations
<b>SPSS</b>	Statistical Package for Social Sciences
<b>WCED</b>	World Commission on Environment and Development.
<b>WHO</b>	World Health Organization

## **ABSTRACT**

Medicinal plants management strategies need to be understood and planned for based on an understanding of indigenous knowledge and practices. Many drugs contain herbal ingredients, and it has been said that 70–80% of the world's population relies on some form of non-conventional medicine. The most serious proximate threats when extracting medicinal plants generally are habitat loss, habitat degradation, and over harvesting. The information in this area was scanty and thus there was need for research which would be helpful to the area in developing measures to curb habitat deterioration leading to loss of medicinal plants. The primary focus of this study was to assess factors that influence sustainability of medicinal plants in the area of study. The objectives of study were: to examine socioeconomic factors affecting sustainability of medicinal plants, to assess environmental factors affecting medicinal plants and finally to establish management factors influencing medicinal plants in Laikipia East District. The study was conducted using a descriptive survey design and the target population was a sample of 50 herbalists from approximated 500 registered herbalists in the District, 50 herbal medicine users from the 500 households which had benefited from the services of 50 herbalists and 5 government officers from key Government departments such as; Agriculture, Public Health, Forest, Wildlife, and Social Services. Open and close ended questionnaires as well as interviews were used for collection of primary data. Quantitative data was analyzed by descriptive statistics using Statistical Packages for Social Sciences while qualitative data was analyzed using content analysis. This research led to shedding light on the utilization and management of medicinal plants, hence forming a foundation upon which effective access, utilization and corrective measures were generated. The study was also to help the communities, other researchers and relevant government ministries in the development of relevant mitigation measures in order to curb medicinal plants deterioration. Based on the findings the researcher recommended medicinal plants to managed and conserved in order continue serving as alternative medicine to community of Laikipia East District, there should be developed guidelines on the access and use.

# CHAPTER ONE

## INTRODUCTION

### 1.1 Background of the study

Conservation in its modern form has been described as a social reaction against the human impacts on living diversity, (Adams 2009). There are now over 100,000 designated protected areas for flora and fauna, governing some 12% of the earth's land surface occurring in every country of the world, (Chape et al, 2005). However, the global protected area network does not mirror global priorities for biodiversity conservation. Furthermore most protected areas for flora and fauna are simply not large enough to ensure the persistence of populations and the species they contain with large wide-ranging species particularly vulnerable, (Woodroffe and Ginsberg 1998)

It is now widely accepted that isolated islands cannot sustain biodiversity (Schaffer 1990). Emerging understanding of the implications of climate change adds a degree of urgency to the need to do more. For all these reasons the focus of the conservation movement has moved beyond protected areas and into the wider human occupied landscape (Western et al, 1994). There is one factor above all others controlling towards this sharp decline in the diversity of life and alarming degradation of natural environment. It is us. There are now an estimated 6.93 billion people on earth and this is projected to reach a high of 10.5 billion by 2050. Humans use, either indirectly, an estimated 40% of terrestrial primary production and our surface of earth (Adams, 2009). The scale of the human impact on the natural environment is not diminishing. If anything it is increasing, we are changing the earth more rapidly than we understand it (Vitousek et al, 1997).

We acknowledge the fact that Africa countries have considerable resources and in all fields:- Minerals and oil resources, agriculture resources, fisheries, forest resources but unfortunately these resources are not processed in a beneficial way in Africa. This constitutes a major lost opportunity for Africa. Africa is currently straining under the burden of communicable diseases that are disabling our economies. Endemic parasitic and infectious diseases have retarded the quality and productivity of Africa's human resources (UNEP report on sustainable Africa 2008).

Many have roots in environmental hygiene, inadequate access to resource, such as water and sanitation, and inadequate nutrition. We all for a holistic approach to health that addresses its: multiple determinants, social, environmental and economic. Efforts in Africa to ensuring greater access to affordable, primary and secondary health care and ,medical technology, improve environment and social conditions that contribute to disease, and build appropriate capacity in local communities are of paramount importance (Mokaila,2010). Trees have profound significance in religious belief and ceremony and their various components are central to traditional medicine and this end we call upon the developed world to offer greater assistance in making both preventive and curative health care available to Africa. (Dharani, 2011)

## **1.2 Statement of the problem**

Medical plants are important part of the daily lives and the cultural heritage of many East African peoples (Dharani, 2011).The use of plants in the treatment of various diseases, as a specific antidote against magic and for religious ceremonies has been an integral element of Africa society for countries. (Najna, 2011).Knowledge of medicinal plant is normally passed on orally from the generation to the next, unfortunately a great deal of valuable information can be lost or distorted if a medicine man dies without revealing such knowledge in preparing these chapters, it become clear that there is a lack of detailed documentation of the significance and application of curative plants in East Africa.

Documentation and conservation is an urgent priority in the fragility of oral-traditional knowledge and rapid place of urbanization and the consequent erosion of tribal culture in this part of Africa, (Najma, 2011).Indeed the forests are precious fragile and irreplaceable repositories of ingredients basic to the treatment of a surprising number of human ailments. The wider world has only recently began to appreciate their value, and their potential in inspect. Indigenous trees and shrubs are part of East Africa legacy (Dharani, 2011)

From the background, a study on sustainability of medicinal plants has not been exhaustibly done. This study entailed looking into factors influencing sustainability of medicinal plants as today much of the forested land with medicinal plants has been cleared for agriculture, and to fuel industry. Thus there was an urgent need to cherish

what remains, and to try to return at least some of the land to its original and pristine condition.

### **1.3 Purpose of the study**

The purpose of the study was to assess the factors influencing sustainability of medicinal plants in Laikipia East District, Laikipia County, Kenya.

### **1.4 Objectives of the study**

The specific objectives of the study were as follows:

- i) To examine socioeconomic factors influencing sustainability of medicinal plants in Laikipia East District.
- ii) To assess environmental factors influencing sustainability of medicinal plants in Laikipia East District.
- iii) To establish management factors influencing sustainability of medicinal plants in Laikipia East District.

### **1.5 Research hypothesis**

The research hypotheses of study were as follows:

- i)  $H_0$  There is no significance relationship between socioeconomic factors affecting medicinal plants and its sustainability in Laikipia East District.
- ii)  $H_0$  There is no significant relationship between environmental factors influencing medicinal plants and its sustainability in Laikipia East District.
- iii)  $H_0$  There is no significant relationship between management factors influencing medicinal plants and its sustainability in Laikipia East District.

### **1.6 Significance of the study**

The study was to inform the Government on policies regarding emerging issues on; access, use and conservation of medicinal plants. Also it would help the government organizations such as: Kenya Forest Service, Kenya Wildlife Service, National Environment Management Authority, Ministry of health and Ministry of Agriculture, Livestock and Fisheries. Finally the study would help establish ways in which

stakeholders such as herbalist and users of herbal medicine would be incorporated in sustainable management of the medicinal plants.

### **1.7 Limitations of the study**

Lack of enough time and resources in terms of finances as well as resistance from the respondents were projected limitations. However, the researcher probed to get information while indicating the importance of research to academic field and community at large. Also expected were rainy seasons within the area of study that would hinder accessibility to the remote areas in search of the respondents. The study was restricted to only herbalists and herbal medicine users in Laikipia East Sub County.

### **1.8 Delimitation of the study**

The findings of the study was limited to herbalists and herbal medicine users in Laikipia East District found in Laikipia County and may not be generalized to other districts in the country as many districts face almost different factors concerning sustainability of medicinal plants.

### **1.9 Definition of significant terms**

- Access:** Means permission to acquire, subject to specific conditions, biological material or genetic products and derivatives including associated knowledge.
- Bio-piracy:** Means access to and exploration of biological resources, their derivatives and associated traditional knowledge without compliance with established legal framework.
- Bio-prospecting:** Means removal or use of biological resource of any organism, mineral or other organic substance for scientific study or commercial development.
- Herbalism:** Is the study and practice of using plant material for the purpose of food, medicine, or health
- Licence:** A permit or written authority from the competent authority granting use of biodiversity intellectual assets and or associated



intellectual property rights within a defined time, context, market line or territory;

**Management:** For the purpose of this study refers to measures put in place to sustainably manage medicinal plants.

**Medicinal plant:** For this study refers to indigenous living thing either tree or shrub that grows on earth that has an ability to treat human diseases.

**Plant:** Refers to indigenous living thing either trees or shrubs that grows on earth.

**Resource Utilization:** Means the act of using resource(s) for social-cultural, aesthetic educational, scientific, development and economic gains.

**Sustainable management:** Refers to utilization of natural resource in a manner that will benefit both present and future generation.

### **1.10 Organisation of the study**

Chapter one provides a background on medicinal plants, its statement of problem, research objectives as well as research questions of the study relevant to answering purpose and significant of study. Chapter two will vividly explain various review of existing literature concerning socioeconomic factors, environmental factors and management factors influencing medicinal plants. Chapter three outlines research design and methodology which in details involves research design, target population, sample sampling procedure and data collection instruments. Chapter four highlights data analysis, presentation and interpretation while chapter five outlines the research findings, discussion, conclusions and recommendations. Research report also includes references and appendices.

## CHAPTER TWO

### LITERATURE REVIEW

#### **2.1 Introduction**

This chapter focused on sustainability of medicinal plants. The socioeconomic factors, environmental factors, and management factors of medicinal plants were discussed. This chapter also included theoretical, conceptual framework of the study and knowledge gap at the end.

Herbal medicines may be presented in many forms including fresh, dried, whole, or chopped. Herbs may be prepared as infusions when an herb is soaked in a liquid, or decocted is when an herb is simmered in water over low heat for a certain period of time. Some examples of infusion are chamomile or peppermint, using flowers, leaves and powdered herbs. For decocting examples may be rose hips, cinnamon bark, and licorice root consisting of fruits, seeds, barks, and roots. They can be preserved as syrups such as glycerites in vegetable glycerin, or put in honey known as miels, both of which have a sweet taste and the lack of alcohol being a more suitable choice for children. Powdered and freeze dried herbs can be found in bulk, tablets, troches similar to a lozenge, pastes, and capsules. Fluid and strong extracts being a stronger concentrate tend to work more rapidly finding a quicker result, (Stanley et al, 2004)

Non-oral herbal uses consist of creams, baths, oils, ointments, gels, distilled waters, washes, poultices, compresses, snuffs, steams, inhaled smoke and aromatics volatile oils. Many herbalists consider using the patient's direct involvement in their own healing process and may use the patient's intellectual, emotional, physical and spiritual attention to the process as critical. All methods of these are delivered differently depending on the herbal traditions of that area. Nature is not necessarily safe; special attention should be used when grading quality, deciding a dosage, realizing possible effects, and any interactions with herbal medications, (Micozzi, 2011).

## **2.2 Overview of herbal medicine**

Herbalism is the study and practice of using plant material for the purpose of food, medicine, or health. They may be flowers, plants, shrubs, trees, moss, lichen, fern, algae, seaweed or fungus. The plant may be used in its entirety or with specific parts being used. In each culture or medical system there are different types of herbal practitioners: professional and lay herbalists, plant gatherers, and medicine makers. (Elwig, 2010). According to Rodgers and Denise (2000), highlighted that in Germany, herbal medications are dispensed by apothecaries and the prescription of drugs are sold alongside essential oils herbal extracts or tisanes. Herbal remedies are seen by some as treatment to be preferred to pure medical compounds which have been industrially produced.

In European Union (EU) herbal medicine are now regulated under European Directive on Traditional Herbal Medicinal Products. In United States most herbal remedies are regulated dietary supplements by the food and drug administration. Manufactures of products falling into this category are not required to prove the safety or efficacy of their products through food and drug administration may withdraw a product from the market should it prove harmful. (Lois, 1992)

Martin de la Cruz cited that herbs were also common in the medicine of ancient India where principal treatment for diseases was diet. The documentation of herbs and their uses was a central part of both western and eastern medical scholarship through the 1600s and these works played an important role in the development of the science of botany. In India the herbal remedy is so popular that the government of India has created a separate department under ministry of health and family care and the national medicinal plants board was established in 2000 by the government in order to deal with the herbal medical system. The World Health Organization (WHO), the specialized of the United Nations (UN) that is concerned with international public health, published quality control methods for medicinal plant material in 1998 in order to support W.H.O. number states in establishing quality standards and

specifications for herbal materials within the overall context of quality assurance control of herbal medicine (WHO, Geneva 2005)

Africa is endowed with many plants that can be used for medicinal purposes to which they have taken full advantage. In fact, out of the approximated 6400 plant species used in tropical Africa, more than 4000 are used as medicinal plants. Medicinal plants are used in the treatments of many diseases and illnesses, the uses and effects of which are of growing interest to Western societies. Not only are plants used and chosen for their healing abilities, but they also often have symbolic and spiritual significance. For example, leaves, seeds, and twigs that are white, black and red are seen as especially symbolic or magical and possess special properties. (Makoila et al, 2010)

According to Nunn 1996, Archaeological evidence indicates that the use of medicinal plants dates at least to the Paleolithic approximately 60000 years ago. Written evidence of herbal remedies dates back over 5000 years to the Sumerians, who created lists of plants. Egypt, herbs are mentioned in Egyptian medical papyri, depicted in tomb illustrations or on rare occasions found in medical jars containing trace amounts of herbs. Only a few fragments of these works have survived intact but from what remains scholars have noted that there is a large amount of overlap with the Egyptian herbals.

In some African countries, up to 80% of the population relies on traditional medicine for their primary health care needs because they are affordable and accessible to many populations in which they live below poverty line (Stanley, 2004). Medicinal Plants are the main source of natural remedies in Kenya nowadays. They exist everywhere and sometimes we step on them not knowing that they have some medicinal uses. It is an advantage for us to know their local use, especially for those people living in the rural areas. Even in the urban areas medicinal plants are the primary source of remedy when people get sick, (Kokwaro, 2008).

In recent years, the treatments and remedies used in traditional African medicine have gained more appreciation from researchers in Western science. Developing countries

have begun to realize the high costs of modern health care systems and the technologies that are required, thus proving Africa's dependence to it. Due to this, interest has recently been expressed in integrating traditional African medicine into the continent's national health care systems, (Rodgers et al, 2000).

Despite the shortcomings that plague devolved democratic structures of development in Kenya, both the critics and the sympathizers of the government cannot ignore one fact; the bottom-up approach of development is a shared responsibility between the government and the citizens and its success or failure lies in the hands of all players in policy making including the citizenry. Since the inception of this approach of development in the country, more gains have been seen at the grass roots in terms of employment opportunities, schools enrolments and increased construction of local infrastructures than at any other time in the history of Kenya, but in order to make these initiatives last the test of time, serious checks and balances must be put in place to ensure that this holistic development approach of engaged governance is watertight from abuse and easy manipulation by people with less regard for the wider society (Bagaka, 2008).

### **2.3 Socioeconomic factors influencing sustainability of medicinal plants**

The medicinal properties of plant species have made an outstanding contribution in the origin and evolution of many traditional herbal therapies. These traditional knowledge systems have started to disappear with the passage of time due to scarcity of written documents and relatively low income in these traditions (Ahuja, 2001). Over the past few years, however, the medicinal plants have regained a wide recognition due to an escalating faith in herbal medicine in view of its lesser side effects compared to allopathic medicine in addition the necessity of meeting the requirements of medicine for an increasing human population. Through the realization of the continuous erosion of traditional knowledge of plants used for medicine in the past and the renewed interest at the present time, a need existed to review this valuable knowledge of medicinal plants with the purpose of developing medicinal plants sectors across the different states in India (Khan and Khanum, 2000). Our major objectives therefore were to explore the potential in medicinal plants resources,

to understand the challenges and opportunities with the medicinal plants sector, and also to suggest recommendations based upon the present state of knowledge for the establishment and smooth functioning of the medicinal plants sector along with improving the living standards of the underprivileged communities.

Traditional medicine is alternative with conventional medical treatment in a belief not proven by using scientific methods that it “complements” the treatment. Traditional medicines were commonly used in salves and drinks to treat a range of maladies. The particular herbs used depended largely on the local culture and had roots in pre Christian religion .Plants have been the basis for medical treatments through much of human history and such traditional medicine is still widely practiced today (Stanley, 2010). Today some people prefer to use natural medicine. We can find them anywhere, in our backyards and even in our gardens. Medicinal plants have important contributions to the healthcare system of local communities as source of medicine for the rural population since plants not only have nutritional value but also medicinal values. (Micozzi et al, 2000). In Ethiopia there is a cultural diversity in various patterns of using flora. According to the World Health Organization (WHO) more than 3.5 billion people in the developing world rely on medicinal plants as components of their healthcare. Traditional medicine has been brought into focus for meeting the goals of a wider coverage of primary healthcare delivery, not only in Africa but also in all countries of the world. Medicinal plants are widely used in treatment of numerous human and livestock diseases in different parts of the world (Mesfin, 2009).

Many traditional medicinal practitioners are people without education, who have rather received knowledge of medicinal plants and their effects on the human body from their forebears. They have a deep and personal involvement in the healing process and protect the therapeutic knowledge by keeping it a secret (Helwig et al, 2010). Generally traditional medicine is made from plant materials such as bark, leaves and seeds. Traditional medicine is any practice that is put as having the healing effects of medicine but is not based on evidence gathered using scientific method(it

consists of a wide range) of health care practices products and therapies(Onwuanibe,1979).

Modern medicine recognizes herbalism as a form of alternative medicine, as the practice of herbalism that is not strictly based on evidence gathered using the scientific method. Modern medicine , does ,however, make use of many plant derived compounds as the basis for evidence tested pharmaceutical –drugs and physiotherapy work to apply modern standards of effectiveness to herbs and medicines that are derived from natural sources (Pizzorna et al ,2008).Modern medicine recognizes herbalism as a form of alternative medicine, as the practice of herbalism that is not strictly based on evidence gathered using the scientific method. Modern medicine , does ,however, make use of many plant derived compounds as the basis for evidence tested pharmaceutical –drugs and physiotherapy work to apply modern standards of effectiveness to herbs and medicines that are derived from natural sources (Pizzorna et al ,2008). It is our Mother Earth who provides an easy access on initial therapy through a vast array of wild- crafted herbal medicinal plants, decocted, infused, juiced, tinctured, powdered, pounded and poultice to provide relief through varied mechanisms with pharmacologic effect (Nautiyal,2004).

The traditional medical systems of northern India such as Ayurveda and Tibetan are part of a time-tested culture and honoured by people still today. These traditions have successfully set an example of natural resource use in curing many complex diseases for more than 3,000 years (Kala, 2004). Many advantages of such eco-friendly traditions exist. The plants used for various therapies are readily available, are easy to transport, and have a relatively long shelf life. The most important advantage of herbal medicine is the minimal side effects, and relatively low cost compared to the synthetic medicines, (Stanley, 2010). The success of medicinal plants sector mainly depends on the awareness and interest of the farmers as well as its other stakeholders, supportive government policies, availability of assured markets, profitable price levels, and access to simple and appropriate agro-techniques. The successful establishments of medicinal plants sector may help in raising rural employment, boost commerce around the world, and contribute to the health of millions (Dharani ,2011).

## **2.4 Environmental factors influencing sustainability of medicinal plants**

The continuous increase in human population is one of the causes for concern in meeting the daily requirements of food and medicine as the economy and livelihoods of human societies living in developing countries primarily depend on forest products. This phenomenon is leading to continuous erosion of forest and the forest products, thus making challenge to meet the requirements as well as to conserve useful bio-resources (Khan, 2000). The market prices for medicinal plants and derived materials provide only a limited insight into the workings of the market, and not on the precise information of profits, supply and demand. We have identified the following major features and challenges on the basis of examining the existing knowledge on the medicinal plants sector: slow rate of production of many medicinal plants, long gestation period, shortage of suitable cultivation technology, production of small quantity, unscientific harvesting, paucity of research on the high yielding varieties, inefficient processing techniques, fluctuation in demand and supply, poor quality control procedures, scarcity of good manufacturers, poor marketing infrastructure, and poor coordination among different stakeholders (Mokaila ,2010).

A number of herbs are thought to be likely to cause adverse effects. Furthermore, "adulteration, inappropriate formulation, or lack of understanding of plant and drug interactions have led to adverse reactions that are sometimes life threatening or lethal. Proper double-blind clinical trials are needed to determine the safety and efficacy of each plant before they can be recommended for medical use (Micozzi and Marc, 2000). Although many consumers believe that herbal medicines are safe because they are "natural", herbal medicines and synthetic drugs may interact, causing toxicity to the patient. Herbal remedies can also be dangerously contaminated, and herbal medicines without established efficacy, may unknowingly be used to replace medicines that do have corroborated (Pizzorna et al, 2008).

Medicinal plants, 'facing threat', hundreds of medicinal plants are at risk of extinction, threatening the discovery of future cures for disease, according to experts. Further highlighted that, over 50% of prescription drugs are derived from chemicals first identified in plants. But the Botanic Gardens Conservation International said many



were at risk from over-collection and deforestation. Researchers warned the cures for diseases such as cancer and HIV may become "extinct before they are ever found". The group, which represents botanic gardens across 120 countries, surveyed over 600 of its members as well as leading university experts.

Micozzi and Marc 2000 identified 400 plants that were at risk of extinction. These included yew trees, the bark of which forms the basis for one of the world's most widely used cancer drugs, paclitaxel. Hoodia, which originally comes from Namibia and is attracting interest from drug firms looking into developing weight loss drugs, is on the verge of extinction, the report said. And half of the world's species of magnolias are also under threat. The plant contains the chemical honokiol, which has been used in traditional Chinese medicine to treat cancers and slow down the onset of heart disease. The report also said autumn crocus, which is a natural treatment for gout and has been linked to helping fight leukaemia, is at risk of over-harvest as it is popular with the horticultural trade because of its stunning petals. Many of the chemicals from the at-risk plants are now created in the lab. But the report said as well as future breakthroughs being put at risk, the situation was likely to have a consequence in the developing world.

It said five billion people still rely on traditional plant-based medicine as their primary form of health care. "The loss of the world's medicinal plants may not always be at the forefront of the public consciousness". However, it is not an overstatement to say that if the precipitous decline of these species is not halted, it could destabilize the future of global healthcare." (Helwig, 2010).

Ley 2011 of the Association of the British Pharmaceutical Industry, added: "Nature has provided us with many of our medicines and miracle cures are most at risk for example: *Autumn crocus* - Romans and Greeks used it as poison, but now one of the most effective treatments for gout. Under threat from horticulture trade: *Yew tree* - Cancer drug paclitaxel is derived from the bark, but it takes six trees to create a single dose so growers are struggling to keep up, *Hoodia* - Plant has sparked interest for its ability to suppress appetite, but vast quantities have already been "ripped from the wild" as the search for the miracle weight drug continues, *Magnolia* - Has been used

in traditional Chinese medicine for 5,000 years as it is believed to help fight cancer, dementia and heart disease. Half the world's species threatened, mostly due to deforestation.

Illegal logging threatens some of the most valuable forest globally- from the Amazon to the Russian Far East, and yet, many of the people that live in these forests, illegal logging is a vital source of income –sometimes it is the only way to survive. But at other times it threatens their lives. Increased demand for forest products has brought some financial benefits for poor people living near to forests. But there is also evidence to show that usually, poor communities who are completely dependent on forest lose out to powerful interests, logging companies and migrant workers who reap most of the benefits. In 1999, following public outcry on the destruction of Mt. Kenya Wildlife Service KWS with the support of UNEP undertook a systematic aerial survey of the forests of Mt. Kenya. The survey was to provide factual information on the extent, the type and the location of destructive activities in the forest. The result established that the whole of Mt. Kenya forests were heavily impacted by extensive illegal activities.

Illegal logging especially of camphor and cedar, encroachment into the fringes of the indigenous forest, extensive charcoal production and marijuana cultivation were recorded throughout the indigenous forest. The shamba- system (non- residential cultivation) regulations had also not been affected and large areas of clear- felled [plantation remained unplanted. As a result of the 1999 survey report, a number of important policy measures were implemented by the government in late 1999 and 2000 , the most significant being the gazettelement of Mt.Kenya National Reserve to provide enhanced conservation status to the entire forest belt on the mountain. The newly established National Reserve was accompanied by a shift in management from forest Department to KWS. (KWS and KFS, Management plan2008),

In order to determine the effectiveness of the new management practices and their impact on the forest cover, four organization, the Durrell Institute for Conservation and Ecology (DICE) of University of Kent, KWS , UNEP and the Kenya Forest Working Group( KFWG), undertook an assessment study of the changes in Mt.

Kenya forest between 1999 and 2002. The study involved three parallel assessment approaches: analysis of satellite images, ground surveys and sampling aerial surveys. The study reveals that the level of destruction activities in particular logging of indigenous trees, identified as the main threat to the forest – has significantly reduced. Since 1999 logging of indigenous trees has fallen by over 93 per cent, with logging of camphor, a highly valuable hardwood, reduced by 96 per cent. The number of recorded charcoal kilns went down by 62 per cent from 547 in 1999 to 205 in 2002. Marijuana cultivation has decreased from 31 ha in 1999 to 5.8 ha in 2002 a reduction in area of 81 per cent and now occurs mainly in the bamboo zone rather than in the mixed broad leaf forest. Effective and regular patrolling of the forest by KWS rangers have much to account for the improvement in the state of the forests.

## **2.5 Management factors influencing medicinal plants**

Effective management in medical practice, public health, food and drugs is essential to safeguard people against risks and unethical practices. This is especially so given the information gaps in the health sector which make it difficult for individual to make reasoned choices, (WHO Report 2008). A strong regulatory system would supervise the quality of services delivered. Standard treatment guidelines should form the basis of clinical care across public and private sectors, with the adequate monitoring by the regulatory bodies to improve the quality and control the cost of care. Previous success may create a success syndrome and lead for example to underestimation of the competition due to excessive self-confidence (Simon *et al.*, 2000)

The provisions of the Wildlife Conservation and Management Act 2013, Regulations and Guidelines under Section 80 of the Wildlife Conservation and Management Act 2013 (on licensing and wildlife user rights) states: any person, who engages in unauthorized wildlife transactions, shall be subjected to Bio-prospecting and any person convicted of an offence under these regulations shall: be liable to imprisonment term not exceeding 24 months or to a fine not exceeding Ksh.500,000 or both and compensation of 60 % of income obtained from commercialization of the products whichever is higher. Also it states any person found having biological

materials, genetic materials, derivatives and commercialized products obtained in contravention of these regulations are confiscated/seized and forfeited to Kenya Wildlife Service. Also a breach of any of these regulations shall lead to automatic cancellation of license /permit and nullification of any future engagement (Wildlife Conservation and Management Act, 2013)

Most people in Kenya are generally behind news or simply, lack interest on the government's new initiatives of spearheading development through the bottom-up approach of engaged governance. This is mainly due to failure on the part of the government in rising above board in building public confidence on the new institutions of development. (Goel, A et al, 2006). The world health organization (WHO), the specialized of the united nations (UN) that is concerned with international public health, published quality control methods for medicinal plant material in 1998 in order to support WHO number states in establishing quality standards and specifications for herbal materials within the overall context of quality assurance control of herbal medicine (WHO, Geneva ,2005)

One of the commonly voiced concerns about complementary alternative medicine (CAM) is the manner in which is regulated. There have been significant developments in how CAMs should be assessed prior to re-sale in the United Kingdom and the European Union (EU) in the last 2 years. Despite this, it has been suggested that current regulatory bodies have been ineffective in preventing deception of patients as many companies have re-labelled their drugs to avoid the new laws. There is no general consensus about how to balance consumer protection (from false claims, toxicity, and advertising) with freedom to choose remedies. (Pizzorna et al, 2008).

Agro forestry is a practice of growing both crop and trees in the farms. This practice influences directly the dependency to forests resources. Here, the farmer has a control on what type of tree to grow for his or her benefit. Agro forestry is a dynamic, ecologically based, natural resource management system, which involves the integration of trees on farms and in the agricultural landscape that seeks to diversify and sustain production for increased social, economic and environment benefits for

land users at all levels. This is a definition that considers Agro forestry as justified for being beneficial to the environment, household income, productivity, and sustained development of the community, (Woodroffe, 2008)

Ideally, Agro forestry systems, capable of providing substantial net economic and ecological benefits to households and communities, should be readily adopted by farmers. According to studies done by Dunn, 2001, there are higher Net present values for agro forestry systems when compared to monoculture systems, yet farmers in developing countries show low rates of adoption. Burley 2002 suggested that the major conditions which must be satisfied before rural people will plant trees are economic, socio-cultural, and environmental and land ownership. One of the critical factors that have been given consideration in determining the potential acceptability and viability of agro forestry is land fragmentation, land tenure systems and tree ownership. Land fragmentation at generational transfers has become a more important tendency in nearly all types of holdings. Rules of inheritance of land by all sons in the family and larger family size inevitably imply a rapid fragmentation of family land.

Agro forestry depends on people's right to plant and use trees, rights which in turn depend on the prevailing system of land tenure and tree tenure. Tree tenure is often distinct from land tenure, but they affect each other. Tree tenure consists of a bundle of rights over trees and their produce, which may be held by different people at different times. These rights include rights to own or inherit trees, the rights to plant trees, the right to use trees and their products, the rights to dispose of trees and the right to exclude others from the use of trees and tree products. The nature of the tree, the nature of the use and the nature of the person or group influences who and what rights. Land owners tend to be advantaged in terms of their rights to trees. (Ginsberg 1998)

## **2.6 Theoretical Frame work**

The study was guided by the following theories:-

### **2.6.1 Humour Theory**

The underlying principle of medieval medicine was the theory of humours. This was derived from the ancient medical works, and dominated all western medicine until the 19th century. The theory stated that within every individual there were four humours, or principal fluids - black bile, yellow bile, phlegm, and blood, these were produced by various organs in the body, and they had to be in balance for a person to remain healthy. Too much phlegm in the body, for example, caused lung problems; and the body tried to cough up the phlegm to restore a balance. The balance of humours in humans could be achieved by diet, medicines, and by blood-letting, using leeches. The four humours were also associated with the four seasons, black bile-autumn, yellow bile-summer, phlegm-winter and blood-spring.

Herbalists must learn many skills, including the wild crafting or cultivation of herbs, diagnosis and treatment of conditions or dispensing herbal medication, and preparations of herbal medications. Education of herbalists varies considerably in different areas of the world. Lay herbalists and traditional indigenous medicine people generally rely upon apprenticeship and recognition from their communities in lieu of formal schooling.

### **2.6.2 Alternative Development theory**

This paradigm rejects economic growth as an end in itself, and instead emphasizes welfare and human development with increased choices (Martinussen, 1999). It emerged in the 1970's as critique to mainstream economic model of modernization that failed to address the problem of massive poverty and environmental sustainability. It was inspired by the works of John Friedman who saw the previous attempts to development hoped to improve the living conditions of the poor especially in rural areas and at the same time be compatible with emerging environmental concerns.

The main ideal about alternative development was not to replace mainstream development path of modernization through the state but rather to transform them so that the disempowered poor are included in political and economic processes and have their rights as citizens and human rights as citizens and human beings acknowledged. It therefore became a bottom-up approach with the major concern on people and not only on production and profits. Alternative development focuses on the fulfilment of practical and strategic interests through collective mobilization-the empowerment approach. This has increasingly been used to mean increasing people's capacities so that they become self sustaining, independent and able to make decisions that affect their lives.

The theory points out that it's only through people-centred and bottom up approaches to development through which people are empowered; socially, economically as well as psychologically. Through the basic needs approach of alternative development theory, herbal medicine is very important as an alternative source of medicinal health care for Kenyan people.

### **2.6.3 The Concept of sustainable Development**

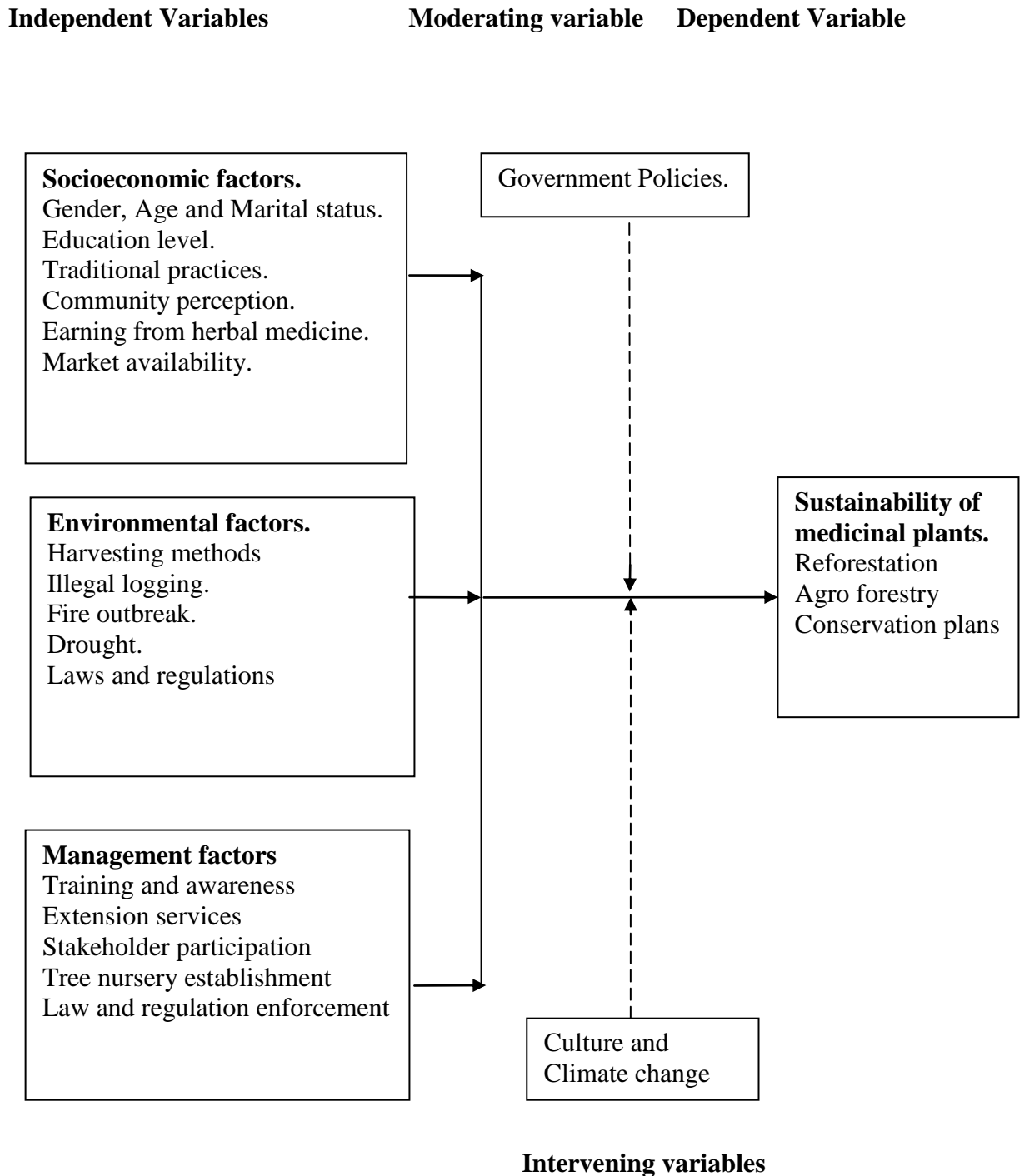
The term was first used in early 1980's in the world Conservation Strategy but became popular after the publication: "Our common Future" by the World Commission on Environment and Development(WCED) in 1987. According to Ashley and Carney(1999) and Johnston et al (2000) there are about eighty definitions of "sustainable development" that can be identified. They point out that the most widely used is that of WCED (1987): "development that meets the needs of the present without compromising the ability of future generations to meet there own needs".

Sustainability is important because it applies that progress is poverty reduction is lasting, rather than fleeting because there is accumulation of broad capital base that provides the basis for improved livelihoods, especially for poor people. With regard to this study, the term sustainability is used to determine whether the long term objectives of management of medicinal plants are achievable.

## 2.7 Conceptual Framework

According to the framework above, the independent variables for the study are socioeconomic factors, environmental factors, management practices influencing medicinal plants while the dependent variable is sustainability of medicinal plants.

The conceptual framework for the research study is shown in Figure 1.



**Figure1. Conceptual Framework**



## **2.8 Knowledge Gap**

The literature review of this study shows that the use of medicinal plants has huge potential of expansion in Kenya. The study revolved around factors influencing sustainability of medicinal plants. The study only focused on; assessing socioeconomic factors, environmental factors and management factors of medicinal plants that influence its sustainability and therefore there is need for carrying out further studies in this area of medicinal plants to provide more information on its management and thus enhance its sustainability.

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.1 Introduction**

The study area, research design and methodology are given in the chapter. Included in this chapter also were; the target population, sample size, sampling procedure, data collection procedure, analysis, ethical consideration and operationalization of variables are given in in the chapter.

#### **3.2 Research design**

This study was conducted using a descriptive survey design. The survey is a non-experimental, descriptive research method. It is the collection of information from a group through interviews or the application of questionnaires to a representative sample of that group. This design was preferred because very large samples are feasible, making the results statistically significant even when analyzing multiple variables. Surveys were useful in describing the characteristics of a large population. Additionally, high reliability is easy to obtain by presenting all subjects with a standardized stimulus which ensures that observer subjectivity is greatly eliminated (Mugenda and Mugenda, 2008).

#### **3.3 Target Population**

Population is the aggregate of all that conforms to a given specification (Mugenda and Mugenda 2008). The definition assumes that the population is not homogeneous. The target population of this study was 500 registered herbalists and 500 households that have benefited from services of the 50 herbalists and 5 officials from relevant Government Ministries in Laikipia East District.

#### **3.4 Sample size and sampling procedure**

Bryman, (2008) hypothesized that at least 10% of the population is appropriate to be used as a sample of the study. Therefore a sample size of 50 herbalists, 50 users of herbal medicines and 5 government officials from relevant ministries, all making a total of 105 respondent were utilized in this study as shown in Table 3.1.

**Table 3.1** Sampling Frame

<b>Group</b>	<b>Population</b>	<b>Sample size</b>
1	Herbalists	500
2	User of herbal medicine	500
3	Government officials	5
<b>Total</b>	<b>1005</b>	<b>105</b>

Sampling is a process used by a researcher to identify people, places or things to study (Kombo and Tromp, 2006). The sampling frame describes the list of all population units from which the sample is selected (Cooper and Schindler, 2003). Stratified sampling technique was used to select the sample. In stratified random sampling subjects are selected in such a way that the existing sub-groups in the population are more or less represented in the sample (Bryman, 2008). Therefore the respondents were selected randomly from the study area.

Stratified random and snow ball sampling techniques were chosen for its advantages of focusing on important sub-populations and allows use of different sampling techniques for different sub-populations thereby improving the accuracy of estimation. Within each stratum simple random sampling technique was used in order to allocate the objects an equal opportunity of being sampled. Sample size for the study was carefully selected to represent the all of Laikipia East District.

### **3.5 Data collection methods**

A structured questionnaire and interview guide were developed and utilized in this study. The questionnaire had both open and close ended items for collection of primary data. The preference for a questionnaire for use is based on the fact that respondents are able to complete them without help, anonymously, and it is cheaper and quicker than other methods while reaching out to larger sample (Bryman, 2008; Cohen et al, 2007). A request to answer all questions was made and completed questionnaires were collected immediately.

The researcher personally and research assistance visited the respondents and explained the purpose of the questionnaire. This was to assure the respondents of the confidentiality of their responses. With the help of a trained research assistant, the researcher and the assistant distributed the questionnaires to the respondents. This was done with the help of herbalist group

officials. The respondents were required to respond to them for a period not exceeding two hours. The researcher sought approval from University's department to conduct the study.

### **3.6 Pilot testing**

The pilot study was conducted to check validity and reliability of the questionnaire and interview guide and check for their appropriateness. The instrument was pilot tested among 5 respondents in one location in Laikipia East District who were selected using simple random method from a group of herbalists and users of herbal medicine.

### **3.7 Validity of instruments**

Validity indicates the degree to which an instrument measures what it is supposed to measure; the accuracy, soundness and effectiveness with which an instrument measures what it is intended to measure (Kothari, 2004). Validity of the instruments is critical in all forms of researchers and the acceptable level largely depends on logical reasoning, experiencing and professionalism of the researchers who should have good understanding of the various quality control techniques (Oso, 2005). To ensure validity, the instruments used in the study were examined by the supervisor and other academic experts in the department. The research instruments were availed to the lecturers and peers, who established its content and constructed validity to ensure that the items were adequately representative of the subject area studied.

### **3.8 Reliability of instruments**

Reliability is a measure of degree to which a particular measuring procedure provides consistent results or data after a repeated trial. A reliability of at least 0.70 estimated using Cronbach's po Alpha Coefficient is accepted. It is a measure of internal coefficient. Adjustments were made accordingly in case a low co-efficient is obtained in order to improve on the instrument (Cooper, 2003). The research instruments were availed on time to ensure its reliability was checked adequately in order to be representative of the subject area.

### **3.9 Data analysis**

Data analysis technique is the examining of what has been collected in a research and making deductions and inferences (Kombo, 2004). Bryman and Cramer (2007) noted that data analysis seeks to fulfill research objectives and provide answers to research questions.

Before processing the responses, the completed questionnaires were edited for completeness and consistency. The data generated from structured and semi structured questionnaires was recorded, coded, numbered and classified under different variables for easy identification and then summarized in answer summary sheet. The data was then coded in order to enable the responses to be grouped into various categories. The collected data was both quantitative and qualitative and was analyzed by descriptive and content analysis respectfully. The descriptive statistical tools helped researcher to describe the data and determine the extent to be used. The findings were presented using tables and percentages.

### **3.10 Ethical Considerations**

The researcher sought research approval from University of Nairobi. In addition, the researcher sought informed verbal consent from study participants after an explanation of the purpose of the study and informal consent from the Sub-County commissioner of Laikipia East District. The researcher further ensured that the information obtained from the respondents was kept confidential and that no name of the respondents was used to refer to the respondents.

### **3.11. Operational definition of variables**

The measurement of the various variables in this study was undertaken as shown in Table 3.2

**Table 3.2:** Operationalization of variables

<b>Objectives</b>	<b>Variable Independent</b>	<b>Indicators</b>	<b>Measurement scale</b>	<b>Tools of analysis</b>	<b>Type of statistical analysis</b>
To examine socioeconomic factors influencing sustainability of medicinal plants in Laikipia East District.	Gender, Age, social status  Education level. Traditional practices. Community perception. Earnings/ Income. Market availability.	Male or female, number of years, marital status. Literacy level. Percentage acceptance. Rate of community use. Rate of returns Rate of consumption.	Ratio, Nominal	Mean Percentage	Descriptive
To assess environmental factors influencing sustainability of medicinal plants in Laikipia East District	Harvesting methods Illegal logging. Fire outbreak. Drought. Laws and regulations	Observed harvest methods No of cases reported. No of cases reported. Recorded weather changes No of laws and regulation put in place.	Ratio, Ordinal	Mean Percentage	Descriptive

<p>To establish management factors influencing sustainability of medicinal plants in Laikipia East District.</p>	<p>Training and awareness.          Extension services.          Stakeholder participation.          Tree nursery establishment.          Law and regulation enforcement</p>	<p>No of trainings undertaken.          Availability of services          No of stakeholders involved          Availability of tree nurseries          Laws and regulation in place</p>	<p>Ratio          Ordinal</p>	<p>Mean          Percentage</p>	<p>Descriptive</p>
	<p><b>Dependent</b>          Reforestation          Agro forestry            Conservation plans</p>	<p>Acreage of under new plantation          Acreage of land under mixed farming          No of conservation plans put in place.</p>	<p>Ratio</p>	<p>Mean          Percentage</p>	<p>Descriptive</p>

## CHAPTER FOUR

### DATA ANALYSIS, PRESENTATION AND INTERPRETATION

#### 4.1 Introduction

This chapter covers data analysis, presentation, and interpretation of the research findings. The data is summarized and presented in form of frequency, percentage, cumulative percentage and tables.

Data was collected from the respondents in each of the study cluster of herbalists, users and organizations. The collected data was analysed and interpreted in line with the objectives of the study; to examine socioeconomic factors influencing sustainability of medicinal plants in Laikipia East District; to assess environmental factors influencing sustainability of medicinal plants in Laikipia East Sub County, and to establish management factors influencing sustainability of medicinal plants in Laikipia East Sub County.

#### 4.2 Return Rate

A total of 93 respondents were sampled for this study. Potential respondents were randomly drawn from the population of all clusters of respondents defined as herbalists, users of herbal medicines and government officials. The return rate of questionnaires is shown in Table 4.1

**Table 4.1** Return rate

<b>Group</b>	<b>Sample size</b>	<b>Responded</b>	<b>Percentage</b>
Herbalists	50	45	90.0
User of herbal medicine	50	43	86.0
Government officials	5	5	100.0
<b>Total</b>	<b>105</b>	<b>93</b>	<b>88.57</b>



Out of 105 questionnaires distributed for this research, 93 questionnaires were returned giving a response rate of 88.57 per cent which was considered satisfactory for subsequent analysis.

### 4.3 Reliability analysis

To determine the reliability of data collected, a pilot study was conducted among a sample of 10 respondents. This led to rephrasing of the questionnaire and a higher score of reliability was measured at Cronbach's alpha of 0.88 indicating higher reliability as shown in Table 4.2.

**Table 4.2** Reliability statistics

<b>Cronbach's Alpha</b>	<b>No. of Items</b>
0.884	36

### 4.4 Respondents Profile

#### 4.4.1 Gender of respondents

Respondents were asked to indicate their gender and shows that insults majority, of the herbalists were males, Table 4.3.

**Table 4.3** Gender frequency of herbalist

<b>Gender</b>	<b>Frequency</b>	<b>Percentage</b>
Male	30	66.7
Female	15	33.3
<b>Total</b>	<b>45</b>	<b>100.0</b>

From the research findings on herbalists, 66.7% of the respondents were males while 33.3% were females.

**Table 4.4** Gender frequency of users

<b>Gender</b>	<b>Frequency</b>	<b>Percentage</b>
Male	25	58.1
Female	18	41.9
<b>Total</b>	<b>43</b>	<b>100.0</b>

It is clear from Table 4.4 that 58.1% of users were males while 41.9% were females.

#### **4.4.2 Marital status**

Analyses of the respondents' marital status are shown in tables below:

**Table 4.5** Marital status of herbalist

<b>Marital status</b>	<b>Frequency</b>	<b>Percentage</b>
Married	31	68.9
Single	6	13.3
Divorced	8	17.8
<b>Total</b>	<b>45</b>	<b>100.0</b>

68.9% were married, 13.3%, 13.3% single and 17.8% divorced for herbalists an indication that most of them are people who are married and respected in the community.

**Table 4.6** Marital status of users

<b>Marital status</b>	<b>Frequency</b>	<b>Percentage</b>
Married	24	55.8
Single	10	23.3
Divorced	9	20.9
<b>Total</b>	<b>43</b>	<b>100.0</b>

On herbal medicine users 55.8% were married, 23.3% single and 20.9% were divorced an indication that most of the users are people who are married in the community.

#### 4.4.3 Education level of respondents

Respondents were asked to indicate their highest education level attained. On herbalists, 28.9% reported as having obtained a primary school education while 71.1% had no education. This is consistent with Helwig et al assertion that many traditional medicinal practitioners are people without education, who have rather received knowledge of medicinal plants and their effects on the human body from their forebears. They have a deep and personal involvement in the healing process and protect the therapeutic knowledge by keeping it a secret (Helwig et al, 2010).

The education level of herbalists and users is shown in Tables 4.7 and 4.8 respectfully.

**Table 4.7** Education level of herbalists

Education level	Frequency	Percentage
Primary	13	28.9
None	32	71.1
<b>Total</b>	<b>45</b>	<b>100.0</b>

Table 4.7 shows that 28.9% of herbalists had primary education while majority of 71.1% had no formal education an indication that most herbalist never went to formal school.

**Table 4.8** Education level of users

Education level	Frequency	Percentage
Primary	19	44.2
Secondary	4	9.3
Certificate	1	2.3
Diploma	5	11.6
None	14	32.6
<b>Total</b>	<b>43</b>	<b>100.0</b>

Table 4.8 shows that 44.2% herbal medicine users had primary education, 9.3% had secondary education, 2.3% had certificate and 11.6% had diploma education while 32.6% of the respondents had no education.

#### 4.4.4 Age structure of respondents

An analysis of respondents' age, as shown in Tables 4.9 and 4.10

**Table 4.9** Age structure of herbalists

Years	Frequency	Percentage
36-50	2	4.4
51-65	21	46.7
>65	22	48.9
<b>Total</b>	<b>45</b>	<b>100.0</b>

On herbalists 4.4% of the respondents were aged between 36 and 50 years, 46.7% were aged between 51 and 65 years and 48.9% were above 65 years.

**Table 4.10** Age structure of users

Years	Frequency	Percentage
20-35	6	14.0
36-50	9	20.9
51-65	11	25.6
>65	17	39.5
<b>Total</b>	<b>43</b>	<b>100.0</b>

On users, 14% were aged between 20 and 35 years, 20.9%. While 31.4 % were aged between 36 and 45 year and 4.8% were above 45 years.

#### 4.4.5 Period of years practicing/ using

An analysis of respondents' period of years practising/ using herbal medicines, as shown in Tables 4.11 and 4.12

**Table 4.11** Herbalists period of practising herbal medicine

Years	Frequency	Percentage
1-10	10	22.2
11-20	10	22.2
21-30	14	31.1
<30	11	24.4
<b>Total</b>	<b>45</b>	<b>100.0</b>

Table 4.11 shows that 22.2% of the herbalist respondents have been practising for between 1 and 10 years. A further 22.2% of the herbalists have been practising herbal medicine while 22.2% were practising herbal medicine for between 11 and 20 years, 31.1% for between 21 and 30 years and 24.4% had been practising herbal medicine for over 30 years.

**Table 4.12** Users period of using herbal medicine

	Frequency	Percentage
1-10	11	25.6
11-20	10	23.3
21-30	14	32.6
<30	8	18.6
<b>Total</b>	<b>43</b>	<b>100.0</b>

On herbal medicine users, 25.6% have been using them for between 1 and 10 years, 23.3% for between 11 and 20 years, 32.6% for between 21 and 30 years while 18.6% for above 30 years.

#### 4.4.6 How learnt medicinal plants/herbal medicines

Analyses of respondents on how they learnt about medicinal plants are shown in Tables 4.13 and 4.14.

**Table 4.13** How herbalists learnt about medicinal plants

	<b>Frequency</b>	<b>Percentage</b>
Inheritance	31	68.9
Training	10	22.2
Self	4	8.9
<b>Total</b>	<b>45</b>	<b>100.0</b>

Results show that, 68.9% of herbalists learnt through inheritance, 22.2% through training while 8.9% learned by themselves.

**Table 4.14** How users learnt about herbal medicine

	<b>Frequency</b>	<b>Percentage</b>
Parent	25	58.1
Friend	7	16.3
Self	11	25.6
<b>Total</b>	<b>43</b>	<b>100.0</b>

Herbal medicine users respondents show that 58.1% learnt through parents, 16.3% through friends while 25.6% learned by themselves.

#### 4.4.7 Diseases diagnosed/treated

An analysis of respondents on which disease they diagnosed or treated is shown in Tables below 4.15 and 4.16.

**Table 4.15** Diseases diagnosed

<b>Disease</b>	<b>Frequency</b>	<b>Percentage</b>
Ingestion	16	35.6
Headache	9	20.0
Malaria	7	15.6
Carcinogenic	7	15.6
Venereal	6	13.3
<b>Total</b>	<b>45</b>	<b>100.0</b>

Herbalists diagnosis shows that 35.6% herbalists treat ingestion related infections, 20% headache, 15.6% malaria, 15.6% carcinogenic and 13.3% treat venereal diseases.

**Table 4.16** Diseases treated

<b>Disease</b>	<b>Frequency</b>	<b>Percentage</b>
Ingestion	16	37.2
Headache	11	25.6
Malaria	8	18.6
Carcinogenic	2	4.7
Venereal	6	14.0
<b>Total</b>	<b>43</b>	<b>100.0</b>

On herbal medicine users it shows 37.2% seek treatment for ingestion infections, 25.6% headache, 18.6% malaria, 4.7% carcinogenic infections and 14% venereal infections.

#### **4.5 Social economic factors affecting sustainability of medicinal plants**

Social economic factors were measured using five items informed on both theoretical considerations and descriptions of herbal medicine tenets found in the literature and operationalized as per the study context. A five point Likert scale was used to measure the items where 1 represented 'strongly disagree' and 5 'strongly agree'. The objective of the study was to measure the extent to which respondents understood social economic factors influencing sustainability of medicinal plants in Laikipia East District. Items in the scale measuring social economic factors were expected to elicit positive responses thus a rate of 4 or 5 denoted a satisfaction with social economic factors, while a rating of 1 or 2 representing negative response denoted dissatisfaction. A rating of 3 was neutral. Thus, the cut-off point between satisfaction and dissatisfaction was then placed at 3.5. A summary of the descriptive statistics for analysis of the extent to which respondents were satisfied or dissatisfied with social economic factors in Laikipia East is presented in Table 4.17 and Table 4.18 below.

From the analysis in Table 4.17, overall results indicate that herbalists agreed with the extent to which social economic factors influence sustainability of medicinal plants in Laikipia East Sub County with a composite mean of 3.7148 out of a possible 5. Moreover, extent to which respondents were assessed by variables in Laikipia East Sub County does not differ significantly between them as reflected in the standard deviation of less than one (Std. Dev. >1.0). This implies that, there is shared opinion among herbalist' respondents in their assessment on social economic factors.



**Table 4.17** Social economic factors of herbalists

	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>
Herbalists earn a living from practicing herbal medicine.	45	3.5111	1.10005
Practicing of herbal medicine improves herbalist economic livelihood.	45	3.8000	0.99087
Practicing of herbal medicine enhance interaction with other people	45	3.9333	0.91453
Community perceptions affect the use of herbal medicine.	45	3.5111	0.84267
Herbal medicine is affordability to customers.	45	3.8889	1.04929
Always customers get satisfied after using herbal medicine.	45	3.6444	0.98062
Cronbach Alpha Coefficient = 0.876			
Composite Mean = 3.7148 SD = 0.9796			

From the analysis in Table 4.18, overall results indicate that users agreed in their assessment with the extent to which social economic factors influence sustainability of medicinal plants in Laikipia East Sub County with a composite mean of 3.95 and 3.95 respectively out of a possible 5. Moreover, extent to which respondents assessed the factors in Laikipia East Sub County does not differ significantly between them as reflected in standard deviation of less than one (Std. Dev. >1.0). This implies that, there is a shared opinion on social economic factors among herbalist's respondents in their assessment of the variables.

This was attributed to a similar assessment of herbalists and users in the two cluster sample.

**Table 4.18** Social economic factors of users

	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>
Herbalists earn a living from herbal medicine.	43	3.5814	0.90615
It costs one some money to access use herbal medicine.	43	3.9302	1.05549
Herbal medicine enhances one’s interaction with other people.	43	3.8837	1.03828
Community perceptions affect the use of herbal medicine.	43	3.9070	0.99556
Herbal medicines are affordable to everyone at any time.	43	4.1163	0.90526
Herbal medicine satisfies one after use.	43	4.3023	0.88734
Cronbach Alpha Coefficient = 0.805			
Composite Mean = 3.95 SD = 0.96468			

It is worth noting that respondents agreed on what with the assessment of the social economic factors influencing sustainability of medicinal plants with mean scores equivalent to 3.5 to 5.0 on the Likert scale ( $3.5 \leq ME < 5.0$ ). This implies that social economic factors influence sustainability of medicinal plants. Cronbach’s Alpha Coefficient of 0.876 and 0.805 respectively shows high internal consistency.

#### **4.6 Environmental factors affecting sustainability of medicinal plants**

Aggregation of the data was carried out to obtain descriptive statistics for further analysis. Selection of the items for measurement was informed by both theoretical considerations and descriptions of sustainability of medicinal plants found in the literature. A five point Likert scale was used to measure the items where 1 represented ‘strongly disagree’ and 5 ‘strongly agree’. The objective was to measure the extent to which respondents assessed the relationship between environmental factors influencing medicinal plants and its sustainability in Laikipia East District by both herbalists and users. The scores “strongly disagree” and “disagree” represented factors influencing medicinal plants and its sustainability to a “Small Extent” (SE), equivalent to 1 to 2.4 on the continuous Likert scale ( $1 \leq SE < 2.4$ ). The scores of “neither agree nor disagree”

represented factors influencing medicinal plants and its sustainability to a “Moderate Extent” (ME). This was equivalent to 2.5 to 3.4 on the Likert scale ( $2.5 \leq ME < 3.4$ ). The score of “agree” and “strongly agree” represented factors influencing medicinal plants and its sustainability to a “Large Extent” (LE). This was equivalent to 3.5 to 5.0 on the Likert scale ( $3.5 \leq LE < 5.0$ ). A summary of the descriptive statistics for analysis of the extent to which respondents were satisfied or dissatisfied with factors influencing medicinal plants and its sustainability is presented in Table 4.19 and Table 4.20.

**Table 4.19** Environmental factors of herbalists

	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>
Fire outbreak in places where medicinal plants are found.	45	4.1111	0.74536
Poor harvesting methods of medicinal plants.	45	4.1333	1.05744
Drought effects on medicinal plants.	45	2.3556	1.41671
Diseases affecting medicinal plants.	45	2.1778	1.31924
Illegal logging of medicinal plants.	45	4.0222	1.03328
Illegal entry to protected areas to harvest medicinal plants.	45	4.1111	0.80403
Lack of laws and regulations enforcement	45	3.9556	0.90342
Lack of conservation plans/strategic plans.	45	2.2222	1.27723
Cronbach Alpha Coefficient = 0.941			
Composite Mean = 3.6361125 SD = 0.8905075			

From the analysis in Table 4.19 above, overall results indicate that herbalists’ respondents rated threat to medicinal plants with a composite mean of 3.63 out of a possible 5. Moreover, extent to which respondents assessed extent of threat to medicinal plants in Laikipia East does not differ significantly between them as reflected in the standard deviation of less than one (Std. Dev.  $> 1.0$ ). Importantly, such factors as ‘Drought effects on medicinal plants’, ‘Diseases affecting medicinal plants’ and ‘Lack of conservation plans/strategic plans’ scored a mean of less than 2.5 indicating a “Small

Extent” (SE) relationship with factors influencing medicinal plants and its sustainability. This “Small Extent” assessment affected the composite mean score to slightly above score of “Agree”. This implies that while some factors influence medicinal plants and its sustainability others do not.

**Table 4.20** Environmental factors of users

	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>
Fire outbreak in places where medicinal plants are found.	43	3.5581	0.58969
Poor harvesting methods of medicinal plants.	43	3.3256	0.91862
Drought effects on medicinal plants.	43	1.8605	1.08192
Diseases affecting medicinal plants.	43	2.0233	0.96334
Illegal logging of medicinal plants.	43	3.5814	0.87919
Illegal entry to protected areas to harvest medicinal plants.	43	3.3488	1.13145
Lack of laws and regulations enforcement	43	3.3868	0.75226
Lack of conservation plans/strategic plans.	43	3.3488	1.17278
Cronbach Alpha Coefficient = 0.844			
Composite Mean = 3.0494125 SD = 0.93615625			

From the analysis in Table 4.20 above, overall, results indicate that users’ respondents rated environmental factors on threat to medicinal plants with a composite mean of 3.04 out of a possible 5. Moreover, extent to which respondents understood extent of threat to medicinal plants in Laikipia East Sub County does not differ significantly between them as reflected in the standard deviation of less than one (Std. Dev. >1.0).

It is worth noting that most, if not all, factors scored a mean of less than 2.5 and less than 3.4 indicating a “Small Extent” (SE) and a “Moderate Extent” (ME) relationship with factors influencing medicinal plants and its sustainability. This assessment affected the

composite mean score of “Moderate”. This implies that in the users’ perspective all factors do not influence medicinal plants and its sustainability. Cronbach’s Alpha Coefficient of 0.941 and 0.844 respectively shows high internal consistency and therefore reliability for further analysis.

#### 4.7 Management practices factors affecting sustainability of medicinal plants

The third specific objective of this study was to establish which management factors influence sustainability of medicinal plants in Laikipia East District. A range of response categories were as follows; strongly disagree (1), disagree (2), neither agree nor disagree (3), agree (4) and strongly agree (5) were given to describe the degree to which management factors influence sustainability of medicinal plants and results are presented in Table 4.21 and Table 4.22.

**Table 4.21** Management practices factors of herbalist

	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>
Awareness, training and extension services.	45	3.2222	1.06363
Stakeholders/community participation	45	3.8667	0.94388
Tree nursery establishment	45	3.8889	0.83182
Re-afforestation	45	3.7111	1.17980
Agro-forestry.	45	3.2222	0.82266
Conservation plan/strategic plans development.	45	3.6667	1.10782
Fire management.	45	3.7111	0.84267
Policy development /law enactment and enforcement.	45	4.1778	1.02888
Cronbach Alpha Coefficient = 0.8634			
Composite Mean = 3.6833375 SD =0.977645			

Results presented in Table 4.21 indicate that management factors contributes to influence sustainability of medicinal plants to a large extent with mean scores equivalent to 3.5 to 5.0 on the Likert scale ( $3.5 \leq GE < 5.0$ ). Moreover, the extent to which management factors

influence sustainability of medicinal plants in Laikipia East District does not differ significantly between respondents as reflected in the standard deviation of less than one (Std. Dev. <1.0).

**Table 4.22** Management practices factors of users

	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>
Awareness, training and extension services.	43	3.3256	1.01702
Stakeholders participation	43	3.0465	1.21407
Tree nursery establishment	43	3.4651	0.90892
Re-forestation	43	3.4186	0.87919
Agro forestry	43	3.3721	0.90035
Conservation plan/strategic plans/development plans.	43	3.2326	0.81174
Fire management	43	3.7907	0.74188
Policy development /law enactment and enforcement	43	3.6047	0.95468
Cronbach Alpha Coefficient = 0.8234			
Composite Mean = 3.4069875 SD =0.92848125			

Results presented in Table 4.22 indicate that management factors contributes to influence sustainability of medicinal plants to a “Moderate Extent” with mean scores equivalent to 2.4 to 3.5 on the Likert scale ( $2.5 \leq ME < 3.4$ ). Moreover, the extent to which management factors influence sustainability of medicinal plants in Laikipia East District does not differ significantly between respondents as reflected in the standard deviation of less than one (Std. Dev. <1.0).

Cronbach’s Alpha Coefficient of 0.86 and 0.823 respectively shows high internal consistency and therefore reliability for further analysis.

#### 4.8 Earning as income /payment for treatment

The researcher wanted to know whether respondents earn/ pay for treatment as shown in Tables 4.23 and 4.24.

**Table 4.23** Earn income

	<b>Frequency</b>	<b>Percentage</b>
Yes	37	82.2
No	8	17.8
<b>Total</b>	<b>45</b>	<b>100.0</b>

As to whether herbalists earn income from the trade, 82.2% while 17.8% do not earn an income an indication that herbalists do make a living out of the practice.

**Table 4.24** Pay for treatment

	<b>Frequency</b>	<b>Percentage</b>
Yes	37	86.0
No	6	14.0
<b>Total</b>	<b>43</b>	<b>100.0</b>

On herbal medicine users, 86% said they pay for treatment while 14% said they do not pay a clear explanation that they pay for service as well as herbalists earn something out of it.

#### 4.9 Community value herbal medicine

An analysis of respondents on whether they community value herbal medicine are as shown in Tables 4.25 and 4.26.

**Table 4.25** Community value herbal medicine of herbalists

	<b>Frequency</b>	<b>Percentage</b>
Yes	37	82.2
No	8	17.8
<b>Total</b>	<b>45</b>	<b>100.0</b>

It is clear that herbalist think at 82.2% that community value while 17.8% think they do not.

**Table 4.26** Community value herbal medicine of users

	<b>Frequency</b>	<b>Percentage</b>
Yes	37	86.0
No	6	14.0
<b>Total</b>	<b>43</b>	<b>100.0</b>

Herbal medicine users on the other hand think at 86% community value herbal medicines while 14% think they do not.

#### **4.10 Other users of herbal medicines**

An analysis of herbal medicine users' respondents on whether they know others who use them is indicated in Table 4.27.

**Table 4.27** Other users of herbal medicines

<b>Users</b>	<b>Frequency</b>	<b>Percentage</b>
Spouse	11	25.6
Children	14	32.6
Parents	16	37.2
Others	2	4.7
<b>Total</b>	<b>43</b>	<b>100.0</b>



It shows that 25.6% are their spouse, 32.6 are children, 37.2% are parents while 4.7% were categorised as others an indication that most children do seek services of herbalists with the help of their parents.

#### 4.11 Where herbal medicines obtain

An analysis of herbalists' respondents on where they obtain medicinal plants is shown in Table 4.28.

**Table 4.28** Where herbalists obtain herbal medicines

Herbal medicine sources	Frequency	Percentage
Government forest	15	33.3
NP/Reserve	7	15.6
Individual farms	12	26.7
Riverine	11	24.4
<b>Total</b>	<b>45</b>	<b>100.0</b>

The results show that 33.3% obtain from government forest, 15.6% from National Park/Reserves, 26.7% from individual farms and with 24.4% from riverine.

#### 4.12 Part of Medicinal plant extracted and given as medicine

An analysis of respondents on part of medicinal plant they obtain or given s shown in the Tables 4.29 and 4.30

**Table 4.29** Parts of medicinal plant extracted

Part	Frequency	Percentage
Root	14	31.1
Branches	10	22.2
Leaves	10	22.2
Bark	11	24.4
<b>Total</b>	<b>45</b>	<b>100.0</b>

Herbalists showed 31.3% of them obtain from roots, 22.2% from branches, 22.2% from leaves and 24.4% from the bark an indication that nearly all parts of the plant are harvested.

**Table 4.30** Part of medicinal plant given

<b>Part</b>	<b>Frequency</b>	<b>Percentage</b>
Root	13	30.2
Branches	9	20.9
Leaves	8	18.6
Bark	9	20.9
Juice	4	9.3
<b>Total</b>	<b>43</b>	<b>100.0</b>

A total of 30.2% of herbal medicines are given to users as roots, 20.9% as branches, 18.6% as leaves, 20.9% as barks and 9.3% as juice extract an indication that nearly all parts of medicinal plants are harvested and given to the herbal medicine users.

#### **4.13 Restocking of herbal medicine/plants extract**

An analysis of respondents on their frequency of restocking medicinal herbs are shown in Tables 4.31 and 4.32.

**Table 4.31** Restocking of herbal medicine/plant part extract

	<b>Frequency</b>	<b>Percentage</b>
1-5	19	42.2
6-10	17	37.8
11-15	8	17.8
20-25	1	2.2
<b>Total</b>	<b>45</b>	<b>100.0</b>

Table 4.31 shows that herbalists at 42.2% re-stock herbal medicine 1-5 times a month, 37.8% between 6-10 times a month, 17.8% for between 11-15 times, and 2.2% for 20-25 times. This implies that most herbalists do stock nearly 5 times herbal medicine in a month.

**Table 4.32** Medicines restocking

	<b>Frequency</b>	<b>Percentage</b>
1-5	7	16.3
6-10	1	2.3
11-15	1	2.3
Sick	32	74.4
Don't know	2	4.7
<b>Total</b>	<b>43</b>	<b>100.0</b>

Majority of herbal medicine users restock at 74.4% when sick, 16.3% frequency of 1-5 times a month, 2.3% between 6-10 times a month, 2.3% for between 11-15 times, and 4.7% were not sure.

#### **4.14 Awareness of organization that deal with management of medicinal plants**

Analyses of all respondents on whether they are aware of organization that deal with management of medicinal plants are as shown in Table 4.33

**Table 4.33** Herbalists awareness on any management organization

	<b>Frequency</b>	<b>Percentage</b>
Yes	36	80.0
No	9	20.0
<b>Total</b>	<b>45</b>	<b>100.0</b>

Results show that 80% of the herbalists are aware of management of medicinal plants and 20% were not aware of any. Therefore the herbalist need to engaged in management of herbal medicine.

**Table 4.34** Users awareness of management organization

	<b>Frequency</b>	<b>Percentage</b>
Yes	32	74.4
No	11	25.6
<b>Total</b>	<b>43</b>	<b>100.0</b>

74.4% of herbal medicine users said they are aware with 25.6 saying they are not aware.

#### **4.15 Management of the medicinal plants**

An analysis of all respondents on whether they have been engaged in any management of the medicinal plants shows are shown in Table 4.35

**Table 4.35** Management of the medicinal plants of Herbalists

	<b>Frequency</b>	<b>Percentage</b>
Yes	35	77.8
No	10	22.2
<b>Total</b>	<b>45</b>	<b>100.0</b>

A total of 77.8% of herbalists are engaged with 22.2% saying they are not.

**Table 4.36** Users opinion on management of the medicinal plants

	<b>Frequency</b>	<b>Percentage</b>
Yes	5	11.6
No	38	88.4
<b>Total</b>	<b>43</b>	<b>100.0</b>

Table 4.36 shows that 11.6% of herbal medicine users were are involved on measurement of medicinal treats while 88.4% of users were not involved.

#### 4.16 Statistical Analysis

##### 4.16.1 Correlation Analysis

This section presents the correlation analysis of various variables in the study. The Pearson’s Product moment correlation, which is a non-parametric measure of the strength and direction of association that exists between two variables was used. (Table 4.37)

**Table 4.37** Pearson’s Correlation Coefficients

	<b>Sustainability of medicinal plants</b>	<b>Social economic factors</b>	<b>Environmental factors</b>	<b>Management factors</b>
Sustainability of medicinal plants	1			
Social economic factors	0.459**	1		
Environmental factors	0.499**	0.461**	1	
Management factors	0.467**	0.321**	0.292**	1

Two predictor variables are said to be correlated if their correlation coefficient between themselves is greater than 0.5. In such a situation, one of the variables is dropped from the analysis. As shown in Table 4.37, none of the predictor variables had correlation coefficient between themselves more than 0.5 hence all of them were included in the model. The matrix also indicated between the response variable (Sustainability of medicinal plants) and predictor variables (Social economic factors, Environmental factors and Management factors).

The Pearson's Product moment correlation results described in Table 4.37 shows that sustainability of medicinal plants showed strong and significant positive relationship with social economic factors, showing a coefficient of  $r = 0.459$ ,  $P < .01$ . Findings that sustainability of medicinal plants showed strong and significant positive relationship with social economic factors lend support to these assertions as reviewed in the literature. According to reviewed literature the success of medicinal plants sector mainly depends on the awareness and interest of the farmers as well as its other stakeholders, supportive government policies, availability of assured markets, profitable price levels, and access to simple and appropriate agro-techniques. The successful establishments of medicinal plants sector may help in raising rural employment, boost commerce around the world, and contribute to the health of millions (Dharani, 2011).

The results in Table 4.37 show that strong and significant positive relationships are observed between sustainability of medicinal plants and environmental factors ( $r = 0.499$ ,  $P < .01$ ). As noted by other scholars such as Helwig et al (2010) five billion people still rely on traditional plant-based medicine as their primary form of health care. "The loss of the world's medicinal plants may not always be at the forefront of the public consciousness". However, it is not an overstatement to say that if the precipitous decline of these species is not halted, it could destabilize the future of global healthcare."

Findings that strong and significant positive relationships are observed between sustainability of medicinal plants and environmental factors are consistent with these empirical assertions. The results in Table 4.36 show that a strong and positive relationship was observed between Management factors and sustainability of medicinal plants ( $r = 0.467$ ,  $P < .01$ ). This is in line with Goel, et al (2006) who says that most people in Kenya are generally behind news or simply, lack interest on the government's new initiatives of spearheading development through the bottom-up approach of engaged governance. This is mainly due to failure on the part of the government in rising above board in building public confidence on the new institutions of development.

### 4.15.2 Regression Analysis

A multivariate regression mode was applied to determine the relative importance of each of the variables with respect to sustainability of medicinal plants. Table 4.38 presents the regression model summary.

**Table 4.38** Regression Model

<b>Model Summary<sup>b</sup></b>					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	<b>Sig.</b>
1	0.927 <sup>a</sup>	0.859	0.828	0.36706	0

a. Predictors: (Constant), Social economic factors, Environmental factors and Management factors

b. Dependent Variable: sustainability of medicinal plants

Analysis in Table 4.38 shows that the coefficient of determination (the percentage variation in the dependent variable being explained by the changes in the independent variable) R-Squared was 0.859. This implies that 85.9 per cent of the variation in sustainability of medicinal plants is explained by social economic factors, environmental factors and management factors leaving only 14.1 per cent unexplained. The P –value of 0.000 (less than 0.05) implies that the model of sustainability of medicinal plants is significant at the 5 per cent significance.

The regression model was as follows: -

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + E$$

**Where:**

**Y** = Sustainability of medicinal plants

**$\beta_0$**  = Constant term (y intercept)

**$\beta$**  = Coefficients of determinants

**$X_1$**  = Social economic factors

**$X_2$**  = Environmental factors

$X_3$  = Management factors

E = Error term

A summary of the coefficients of regression equation is presented in Table 4.39.

**Table 4.39** Coefficients of Regression Equation

		Unstandardized Coefficients		Standardized Coefficients	T	R	R <sup>2</sup>	p-value
		B	Std. Error	Beta				
(Constant)		2.332	0.085		27.455			.000
Social economic factors	X <sub>1</sub>	0.429	0.123	0.459	3.956	0.459	0.211	.000
Environmental factors	X <sub>2</sub>	0.449	0.026	0.499	17.473	0.499	0.249	.000
Management factors	X <sub>3</sub>	0.442	0.027	0.467	13.85	0.467	0.218	.000

The established multiple regression equation becomes:

$$Y = 2.332 + 0.429X_1 + 0.449X_2 + 0.442X_3$$

An analysis of variance (ANOVA) was conducted to establish the variability or spread of scores in the sample and the results were as shown in Table 4.40.

**Table 4.40** ANOVA Table

	Sum of Squares	df	Mean Square	F	Sig.
Regression	33.670	8	2.806	2.007	0.081
Residual	27.967	96	1.398		
<b>Total</b>	<b>61.636</b>	<b>104</b>			



From the information presented in the ANOVA table, given that the probability of variation, (0.081) is more than the critical value (.05), then the effect of variability is insignificant. Thus, the two set of sample clusters (herbalists and users) have positive assessment of sustainability of medicinal plants resulting from social economic factors, environmental factors and management factors. Furthermore, given that the regression mean ( $m = 33.670$ ) is significantly greater than the residual variability ( $m = 27.967$ ), it is concluded that the research samples differed on the outcome variable. This is supported by the ratio  $F$  (2.007), which serves as a measure of the statistical importance or significance of the differences among the group means. Given that the value of  $F$  (2.007) is much larger than one, this indicates that some of the groups differed significantly in terms of their mean or average values. This could be attributed to varying perceptions of sustainability of medicinal plants both by herbalists and users.

#### 4.16 Content analysis

The Government officers from relevant Ministries were interviewed and results were analysed as shown in Table 4.41.

**Table 4. 41** Government officers in-depth interview results

QUESTIONS		RESPECTIVE RESPONDENT ANSWERS				
No	Questions	KWS	KFS	Public health	Agriculture	Social service
<b>Section A About respondent</b>						
1	State your name and designation?	Vincent Ongwae Research scientist	James Kariuki Botanist	David Nderitu. Public health officer	Boniface Kipchumba Sub-county Agricultural officer	Joyce Ndirangu social & gender officer.
<b>Section B Social economic factors</b>						
2	Do you support use of herbal medicine?	Yes	Yes	Yes	Yes	Yes
3	Where herbal medicinal obtained?	Mt Kenya Aberdares forest Likii riverine	Mt Kenya forest. Meru forest reserve.	Mount Kenya	Laikipia ranches Mt Kenya forest	Mt.kenya forest.
4	Is there any payment to access medicinal herbs?	No	No	No	Don't know	No
5	Does herbalists earning a living on herbal medicine?	Yes	Yes	Yes	Yes	Yes
6	Do community have faith in using herbal medicine?	Yes	Yes	Yes	Yes	Yes

<b>Section C -Environment factor</b>						
7	What are environmental factors affecting medicinal plants?	Fire outbreaks Over harvesting Unregulated business(free for all)	Illegal entry to harvest. Poor policy guidelines wild fires.	Poor hygiene conditions Poor harvesting	Lack of agro forest Lack of afforestation.	Unregulated entity.
8	Is there any Government body charged with responsibility of herbal medicine?	Yes KWS, KFS	Yes KFS,KWS, NEMA	Yes KFS,KWS, Public Health.	Yes KFS,KWS	Yes Public Health
9	What is your opinion on environmental factors affecting medicinal plants?	Threat to the existence of the medicinal plants if not checked early enough.	Affect the future existence of medicinal plants.	If not controlled early enough will compromise Its existence.	Need urgent intervention especially educational awareness.	Will lead to extinction of medicinal plants.
<b>Section D Management factors.</b>						
10	What are management measures under taken?	Yes e.g. developing policy Guidelines on access and use of medicinal plants by KWS Developing management strategies	Yes e.g. Checking on the rate of harvesting and licensing only the vetted herbalist.	Yes e.g. Community aware Public participation.	Yes e.g. practicing agro forestry, afforestation and tree nursery establishment	Yes e.g. registration of herbalist Community participation in management.
11	Is there any future for medicinal plants?	Yes by government putting more efforts in conserving them	Yes by engaging in research and community participation	Yes by educating the both herbalists and users on the importance of trees.	Yes by developing policy guideline that allow inter cropping	Yes by encouraging communities to manage the trees.

**CHAPTER FIVE**  
**SUMMARY OF FINDINGS, DISCUSSION, CONCLUSIONS AND**  
**RECOMMENDATIONS**

**5.1 Introduction**

The findings presented in previous chapter were further summarized here so that specific findings can be obtained clearly in relation to the research objectives. In this chapter clear summary of findings, discussion, conclusions and recommendations are highlighted.

**5.2 Summary of the findings**

The major purpose of the study was to establish factors influencing sustainability of medical plants, a case study Laikipia East Sub County, Kenya. This was arrived at through the use of research questions out of which the model was used to analyse the data and draw conclusion of the findings.

A total of 93 respondents were sampled for this study out of the target sample of 105 respondents depicting a return rate of 88.57% with a reliability measured at Cronbach's alpha of 0.88 indicating a higher reliability of the sample taken for this study. Most of the respondents for both herbalist and herbal medicine users were males at 66.7% and 58.1% respectively. Also most of them were married as 68.9% of herbalists were married and 55.8% of herbal medicine users were married too and majority of them were over 65 years of age.

While on education background it was evident that most of the herbalist had no formal education as 71.1% indicated to have not gone to school, while the majority of the herbal medicine users had primary education at 44.2%, and most of them have either been practising or using the herbal medicine over 10 years having learnt the practice through

inheritance at 68.9% while users knew use of herbal medicine through their parents at 58.1% ( Table 4.14)

From the perspective of the disease treat by the herbalist and those users get treated for are mainly indigestion and headache combined at 55.6% and 62.8% respectively. Other diseases treated frequently include malaria, venereal and carcinogenic diseases.

From the study, it was noted socioeconomic factors which influence sustainability of medicinal plants were as follows: herbalists earn a living from practicing herbal medicine at mean of 3.51(herbalists) and 3.58(users), practicing of herbal medicine improves once economic livelihood of herbalists at mean of 3.80 (herbalist) and 3.93 (users), practicing of herbal medicine enhance interaction with other people at a mean of 3.93(herbalists) and 3.88(users), community perceptions affect the use of herbal medicine at mean of 3.51(herbalists) and 3.90(users), herbal medicine is affordability to customers rated at mean of 3.88(herbalists) and 4.12(users) and finally on how customers get satisfied after using herbal medicine was rated at 3.64(herbalists) and 4.30(users) thus showing that herbal medicine are always affordable and satisfies the users. Furthermore, at a composite mean of 2.95 (herbalists) and 3.95 (users) have shown satisfaction upon using herbal medicines, obtained majorly from the roots, branches and leaves of the medicinal plant. This is further elaborated by Cronbach Alpha coefficient of 0.876 by herbalists and 0.805 by herbal medicine users that socio economic factors have got strong relationship with sustainability of medicinal plants.

Environmental factors overall results indicated that herbalists and users herbal medicine rated environmental factors as threat to sustainability of the medicinal plants. They rated environmental factors at a composite mean of 3.636 and 3.049 respectively out of possible 5. Moreover, the extent to which both the herbalists and users understood the threats to medicinal plants in Laikipia East Sub County does not differ significantly between them in the standard deviation of less than one (Std dev>1.0)

Management factors affecting sustainability of medicinal plants too were rated by both herbalists and users to be affecting sustainability of herbal medicine in Laikipia East Sub County at a composite mean of 3.683 and 3.4069 respectively out of possible 5, with lack of policy development, low enactment and enforcement being the major environmental factor. A composite Alpha coefficient of 0.86 and 0.823 respectively also shows a high internal consistency and therefore reliability for further analysis.

Earning from the use of herbal medicine is also evidenced as 82.2% of the herbalists agree to be sustaining their lives from the earning. They obtain from the practicing of herbal medicines. Also the herbal medicine users agree with the herbalists as they agree they pay money in exchange of the herbal medicine 86.0% of the users indicated that they pay to get the service. A clear indication that most of the community members value the use of these herbal medicine with 82.2% and 86.0% of the herbalists and users put it. (Table 4.25 and 4.26)

Most of the herbal medicines were obtained from the government owned forest and individual farms by herbalists at 33.3% and 26.7% respectively with nearly all parts of the medicinal plants being harvested but roots and the bark topped the parts harvested at 31.1% and 24.4% respectively. Other parts harvested included leaves, branches and sap which are extracted to be used as part of the herbal medicines. Most of the herbal medicine users agreed that they always go for treatment when they are sick as 74.4% of them put it. (Table 4.32)

Most of the herbalist and users agreed that they were aware of organisations dealing with the management of medicinal plants with overwhelming 80.0% and 74.4% respectively. However, despite being aware of the organisation dealing the management of these medicinal plants they feel not involved at all has 77.8% of herbalist and 88.4% of herbal users medicine do not feel satisfactory involved indicated a serious gap.

### 5.3 Discussion

The aim of this research study was to assess factors that influence sustainability of medicinal plants in the area of study. It was further designed to assess the socioeconomic, environmental and management factors affecting sustainability of medicinal plants.

The demographic information shows that most people involved in herbal medicine are males herbalists and users at 66.7% and 58.1% respectively. The older people aged between 51- 65 years and over 65 years were majority of herbalists and users of herbal medicine at 95.6% and 61.5% respectively. It was also found that majority of herbalist had no formal education rated at 71.1% while most of the users of herbal medicine had primary and none formal education rated at 44.2% and 32.6% respectfully. This is in consistent with Helwig 2010 arguing that many traditional medicinal practitioners are people without education, who have rather received knowledge of medicinal plants and their effects on the human body from their forebears. They have a deep and personal involvement in the healing process and protect the therapeutic knowledge by keeping it a secret.

Most of the older married men and women had more knowledge on these herbs and even their users too as per 68.9% and 55.8% respectively .In terms of transfer of knowledge to coming generations seems to be good thus increasing the sustainability of medicinal plants, 68.9% of the herbalists claimed to have inherited the knowledge from their parents, and 22.2% underwent training while only 8.95 learnt on their own, while 58.1% of herbal medicine users learned the use from their parents,16.3% from their friends and 25.6% got the information from their friends. It was also noted that nearly all parts of the medicinal plants were being harvested but roots and the banks topped the parts harvested at 31.1% and 24.4% respectively, this is in agreement with Micozzi, 2011 saying traditional medicine is made from plant materials such as bark, leaves and seeds. To a greater extent, more barks, leaves, and roots among other useful parts of the plant are being extracted by the elderly people who have herbal knowledge and also who earn a living from being herbalist. This is further supported by Stanley, 2004 that herbal

medicines may be presented in many forms including fresh, dried, whole, or chopped. Herbs may be prepared as infusions when an herb is soaked in a liquid, or decocted is when an herb is simmered in water over low heat for a certain period of time. Some examples of infusion are chamomile or peppermint, using flowers, leaves and powdered herbs. For decocting examples may be rose hips, cinnamon bark, and licorice root consisting of fruits, seeds, barks, and roots.

Socioeconomic factors are seen to influence sustainability of medicinal plants, overall results indicate that herbalists and herbal medicine users respondents were in agreement to a “Moderate Extent” that social economic factors influence sustainability of medicinal plants in Laikipia East with a composite mean of 3.7148 and 3.95 respectfully out of a possible 5. Moreover, extent to which respondents assessed variables in Laikipia East District does not differ significantly between them as reflected in the standard deviation of less than one (Std. Dev. >1.0). This implies that, there is shared opinion among herbalist and users respondents in their assessment that social economic factors influence sustainability of medicinal plants. This is also voiced by herbalists and herbal users Cronbach’s Alpha Coefficient of 0.876 and 0.805 respectively showing high internal consistency. The results from regression test in hypothesis testing rejected the null hypothesis,  $H_0$  there is no significance relationship between socioeconomic factors affecting medicinal plants and its sustainability in Laikipia East District. This shows that the higher the socioeconomic status of the community the more sustained medicinal plants it becomes an idea supported by Government Officers from relevant ministries.

According to Stanley, 2004 some African countries, up to 80% of the population relies on traditional medicine for their primary health care needs because they are affordable and accessible to many populations in which they live below poverty line while Kokwaro, 2008, argued that medicinal Plants are the main source of natural remedies in Kenya nowadays. They exist everywhere and sometimes we step on them not knowing that they have some medicinal uses. It is an advantage for us to know their local use, especially for



those people living in the rural areas. Even in the urban areas medicinal plants are the primary source of remedy when people get sick. Also according to Micozzi, 2000, today some people prefer to use natural medicine. Medicinal plants have important contributions to the healthcare system of local communities as source of medicine for the rural population since plants not only have nutritional value but also medicinal values.

Environmental factors are equally important as they influence sustainability of medicinal plants despite such factors as 'Drought effects on medicinal plants', 'Diseases affecting medicinal plants' and 'Lack of conservation plans/strategic plans' scoring a mean of less than 2.5 indicating a "Small Extent" relationship with factors influencing medicinal plants and its sustainability. This "Small Extent" assessment affected the composite mean score to slightly above score of "Agree". This implies that while some factors influence medicinal plants and its sustainability others do not. It is worth noting that most, if not all, factors scored a mean of less than 2.5 and less than 3.4 indicating a "Small Extent" and a "Moderate Extent" relationship with factors influencing medicinal plants and its sustainability. This assessment affected the composite mean score of "Moderate". This implies that in the users' perspective all factors do not influence medicinal plants and its sustainability. Cronbach's Alpha Coefficient of 0.941 and 0.844 respectively shows high internal consistency and therefore reliability for further analysis. The results from regression test in hypothesis testing rejected the null hypothesis,  $H_0$  there is no significant relationship between environmental factors influencing medicinal plants and its sustainability in Laikipia East District implying that the more we deal with environmental factors affecting medicinal plants the more medicinal plants become sustainable. The same opinion was echoed by Government Officers from relevant ministries.

Mokaila ,2010, identified the following major features and challenges on the basis of examining the existing knowledge on the medicinal plants sector: slow rate of production of many medicinal plants, long gestation period, shortage of suitable cultivation technology, production of small quantity, unscientific harvesting, paucity of research on

the high yielding varieties, inefficient processing techniques, fluctuation in demand and supply, poor quality control procedures, scarcity of good manufacturers, poor marketing infrastructure, and poor coordination among different stakeholders

Helwig, 2010 is also in agreement that five billion people still rely on traditional plant-based medicine as their primary form of health care. "The loss of the world's medicinal plants may not always be at the forefront of the public consciousness". However, it is not an overstatement to say that if the precipitous decline of these species is not halted, it could destabilize the future of global healthcare." The KWS and KFS results of the 1999 survey report also substantiates further that illegal logging especially of camphor and cedar, encroachment into the fringes of the indigenous forest, extensive charcoal production and marijuana cultivation were recorded throughout the indigenous forest. The Shamba- System (non- residential cultivation) regulations had also not been affected and large areas of clear- felled plantations that remained unplanted.

Moreover, the extent to which management factors influence sustainability of medicinal plants in Laikipia East District indicate that herbalists are in agreement that management contribute to influence sustainability of medicinal plants to a large extent with mean scores equivalent to 3.5 to 5.0 on the Likert scale ( $3.5 \leq GE < 5.0$ ). The results presented by herbal medicine users also indicate that management contribute to influence sustainability of medicinal plants to a "Moderate Extent" with mean scores equivalent to 2.4 to 3.5 on the Likert scale ( $2.5 \leq ME < 3.4$ ), this is further substantiated by the herbalists and herbal medicine users Cronbach's Alpha Coefficient of 0.86 and 0.823 respectively that shows high internal consistency and therefore reliability for further analysis. The results from regression test in hypothesis testing rejected the null hypothesis,  $H_0$  that there is no significant relationship between management factors influencing medicinal plants and its sustainability in Laikipia East District. This shows that the higher the management of medicinal plants the more sustained it will be as agreed by Government Officers interviewed from relevant ministries.

In reference to WHO Report 2008, effective management in medical practice, public health, food and drugs is essential to safeguard people against risks and unethical practices. This is especially so given the information gaps in the health sector which make it difficult for individual to make reasoned choices. Simon, 2000 argues that a strong regulatory system would supervise the quality of services delivered. Standard treatment guidelines should form the basis of clinical care across public and private sectors, with the adequate monitoring by the regulatory bodies to improve the quality and control the cost of care. Previous success may create a success syndrome and lead for example to underestimation of the competition due to excessive self-confidence The provisions of the Wildlife Conservation and Management Act 2013, Regulations and Guidelines under Section 80 of the Wildlife Conservation and Management Act 2013 on licensing and wildlife user rights highlights access and use of natural resources in protected areas.

Goel, 2006, is also in agreement by further highlighting that, most people in Kenya are generally behind news or simply, lack interest on the government's new initiatives of spearheading development through the bottom-up approach of engaged governance. This is mainly due to failure on the part of the government in rising above board in building public confidence on the new institutions of development. Burley 2002 also suggested that the major conditions which must be satisfied before rural people will plant trees are economic, socio-cultural, and environmental and land ownership. One of the critical factors that have been given consideration in determining the potential acceptability and viability of agro forestry is land fragmentation, land tenure systems and tree ownership. Land fragmentation at generational transfers has become a more important tendency in nearly all types of holdings. Rules of inheritance of land by all sons in the family and larger family size inevitable imply a rapid fragmentation of family land.

## 5.4 Conclusion

The study come up with a number of conclusions, firstly, socio economics factor which affects medicinal plants and their sustainability had a near parity assessment of herbalists and users in their assessment of all factors. It was prudent to note that most of the herbal medicine users and herbalists value the use of herbal medicines. From overall results of the social economic factors indicate that herbalists and herbal medicine users agree that socioeconomic factors influence sustainability of medical plants with a composite mean 3.7148 and 3.95 respectively out of a possible 5. To ensure constant value and appreciation of herbal medicine there should be encouragement of indigenous knowledge system for both herbalists and users of herbal medicine.

Secondly, despite encouraging value for herbal medicine, medicinal plants are facing threats from certain environmental catastrophes such as fire outbreak and anthropogenic factors like poor harvesting methods, illegal logging as well as illegal entry into protected areas. In addition to what could impact negatively on the sustainability of medicinal plants is the lack of laws and regulation as well as enforcement. Therefore proper and realistic strategic plans should be made and well implemented to ensure sustainability of these medicinal plants. The herbalists and users rated environmental factors at a composite mean of 3.63 and 3.05 respectively thus showing to a greater extend environmental factors affect sustainability of medicinal plants.

Thirdly, it was very motivating to realize that the community living in Laikipia East District had some knowledge on management methods of medicinal plants such as tree nursery establishment and planting techniques. They were also aware of some of the organizations responsible for conserving medicinal plants. There is future for medicinal plants if they are properly conserved and managed. Both herbalists and users rated management factors as at a composite mean of 3.68 and 3.40 respectively thus showing to a greater extend management factors affect sustainability of medicinal plants. There is urgent need to include members of the public in the management of medicinal plants to

ensure that it remains as an alternative health for the local communities in Laikipia East District.

## **5.5 Recommendations**

Given that the local people of Laikipia East Sub County value herbal medicines, a number of recommendations were made: marketing of herbal medicines should be done in other Sub Counties in order to provide wide supply from herbalist. This can be done through licensing of herbal drugs by government in order to protect the consumers from fake medicine men. This can be achieved through supplementation of manufactured medicines and having specifically pharmaceutical outlets that only provide herbal medicines. This will also create more jobs and passing of knowledge of herbal medicines. Such an intervention is likely to boost market response, and reduce brokers in this field of medicine.

Government should conduct massive awareness campaigns on herbal medicines policies in place through the media using local language and national language so as to reach the wider community on issues of accessing government natural resources especially national parks so as to maintain the natural environment. The media should help advocate the rights of registered herbalist and promote the consumption of their products and expand literacy programme where clients can directly contact the herbalist.

Many farmers should be encouraged to plant medicinal plants in their homesteads, farms, public areas, National reserves and riverine areas in order to prevent illegal entry into protected areas in search for these medicinal plants. This will also increase the number of medicinal plants available for the herbalists and users can access their services at ease.

Lastly, there is also a need to provide medicinal financial support from the Government and NGOs in order to conserve the environment. The funds should be used to train communities on the importance of maintaining a clean healthy environment

## **5.6 Areas for further studies**

The following areas were proposed for further studies.

1. Assess importance of herbalists in managing diseases in Kenya.
2. The role of Kenyan government in sensitisation of communities in utilization of herbal medicines.
3. Assess the impact of herbal medicines use in Kenya.
4. Determine the effects of policies and regulations on sustainability of herbal medicines in Kenya.

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## APPENDICES

### APPENDIX 1: INTRODUCTION LETTER FOR RESPONDENTS.

University of Nairobi,  
P.O Box 30197,  
Nairobi.  
TEL NO.: 0722355526

Date.....

Dear Sir/Madam/Student,

#### RE: LETTER OF INTRODUCCION

I am the University of Nairobi student taking a Master of Arts degree course in Project Planning and Management. As a requirement for the fulfilment of the Master degree, I intend to carry out research on: **Factors influencing sustainability of medicinal plants: A case of Laikipia East District, Kenya**

Kindly spare some time to complete the questionnaire attached herein. The information given will be handled with utmost confidentiality.

Yours faithfully

Daniel Kipkosgei K.

REG. : NO 150/66055/20

## APPENDIX 2: QUESTIONNAIRE FOR HERBALISTS

**Instructions: Please read the questions carefully and correctly fill in the blank space and tick the boxes provided in each section.**

### Section A: Demographic Information

1. What is your gender?                      Male                                            Female                     

2. Which is your age bracket?

20-35 years     36-50 years     51-65 years     Over 65 years .

### Section B: Socioeconomic factors influencing medicinal plants.

3. Which is your marital status?

Married        Single        Divorced   

4. What is your highest level of education?

Primary school  Secondary School  Certificate  Diploma  None

5. How many years have you been practicing traditional medicine?

1-10                       11-20                       21-30                       over 30

6. How did you learn about medicinal plants?

Inheritance     Training     Self     others

(specify).....

7. Which diseases do you deal with mostly? (You can tick more than one)

Ingestion/Stomachache  Headache  Malaria  Carcinogenic  Venereal

Others (specify).....

8. a) Do you earn any money from practicing herbal medicine?

Yes [ ] No [ ]

8 b) If yes in above please give an approximate monthly earning.....

.....  
 .....

9. a) Do community members value the use of herbal medicine?

Yes [ ] No [ ]

9. b) If yes please give an approximate number of people you attend to per month.....

.....

10. According to your own understanding how would you rate the below statements regarding socioeconomic factors influencing sustainability of medicinal plants in Laikipia East. Use a scale 1-5, where 1- strongly disagree, 2- disagree, 3- moderate, 4- agree and 5- strongly agree.

Questions.	1	2	3	4	5
Herbalists earn a living from practicing herbal medicine.					
Practicing of herbal medicine improves once economic livelihood.					
Practicing of herbal medicine enhance interaction with other people.					
Community perceptions affect the use of herbal medicine.					
Herbal medicine is affordability to customers.					
Always customers get satisfied after using herbal medicine.					

11. What is your general view concerning future use of herbal medicine in relation to your customers and community? (If any).....  
.....  
.....

**Section C: Environmental factors influencing medicinal plants.**

12. Where do you obtain your herbal medicine from?

- Government forest                       National park/reserve   
Individual farms/forests                       Riverine   
Others

(specify).....  
.....  
.....

13. Which parts of the plant do you extract? (You can tick more than one)

- Roots     Branches     Leaves     Bark     Juice extract

Others  
(specify).....  
.....  
.....

14. How many times do you go for stocking your medicinal herbs in a month?

- 1-5             6-10             11-15             20-25             26-30

15. The following are some of the environmental factors influencing sustainability of medicinal plants. Rate their extent of threat to medicinal plants in Laikipia East District. Use a scale 1-5, where 1= To a very low extent, 2= To a low extent, 3=To a moderate extent, 4=To a great extent and 5=To a very great extent.

Environmental factors	1	2	3	4	5
Fire outbreak in places where medicinal plants are found.					
Poor harvesting methods of medicinal plants.					
Drought effects on medicinal plants.					
Diseases affecting medicinal plants.					
Illegal logging of medicinal plants.					
Illegal entry to protected areas to harvest medicinal plants.					
Lack of laws and regulations enforcement					
Lack of conservation plans/strategic plans.					

16. Are you aware of any other challenges (specify)

.....

.....

.....

.....

.....

**Section D: Management factors influencing medicinal plants.**

17 a). Are you aware of any organization put in place to deal with sustainable management of medicinal plants?

Yes [ ] No [ ]

17 b) If yes in above, please specify.....

.....  
 ....

18 a). Have you engaged yourself in any management practice of medicinal plants?

Yes [ ] No [ ]

18 b). If yes in above, please specify.....

.....  
 .....

19. Below are some of the management practices influencing sustainability of medicinal plant in Laikipia East District. Rate your level of agreement regarding below given management practices. Use a scale, where 1=To a very low extent, 2=To a low extent, 3=To a moderate extent, 4=To a great extent and 5=To a very great extent

Management practice.	1	2	3	4	5
Awareness, training and extension services.					
Stakeholders/community participation					
Tree nursery establishment					
Re-forestation					
Agro-forestry.					

Conservation plan/strategic plans development.					
Fire management.					
Policy development /law enactment and enforcement.					

20. Recommend on any other way(s) in which you think it is prudent for the management of medicinal plants in Laikipia East District sustainably?

.....

.....

.....

**Thank You for your Participation.**



### APPENDIX 3: QUESTIONNAIRE FOR HERBAL MEDICINE USERS

Instructions: **Please read the questions carefully and correctly fill in the blank spaces and tick the boxes provided in each section.**

#### Section A: Demographic Information

1. What is your gender?                      Male                                            Female
2. Which is your age bracket?  
20-35 years        36-50 years        51-65 years        Over 66 years    .

#### Section B: Socioeconomic factors influencing medicinal plants.

3. Which is your marital status?  
Married        Single        Divorced
4. What is your highest level of education?  
Primary school  Secondary school  Certificate  Diploma  None
5. How many years have you been using herbal medicine?  
1-10                       11-20                       21-30                       over 30
6. How did you learn about the use of herbal medicine?  
Parents     Friend     Self     others (specify).....
7. Which disease(s) do you always go for treatment? (You can tick more than one).  
Indigestion/Stomachache  Headache  Malaria  Carcinogenic  Venereal   
Others  
(specify).....

8. a) Do you pay any money to be given herbal medicine?

Yes [ ] No [ ]

8. b) If yes in above please give an approximate amount you normally pay?.....

9. a) Do your community members value the use of herbal medicine?

Yes [ ] No [ ]

9. b) If yes (above) please who other family members you are aware of to be using herbal medicines?

Spouse(s) [ ] Children [ ] Parents [ ] others  
(specify).....

10. According to your own understanding how would you rate the below statements regarding socioeconomic factors influencing sustainability of medicinal plants in Laikipia East. Use a scale 1-5, where 1- strongly disagree, 2- disagree, 3- moderate, 4- agree and 5- strongly agree

Statement.	1	2	3	4	5
Herbalists earn a living from herbal medicine.					
It costs one some money to access use herbal medicine.					
Herbal medicine enhances one's interaction with other people					
Community perceptions affect the use of herbal medicine.					
Herbal medicines are affordable to everyone at any time.					
Herbal medicine satisfies one after use.					

**Section C: Environmental factors influencing medicinal plants.**

11. Which parts of the plant you are given as herbal medicine? (You can tick more than one)

Roots [ ]    Branches [ ]    Leaves [ ]    Bark [ ]    Juice extract [ ]

Others

(specify).....

12. How often do you go to herbalist for re-stocking of your herbal medicine in a month?

1-5 [ ]    6-10 [ ]    11-15 [ ]    When sick [ ]    Don't Know [ ]

13. The following are some of the environmental factors influencing sustainability of medicinal plants. Rate their extent of threat to medicinal plants in Laikipia East District. Use a scale 1-5, where 1= To a very low extent, 2= To a low extent, 3=To a moderate extent, 4=To a great extent and 5=To a very great extent.

Statement.	1	2	3	4	5
Fire outbreak in places where medicinal plants are found.					
Poor harvesting methods of medicinal plants.					
Drought effects on medicinal plants.					
Diseases affecting medicinal plants.					
Illegal logging of medicinal plants.					
Illegal entry to protected areas to harvest medicinal plants.					
Lack of laws and regulations enforcement					
Lack of conservation plans/strategic plans.					

14. Are you aware of any other challenge? (Specify)

.....  
 .....  
 .....

**Section D: Management factors influencing medicinal plants.**

15 a) Are you aware of any organization put in place to deal with utilization of medicinal plants?

Yes [ ] No [ ]

15 b) If yes in (above)

specify.....  
 .....  
 .....

16 a) Have you engaged yourself in any management of the medicinal plants?

Yes [ ] No [ ]

16 b) If yes in above please (specify)

.....  
 .....  
 .....

17. Below are the management practices influencing sustainability of medicinal plant in Laikipia East District? Rate your level of agreement regarding below given management practices. Use a scale, where 1=To a very low extent, 2=To a low extent, 3= To a moderate extent, 4=To a great extent and 5=To a very great extent

Management practice.	1	2	3	4	5
Awareness, training and extension services.					
Stakeholders participation					
Tree nursery establishment					

Re-forestation					
Agro forestry					
Conservation plan/strategic plans/development plans.					
Fire management					
Policy development /law enactment and enforcement					

18. Recommend on any other way(s) in which you think it is prudent for the management of medicinal plants in Laikipia East District sustainably?

.....

.....

.....

**Thank You for your Participation.**

## **APPENDIX 4: INTERVIEW GUIDE FOR THE GOVERNMENT OFFICERS**

### **Section A: About the respondent.**

1. Please start by telling me your name, designation and the organization you work for?

### **Section B: Socioeconomic factors influencing sustainability of medicinal plants.**

2. In your own opinion do you support the use of the plant medicine?

3. Where do herbalists obtain these herbal medicines from?

4. Do herbalist pay any amount to access herbal medicine? If yes how much?

5. In your own opinion do you think herbalists earn a living through this practice of herbal medicine?

6. Do community members have faith in using this herbal medicine?

### **Section C: Environmental factors influencing medicinal plants.**

7. What are the major environmental factors faced with sustainability of medicinal plants?

8. Is there any government institution charged with the responsibility of managing environmental challenges facing medicinal plants? If yes name them?

9. What is your own opinion concerning the challenges facing medicinal plants?

### **Section D: Management factors influencing medicinal plants.**

10. Is there any management measures undertaken to curb environmental challenges facing medicinal plants?

11. In your own opinion do you see any future for sustainability of medicinal plants? If yes how?

**APPENDIX 5: COMMON MEDICINAL PLANTS IN LAIKIPIA EAST DISTRICT.**

<b>Plant name</b>	<b>Plant part</b>	<b>Medicinal use.</b>
<i>Acacia elatior</i> River acacia(English) Ol-lerai(Maasai)	Bark	Diarrhoea Cough
<i>Acacia gerrardii</i> Gerald's acacia Ol-debbei (Maasai)	Bark	Sore throats Coughs
<i>Acacia Kirkii</i> Kirk's acacia Ol-lerai (Masaai)	Roots	Stomach ailments
<i>Acacia lahai tepesi</i> Red thorn acacia Ol-tepessi (Maasai) Mugaa (Kikuyu)	Bark	Skin eruptions in children. Clear toxemia during pregnancy
<i>Acacia nilotica</i> Egytian thorn acacia Ol-kiloriti(Maasai)	Bark,leaves and roors	Coughs, Sore throat. Chest pains or pneumonia Indigestion and stomach trouble Gonorrhea and impotence
<i>Acacia seyal</i> White thorn	Bark Gum	Colds Dysentery Stomachache
<i>Acacia xanthophloea</i> Yellow barked acacia (English) Ol-lerai (Masaai) Murera (kikuyu)	Bark	Coughs Sore throat
<i>Acokanthera oppositifolia</i> Poison arrow tree Ol-morijoi (maasai) Mururu (kikuyu)	Roots Leaves	Syphilis Headache Snake bite Abdominal pain
<i>Acokanthera schimperi</i> Arrow poison tree Murichu (kikuyu)	Roots	Syphilis
<i>Albizia amara</i> Bitter albizia	Bark	Wounds treatment Vomiting indictment
<i>Albilizia anthelmintica</i> White albizia Olmukutan- samburu	Roots	Gonorrhea Fever Sexual stimulant (women) Tapeworm treatment Malaria
<i>Albizia coriaria</i> Giant albizia	Roots Bark	Venereal diseases(gonorrhea) Sore eyes

		Malaria and Pain reliever
<i>Bersama abyssinica</i> Muthandi (kikuyu)	leaves	Colds dysentery Round worm Epilepsy ,Hemorrhoids and Wounds cleaning
<i>Bridelia mierantha</i> Black sweetberry Mukoigo(kikuyu)	Bark Roots	Stomach Tapeworm Diarrhoea (children) Headache
<i>Catha edulis</i> Miraa,khat Miraa (kikuyu,embu,meru)	Roots,stem bark leaves	Gonorrhea Reduce hunger and prevent sleep Malaria, Coughs, Flu and Stomach
<i>Cordia monoica</i> Sand paper tree Oseki maasai Muthigi kikuyu	Roots leaves	Vomiting Malaria (children) Placenta removal (women) Leprosy
<i>Craibia brownie</i> Hard peawood Mukubu(kikuyu)	Root	Stomach
<i>Croton megalocarpus</i> Croton Mukinduri(kikuyu)	Bark Leaves	Intestinal worms Whooping cough Chest pain
<i>Cussonia holstii</i> Cabbage tree Muroha (kikuyu)	Bark	Uterus cleaning after birth
<i>Cussonia spicata</i> Cabbage tree, elephant's toothbrush Mwenyiere(kikuyu)	Leaves	Indigestion.
<i>Dorubeya goetzenii</i> Forest dombeya Mukeu (kikuyu)	Leaves	Indigestion
<i>Doryalis abyssinica</i> Abyssinian gooseberry Muirungi(kikuyu) Ol-morogi(maasai)	Leaves	Indigestion
<i>Dracaena steudneri</i> Steudners dracaena Muthari (kikuyu)	Stem bark	Hepatic liver disease
<i>Ekebergia capensis</i> Dog plum Mununga (kikuyu)	Leaf Bark Roots	Intestinal worms(Hookworm and tapeworms) Dysentery Heart burn, Headache and Skin rashes
<i>Elaeodendnen buchananii</i> Moth tree	Bark	Diarrhoea



Mutunga (kikuyu)		
<i>Ensete ventricosum</i> Wild banana	Stem leaves	Liver problem Hepatic diseases
<i>Euclea divinomm</i> Euclea Mukinyai (kikuyu)	Bark roots Bark	Headaches Toothaches Appetizer
<i>Ficus natalensis</i> Bark cloth fig Mugumo(kikuyu)	Bark	Influenza Induce lactation
<i>Ficus sur</i> Cape fig Mukuyu(kikuyu) Ol-ngaboli(maasai)	Bark Sap brunches Roots	Stomachache Diarrhea Foot ache coughs
<i>Ficus sycomorus</i> Sycamore fig Mukuyu(kikuyu) Ol-gnagboli(maasai)	Roots bark	Abdominal pain Stomach disorders
<i>Ficus thonningii</i> Wild fig strangler fig mugumo (kikuyu) oretiti (maasai)	Roots bark	Induce lactation influenza
<i>Hagenia abyssinica</i> Hagenia Muthithiku (kikuyu)	Flower heads Bark	Intestinal worms (tape worm) Diarrhoea and Stomach ache Induce abortion.
<i>Ilex mitis</i> African holly Muthumura (kikuyu)	Bark	Stomach ache Coughs Bilharzia
<i>Juniperus procera</i> African pencil ceda Mutarakwa(kikuyu)	Twigs and buds	Intestinal worms
<i>Macaranga kilimandscharica</i> Macaranga Mukuhakuha (kikuyu)	Leaves Roots	Stomachache Coughs Bilharzia
<i>Maesa lanceolata</i> Maesa Mundume (kikuyu)	Fruits Root Fruits	Sore throat and cholera and Tape worm expelling Abdominal pain and Stomach ailment (children)
<i>Markhamia lutea</i> Markhamia Muho (kikuyu)	Leaves Bark	Snake bite Syphilis Tooth ache
<i>Newtonia buchanani</i> Newtonia	Roots	Intestinal worms removal

Mukui (kikuyu)		
<i>Ocotea usambarensis</i> Camphor tree Muthaiti(kikuyu)	Bark Roots	Whooping cough Bronchitis ,Stomach pain Headaches, Back ache, and Malaria.
<i>Olea europaea</i> Wild-olive Mutamaiyu(kikuyu)	Bark	Tape worm Itchy rashes
<i>Oncoba routledgei</i> Fried eggs tree	Roots	Headache
<i>Piltosporum viridiflorum</i> Pittosporum ,cheese wood. Munyamati (kikuyu)	Bark	Emetic and Chest complaints Malaria. Confer strength
<i>Sapium ellipticum</i> Milk tree Muthathi (kikuyu)	Roots	Coughs
<i>Syzygium cordatum</i> Water berry , red berry Mkukoe (kikuyu)	Bark and roots Leaves	Stomachache Indigestion Diarrhoea
<i>Tunaea robusta</i> Honey suckle tree Muringa (kikuyu) Ol-burobinik (maasai)	Leaves	Antidote to general poisoning Diarrhoea Stomachache
<i>Vepris simplicifolia</i> Teclea Manderendu (kikuyu) Olgelai(maasai)	Bark	Malaria Hepatitis
<i>Vitex doniana</i> Black plam , vitex Muhuru(kikuyu)	Roots leaves	Back ache Eye infection
<i>Warburgia ugandensis</i> East African green heart Muthiga (kikuyu) Ol- msogoni (maasai)	Bark leaves	Stoma ache and Tooth ache Fever and Cold Malaria Muscular pains