

**CONSERVATION, PHENOLOGY AND ETHNOBOTANY
OF SOME LOWLAND SPECIES OF THE GENUS
SANSEVIERIA THUNB: CASE OF TAITA –
TAVETA AND MALINDI DISTRICTS,
KENYA //**

BY

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*Conservation,
phenology and*



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DECLARATION

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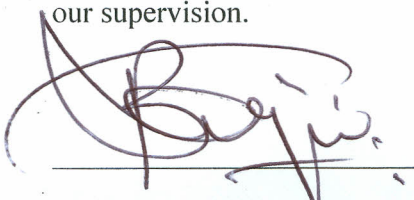
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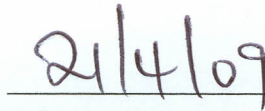
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DECLARATION BY SUPERVISORS

We confirm that the work reported in this thesis was carried out by the candidate under our supervision.



Prof. James B. Kung'u

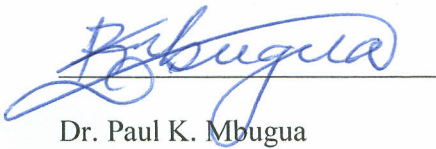


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DEDICATION

To my loving wife, and to my Children: Calvin, Caron, Darlene and Sanford.

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LIST OF ABBREVIATIONS

NGO -	Non – Governmental Organisation
ASAL –	Arid and Semi-Arid Lands
PGR –	Plant Genetic Resources
SPSS -	Statistical Package for Social Sciences (t - test)
UN -	United Nations

DEFINITION OF OPERATIONAL TERMS AND CONCEPTS

Terms related to this study are defined below:

Indigenous plants – Refers to natural plants originating from the study area.

Niche – Profession or functional role of an organism in the community where it occurs (Ecosystem).

Phenology – The study of the time of appearance of characteristic periodic phenomena in the life cycle of organisms in nature, for example, flowering or leaf fall, especially as influenced by environmental factors.

Socio-cultural value – Concerned with human beliefs, taboos, tastes and manners.

ABSTRACT

Many world governments, NGO's and researchers have raised concern on the sustainable utilisation of indigenous plants. It is against this background that this study was undertaken to try and establish the current phenological patterns, ethnobotany, threats to conservation and possible conservation measures of selected lowland *Sansevieria* plants in Taita Taveta and Malindi districts, Kenya. The genus *Sansevieria* Thunb, has about 19 recognised species in Kenya of which 8 are endemic. The species are fast disappearing hence becoming endangered since they grow in marginal areas, which are experiencing serious problems of overgrazing, climatic change, increasing human population and depletion of natural resources. Systematic sampling was used in selecting quadrats for phenological observations. Cluster sampling was used to select regions for studies on uses and conservation of *Sansevieria* plants. Structured interviews, questionnaires, direct observations, measurements and Focussed Group Discussions were used to collect data. Data was analysed using MANN-WHITNEY (U) ranking test and presented in frequencies, percentages, tables and graphs at a 0.05 level of significance. The study revealed that lowland *Sansevieria* plants have clear phenological patterns as exhibited in their leaf growth, budding, flowering, fruiting and seeding. It was also noted that communities living in rangelands use the plants for social-economic and cultural values such as weaving, medicine, fencing, fodder and keeping a way evil spirits. Wild animals, on the other hand, consume the succulent plants. As a result, there has been a considerable reduction in the cover status of these indigenous plants. The results also indicate existing poor management of indigenous plants, mainly due to failure in the enforcement of the already set down regulations on conservation. The lowland *Sansevieria* plants have been highly degraded due to destruction of its habitat by both man and wildlife. It is likely that efforts at the national or local level can save the rangelands even though pressures behind its accelerated destruction continue to intensify. Timely grass root action by fully involving the community can help preserve the indigenous *Sansevieria* plants for future generations and this will provide a model for community-based rangelands conservation in other areas of Kenya. The study calls for a well co-ordinated multi-use conservation and management strategy involving the participation of all stakeholders. There is also need to harmonise different conservation strategies so as to avoid conflicts and duplication of duties. These results will be used by the community, policy makers, development agencies, conservationists, ethnobotanists and anthropologists in effective use and conservation of indigenous lowland *Sansevieria* plants. The findings will enhance knowledge on the use of indigenous *Sansevieria* plants by providing a baseline data for pharmaceutical prospecting.

CHAPTER ONE

INTRODUCTION

1.1 Background Information

The genus *Sansevieria* Thunb is chiefly confined to Africa and the islands near its coast and Arabia (Brown, 1915). Nearly all the species are congregated in the tropical area of the continent as only a few occur in South Africa, and none is found in the northern extra – tropical region. Few species are reported from Sri Lanka, India, Myanmar and China (Brown, 1915). The genus has 50 – 60 species (Perseglove, 1972) world wide.

Sansevieria is mostly a tropical genus of great importance to rural Kenyan communities (Anonymous, 1907). In Kenya 19 species are recognised of which eight are endemic and are found from the sea level to about 1600m above sea level. The plants are fast disappearing hence becoming endangered since they grow only in marginal areas. It has been reported that *Sansevieria* species have been used at local levels for centuries (Brown, 1915; Watt and Breyer- Brandwijk, 1962). The leaves of this plant have been used to treat toothache, earaches and ulcers amongst other diseases (Watt and Breyer Brandwijk, 1962; Kokwaro, 1993). These plants are facing a threat from wild harvesting and from destruction by domestic animals such as goats.

Kenya has the great distinction of having in its expanse abundance and variety of *Sansevieria* possibly unequalled in any other country in the world. Both the number of plants, with their agglomeration in large stretches and the number of species with such varied appearance, makes the country a paradise for *Sansevieria* fanciers. Regrettably, the cultivation of the land along with the human overpopulation of extensive areas has caused the loss of the type localities of several plants. Some of these plants may have to be typified with new type localities (Chahinian, 1994).

The potentiality of *Sansevieria* as a crop has been recognised since early times. Africans have harvested the plant in the wild and the fibre used for making coarse fabrics, fishnets and bowstring for a long time (Perseglove, 1972). During the early part of the last century, various attempts were made to harvest extensive acreages of wild growth in Africa but without commercial success (Wiggles, 1931). The peoples of India and Sri Lanka are reported to have cultivated *Sansevieria zeylanica* wild for local export (Royal, 1987).

The individual species of *Sansevieria* show an extremely wide variation in growth, form and habitat. For example, *S. fischeri*, N.E. Br. which grows in the arid plateaux of Central Africa, has a solitary cylindrical leaf of 2 – 3 m in height, as compared to a species like *S. parva*, N.E. Br. which has about 20 short lanceolate leaves in a tuft and grows in more humid regions. These variations in botanical structure affect the yield of fibre and the cultural characteristics of the plant.

In order to harness the use of Plant Genetic Resources (PGR), it is very important to know as much as possible about these plants. For *Sansevieria* species, data are incomplete in their phenology and ethnobotany (Anonymous, 1951; Bally, 1937; Agnew and Agnew, 1994; Mbugua, 1995). The study was aimed at investigating various aspects of four *Sansevieria* taxa namely *S. arborescens* Cornu ex Gerone and Labroy, *S. volkensii* Gurke, *S. powelli* N.E.Br. and *S. robusta* N.E.Br., in their natural habitats.

1.2 Statement of the Research Problem and Justification

Besides being useful ornamental plants (Brown, 1915; Chahinian 1994 – 1996; Pfennig, 1997), most of the *Sansevieria* species are important for their leaf fibres which are used for fine matting, rope or cordage, hats, bowstrings and articles of clothing (Dodge, 1893; Anonymous, 1907; Biswas, 1935; Crane and Alonso, 1945; Byron, 1951; Joyner *et al.*, 1951; Turrill 1959;). The utilisation of *Sansevieria* as fibre plants tends to overshadow the many uses in which these plants are put medicinally. The medicinal uses range from uses of the leaf concoction for the treatment of ear-aches, stomach-aches, tooth-aches, wounds, ulcers, haemorrhoids and expelling worms (Watt and Breyer – Brandwijk, 1962; and Kokwaro, 1993). These accounts, however, do not state which specific species, what parts and how those parts are used in any of the above ailments – an aspect that was investigated through herbarium specimens and field interviews during this study.

In order to carry out comprehensive conservation strategies for the *Sansevieria* plants, phenology has to be carefully documented, that is, when the *Sansevieria* plants vegetate, flower, fruit, what are the agents of dispersal, longevity of flower buds and fruits on the plants. Preliminary data indicate that some species flower around October, but how long the fruits take to mature is not known. This information is needed in biomedical studies of these plants, e.g. when to visit the wild populations to collect the flowers and fruits.

1.3 Research Questions

The study was guided by the following questions: -

1. What is the phenology of the *Sansevieria* species?
2. Which are the local uses of *S. robusta*, *S. powelli*, *S. volkensii* and *S. arborescens* by communities in Kenya?
3. What are the key threats to conservation of the *Sansevieria* species in Kenya?
4. Which are some of the possible avenues of enhancing conservation of *Sansevieria*?

1.4 Research Objectives

The broad objective of this study is to fill the gap of information on the phenology, ethnobotany and conservation status of *Sansevieria* taxa in Kenya but more specifically the research tried to:

1. Study the phenological patterns of the lowland *Sansevieria* species.
2. Come up with a detailed account on uses of *S. robusta*, *S. powelli*, *S. volkensii* and *S. arborescens*.
3. Investigate the major threats that hinder conservation of *Sansevieria* in their natural environment.
4. Determine possible avenues of enhancing conservation of the lowland *Sansevieria* species

1.5 Research Rationale

The findings of this research can be a major contribution to the Arid and Semi-Arid Lands (ASAL) conservation and management of the diminishing arable lands resulting from over grazing, increasing human population and subsequent depletion of natural resources. This study also singled out the four species of *Sansevieria* as needing urgent conservation measures. *Sansevieria* species are of great importance to the local communities who use them for, weaving, tying, fencing and for obtaining medicinal extracts, the extent, and weight of their economic use is however not yet known in Kenya.

Conservation status of the four *Sansevieria* taxa can help the decision makers such as Rangeland Managers in setting aside areas of great importance in Plant Genetic Resources Conservation. This can also serve as a tool in guiding the local communities, foresters and flora conservationists in knowing which areas to give priority in conservation measures. *Sansevieria* species can also be regarded as indicator species, with their conservation status reflecting the success or failure of the overall conservation measures being undertaken where they dominate or occur.

Phenological information can help plant enthusiasts and professionals when they need to collect specific plant products and plant organs such as fruits, young or old leaves, flowers and rhizomes. They can also be able to decide the particular month or approximate days of the year to collect whatever products they require from a specific taxa.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

2.1 The Relevance of Traditional Medicine

The degeneration of aboriginal knowledge of the biodynamism of plants has led certain specialists recently to assert that there is little or no correlation between native uses of medicinal plants and the chemistry of these species (Khalil, 1996). This view point is shared by the history of some of the most recently discovered drugs that have come originally from the plant kingdom – the so called “wonder drugs” of the past half century.

These numerous ‘wonder drugs’ that have revolutionised modern medical practices have almost all been initially isolated from plants employed for one purpose or another in primitive or ancient societies; the curative alkaloids, penicillin and other antibiotics; cortisone; reserpine; vincolencoblastine; the *Veratrum* alkaloids; podophyllotoxin; straphanthine and other new therapeutic agents (Schultes and Swain, 1976). This spirit of denigration is not supported by chemical and pharmacological studies of numerous native drug plants currently under investigation.

A statistical study of empirical medicine amongst the Aztecs indicates that their medicinal plants appear to be effective when judged by native standards. Of the 25 plants evaluated, 16 are known chemically to be able to produce the results claimed by the Aztecs; four could possibly be active, whereas five – only 20 per cent – seem not to be able to produce the effects attributed to them by the Indians (Ortiz de Montellano, 1975).

While magic and religion played an important role in Aztec medical practices, there did exist a real empirical basis, which has often been ridiculed or ignored.

A very recent ethnopharmacological study of *Buddleja* a loganiaceous genus of 100 species from the tropics and sub-tropics of both hemispheres, has found a high degree of correlation between the wide variety of uses in traditional medicine and what is known may be cited amongst the few groups of plants that have to date been ethnobotanically studied.

We can no longer afford to ignore reports of any aboriginal use of a plant merely because they seem to fall beyond the limits of our credence. To do so would be tantamount to the closing of a door forever to entomb a peculiar kind of native knowledge; this might lead us along paths of immeasurable progress (Khalil, 1996).

2.2 Native Biodynamic Uses of Plants

One of the best examples perhaps, is the hallucinogenic drink variously called *ayahuasca*, *caapc*, *natema* or *yaje* in western Amazon. It is prepared from the bark of two species of lianas of the malpighiaceae genus *Banisteriopsis*, *B. Caapi* (Spruce ex Griseb.) Morton and *B. inebrians* Morton (Schultes, 1972). This bark contains B-carboline alkaloids – hermine, harmaline and tetrahydroharmine – capable of inducing visions, usually in blues, greys, or purples. To increase the intensity and duration of the intoxication, however, the Amerindian natives, especially those in Columbia, Ecuador and Peru, sometimes add the leaves of another liana of the same family, *Diploteris cabrerana* (Cuatr.), Gates (syn. *Banisteriopsis rusbyama* Ndz.) Morton, or the leaves of a bush belonging to the Rubiaceae, *Psychotria viridis* Ruiz and Pav. From both of these other types of psychoactive alkaloids, the tryptamines have been isolated (Der

Merdenosian, *et. al.*, 1968). Tryptamines are inactive in the mammalian body, unless a constituent protects them with monoamine oxidase inhibitory activity (McKenna, *et. al.*, 1984).

2.3 Uses of *Sansevieria* Species

The genus *Sansevieria* is important from the economical point of view for the numerous fibre species, which it comprises (Gerome and Labroy, 1903). Many species of the genus *Sansevieria* are largely cultivated in various parts of the tropics for their valuable fibre, which is an excellent quality in almost all, although varying with the species (Brown, 1915; Dyer, 1950 – 51; Burger, 1967; Purseglove, 1972; Lind and Morrison, 1974; Edwards, 1976). The fibre is known for its fineness, elasticity and for strength (Brown 1887). Leaves of *Sansevieria* contain 1.5 – 3% fibre, which ranges from 0.3 – 1.8 m in length, depending on the species (Purseglove, 1972). The fibres are used locally for making ropes of different sorts, nets, sails and sometimes paper (Ushers, 1971).

In Africa, the string is used for bows hence the name bowstring hemp is used as a common name for *Sansevieria* (Purseglove, 1972). The flat leaved species are sometimes called mother-in-law's tongue because of their sharp points. Various attempts have been made from time to time to produce fibre commercially from *Sansevieria* species as a substitute for sisal; both from wild stands and under cultivation, but these have never been successful. Yields obtained from the most commonly met species vary from 560 – 2250 kg of fibre per hectare (Purseglove, 1972).

Most of the fibre used in Kenya is obtained from the wild plants (*Sansevieria* and dome palm) or as a by-product from cultivated plants known as "Enset" (*Ensete ventricosum* Welw.). *Sansevieria* and dome palm fibre are harvested in their natural growing areas

and the only cultivated fibre plant is sisal. Nearly two million bags are manufactured from these fibres, but another two million bags are imported yearly, mainly from India. Of the species known, *S. ehrenbergii* is harvested in the largest quantity, followed by *S. forskaoliana*, which is easier to handle. The fibre is obtained with a decorticator with a large supply of water for scraping and brushing. Since the beginning of 21st century, several traders have tried to harvest the wild *Sansevieria* plants. However, they did not have any success. This was because the harvesting areas were too extensive while the decorticating equipment they were using was not transportable or because their transportable equipment failed technically or through lack of water. The culture of *Sansevieria* in the British Empire is discussed freely by Goulding (1937), and Greenway (1941) discussed the fibre characteristics of wild species in British East Africa. They reported that the commercial exploitation of the wild fibre plants cut in the wild do not recover well. However, Crane and Alonso (1945) reported a yield of about 2500 kg of dry fibre per acre from 7 to 8 year old stands in Cuba. They found that the percentage of fibre in *Sansevieria thyrsoflora* increased with age and length of leaf.

Domestic animals, particularly goats, browse on young leaves while baboons, kudus and rhinoceros have been observed eating older leaves right down to the ground (Lind and Morrison, 1974; Edwards, 1976). Leaves of *Sansevieria* have also been reported as being thirst quencher for baboons, especially during dry periods of the year in Kenya (Newton and Mbugua, 1992). Jex-Blake (1948) noted that *S. forskaoliana* is a favourable food for rhinoceros and elephants that suck the green juice of the fibrous leaves and spits out the white fibres dry and clean.

Species of this genus are used as indoor as well as outdoor ornamental plants both in the tropics and temperate regions. In about 1910, a factory was set up at Voi, Kenya, for the

purpose of extracting fibres from the leaves of *Sansevieria*. But this was not a commercial success and was abandoned (Dyer, 1950 – 51) due to scarcity of raw materials.

Sansevieria fibres have at various times entered the cordage markets as substitutes. The fineness, strength, uniformity and quality of the fibres vary with the individual species and with the particular conditions of growth and preparation. Until a high quality standardised product can be offered in substantial quantities, the commercial market is likely to remain uncertain (Joyner *et. al.*, 1951).

2.4 Propagation of *Sansevieria* Species

Seeds, rhizomes, and leaf cuttings can propagate most species of *Sansevieria*. *S. trifasciata* (Chahinian, 1986) and *S. longiflora* readily produce seed, but *S. trifasciata*, *var. laurentii* rarely produces seed and no viable seeds have been obtained from *S. guineensis*. The necessity of gathering the seed by hand and the low yield per plant make it uneconomical to propagate *Sansevieria* in this manner. Vegetative cuttings must be used for commercial plantings (Joyner *et. al.*, 1951) – Plates 2.1 and 2.2.

When the rhizomes as well as the seed of *Sansevieria* species are planted, a juvenile rosette type of plant is usually produced. As this leaf matures, “character” or upright leaves develop. It is the upright leaf, which is valuable for its fibre. If leaf cuttings are planted instead of seed or rhizomes, the fibre plant is usually produced without going through the rosette stage. The more basal leaf cuttings do, however, produce some rosette plants and others that are volkensiiite between the rosette and fibre type (Joyner *et al.*, 1951).

The leaf cuttings of *Sansevieria* are highly polar and must be planted with the basal portion on the ground. If the tip is put in the ground, roots do not form. Rooting is normally slow and requires a considerable period of time, approximately, 3 weeks. Suitable hormone treatment to the roots may enhance a more rapid and prolific growth of *Sansevieria* cuttings.

Dodge (1893) reported on the propagation of *Sansevieria* and its potentiality as a fibre crop in Florida. He noted the ease with which the flat leaved species could be propagated by leaf and cuttings. *Sansevieria thyrsiflora* Thunb *S. guineensis* wild is reported to have about two percent fibres. Preliminary trials indicated that a good crop of leaves could be harvested every year after the stand was established. De Mola (1929) and Toro (1942) discussed the cultivation of *Sansevieria* in Yucatan, Mexico. They noted the method of propagation by leaf cuttings and rhizomes and the general characteristics of fibre species.



Plate 2.1: Vegetative propagation, *S. arborescens* at Kenyatta University green house



Plate 2.2: Vegetative propagation, *S. powelli* & *S. longiflora* at Kenyatta University green house

CHAPTER THREE

MATERIALS AND METHODS

3.0 Introduction

This chapter outlines the different methods used in carrying out the study. It also focuses on the nature and sources of data, population description, sample size, sampling methods and analysis.

3.1 The Study Area

3.1.1 Location, Extent and Physiographic Conditions

3.1.2 Taita- Taveta District: Maungu Study Site

The study area for *S. powelli*, *S. robusta* and *S. volkensii* was located at Marungu (Maungu) in Taita-Taveta District about 320 km from Nairobi along Nairobi-Mombasa Road. (Figure1). Taita-Taveta District borders Tana River, Kitui and Makueni Districts to the North, Kwale and Kilifi Districts to the East, Kajiado District to the Northwest and the Republic of Tanzania to the South and Southwest. The District lies between latitudes 2° 46' South and 4° 10' South, and longitudes 37° 36' East and 30° 14' East. The altitude of the District varies between 481m above sea level in the lowlands to 2,200 m above sea level on the highlands, giving two distinct climatic characteristics, with the hills experiencing lower temperatures (as low as 18.2° C) compared to the lower zones with an average mean temperature of 24.6° C (<http://www.Kenya food security, 2005>).

The district is dry, except for high catchment areas in the hills. The effect of the South-easterly winds influences the climate of the district. The hilly areas have ideal conditions for condensation of moisture, which results in relief rainfall. The district experiences

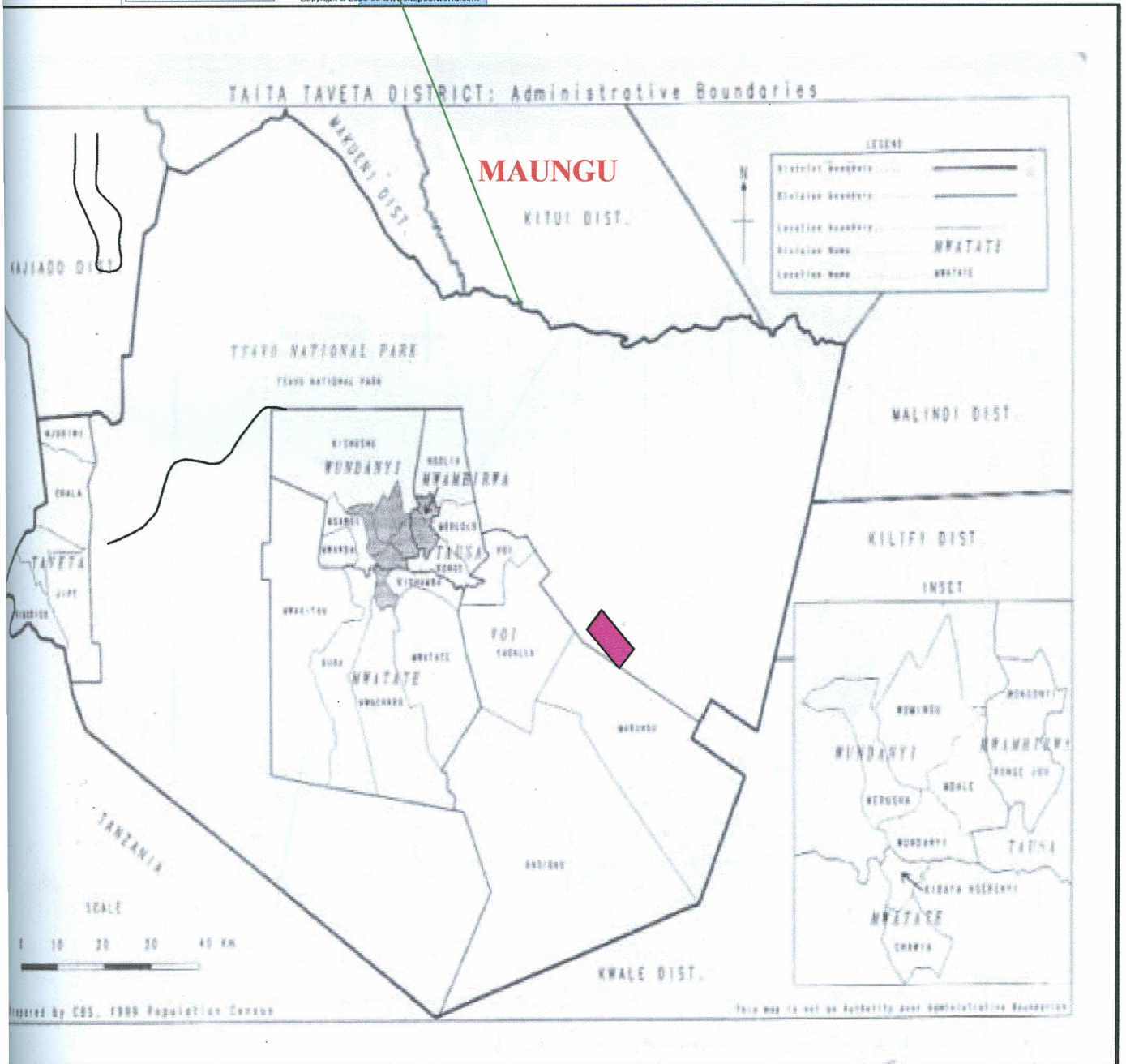
two rainy seasons: the long rains in the months of March to May and the short rains in November to December.

The rainfall distribution is uneven in the district, with the highlands receiving higher rainfall than the lowland areas. This, coupled with the cooler temperatures, makes the highlands more potential for the production of horticultural crops such as maize and beans. The lowland areas, which are mainly ASAL, are only suitable for a variety of ASAL activities such as ranching and sisal growing. Tsavo East and Tsavo West National Parks, home to various types of wild animals, occupy a large portion of the lowlands (<http://www.Kenya food security, 2005>).

3.1.3 Malindi District: Arabuko Sokoke Study Site

Sansevieria arborescens was studied in the expansive Arabuko Sokoke forest in Jilore area of Malindi District, about 150 km from Mombasa City (Figure 3.2). The District is one of the seven districts in Coast Province. It borders Kilifi District to the south, Tana River District to the north and Northwest and Indian Ocean to the east. It lies between latitude $2^{\circ} 20'$ and 4° South and longitude 39° and $14'$ east. The study area is characterised by low range sandstone hills of 130 m – 420 m above sea level where the cashew-nut / cassava zone is found. This is a major cropping zone with high and moderately fertile soils. Annual rainfall is 1,200 mm making it high potential for rain – fed agricultural crops (<http://www.Birdlife, 2009>).

Figure 3.1: Map of Kenya showing the study area
Area and Map Taita-Taveta District
showing Maungu study site.



LEGEND



Taita- Taveta District





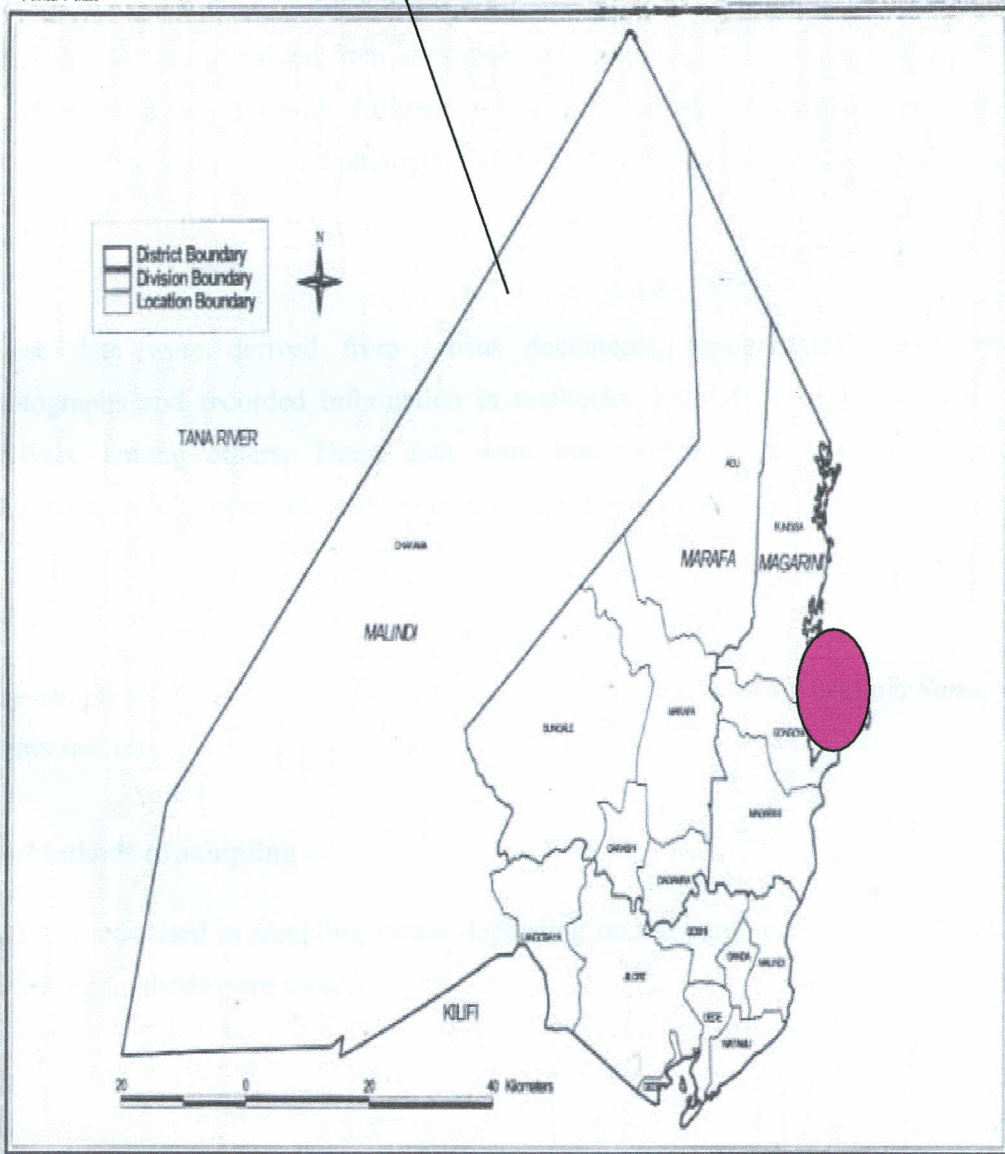
Maungu site



Figure 3.2: Map of Kenya showing the study area and Map of Malindi District showing the study site

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-  Arabuko Sokoke
-  Arabuko sokoke study site



The district has a monsoon type of climate with hot and humid conditions all the year round. It is hot and dry from January to April while June to August is the coolest period. Average annual temperature range from 22.3° C to 26.6° C in the coastal lowlands while the hinterland temperatures range from 30°C to 34° C. Average temperatures range is between 28° C to 32° C between January and March and lowest in July and August when temperatures range from 21° C in July to 24° C in August (<http://www.Birdlife>, 2009).

3.2.0 Nature and sources of data

Both primary and secondary data were collected in this study.

3.2.1 Primary data

These included data derived from questionnaires, interviews, observations, random field walks, workshops held with different user group members (herbalists, cordage users e.t.c.), fieldwork surveys and photographs taken.

3.2.2 Secondary data

These data were derived from census documents, topographical maps, ground photographs and recorded information in textbooks, journals, research reports, news analysis, among others. These data were important in studying the phenology, ethnobotany and conservation of lowland *Sansevieria* species.

3.3 Sample size

The sample size was 258 respondents who were actual users of the lowland *Sansevieria* plants species.

3.4 Methods of sampling

The methods used in sampling varied depending on the parameters studied. In all, the following methods were used: -

3.4.1 Systematic sampling

The transects were laid down through transect walk method. The quadrats were established along the transect lines at a distance of 20m from each other.

The sampling involved systematic selection of quadrats along transects lines. Simple random sampling was then used to select specific plants (marked) within the quadrat for phenological observations over a period of twelve months. The observations covered both reproductive and vegetative phases of plant development. Reproductive phase included timing for flowering onset, fruit onset and maturity for berries. Vegetative studies included monthly measurements of randomly selected young leaves for leaf length, leaf width and number of leaves. Similar observations were also carried out in the green house and Botanical Garden at Kenyatta University.

3.4.2 Cluster sampling

The sampling involved the selection of clusters (human settlement) that were based on plant communities of interest. This sampling was done for studies in uses and conservation of *Sansevieria* plants. The study was composed of three clusters, which represented regions namely: Arabuko-Sokoke, Mackinon Road and Maungu.

The clustering was to facilitate data collection and ease repeat visits when collecting information from respondents who may not have been present at the first visit or for supplementary questions and editing purposes (Deaton, 1997). Household units in different clusters were numbered after which systematic sampling was carried out. Eighty-six users in each cluster were interviewed. The desired sampling unit was taken as a household, which had its farm having, or neighbouring *Sansevieria* population.

3.5 Methods of data collection

The methods used in data collection varied depending on the variables studied. In all, the following methods were used:

3.5.1 Quadrat Placement Method

Transects were laid in each locality of *Sansevieria* population using Transect Walk Method after which quadrats were placed on each line transect at intervals of 10 metres in the study areas. The quadrat boundaries were marked using permanent Marker -pens.

3.5.2 Interviewing

Interviewing was carried out as outlined by Sekravan (1992). In this case, personal interviews were necessary to obtain the required information for the following reasons. First, most respondents had very little reading skills hence questions had to be read to them and interpreted in Kiswahili by a local person. Second, the interview was to allow the respondents identify the main agents they considered a threat to *Sansevieria* plants and therefore needed interpretation of questions. 258-guided personal interviews were carried out to obtain the required information.

3.5.3 Questionnaires

Questionnaires (Appendix1) were administered to gather information on the social, cultural and economic aspects of *Sansevieria* plants as well as on conservation issues. Questionnaires were administered to both literate and illiterate respondents and the information obtained were recorded.

3.5.4 Photograph Taking

Photographs (Plates) were taken to capture salient information about the study. These were later used in the text to support the discussions and to explain some facts about the study for example, nature of growth of the species, etc.

3.5.5 Workshops

Two workshops were held on February 24, 2004 and May 11, 2004 in Maungu, Taita-Taveta District, to collect more information on *Sansevieria* and 160 - 176 participants attended the workshops respectively. Both sexes were represented in the workshop.

3.5.6 Focus Group Discussions

During the second workshop, topical issues emerging from the interviews, questionnaires and direct observations by the researcher such as actual lengths of *Sansevieria* fibres and importance in brick making were discussed. Treatment dosages for *Sansevieria* juice were also discussed.

3.5.7 Direct observations

Direct observation was done throughout the research especially when there was new and unique biotic association with *Sansevieria* plants, e.g. *Sansevieria* plants growing on baobab trees.

3.5.8 Random walks

Much walking and climbing hills were done to reach remote and inaccessible homesteads to collect information and to avoid “homestead bias”. It was also used to find out new threats to conservation of *Sansevieria* species through estimation of percentage cover, Relative Abundance of Associating species, Height Class Structure and Dispersal agents.

3.6 Research instruments

Different instruments were used for the collection of particular type of data. For social, cultural, economic (use) data and conservation strategies, the interview schedules were used.

3.6.1 Interview Schedule

The interview schedule was developed in English for easy compilation of the study, and later, when in use, was orally administered in local language (Kiswahili). The interview schedules had three sections: the Demographic Section, which included information on

social-economic features such as age, gender, education, farm size and occupation. This was used to evaluate sample characteristics and relationships between demographic factors and use of different lowland *Sansevieria* plants. The second section focused on the Phenological Patterns of *Sansevieria* plants. The third section focused on conservation and conservation strategies of the *Sansevieria* plants.

3.7 Data analysis

Information on phenostages, cover estimates, associated species and species abundance was presented using percentages and tables. MANN-WHITNEY 'U' test was used to rank the various uses as generated from the questionnaires (Table 4.5).

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

The aim of this study was mainly to fill the gap of information on the phenology, ethnobotany and conservation status of *Sansevieria* taxa in lowland areas of Kenya. In view of this the techniques used to analyse growth and survey data were mainly geared towards this main goal and more so, suggest aspects that could be investigated further.

4.1 Phenology

4.1.1 Growth of leaves under different environments

The first objective of this study was to come up with the phenological patterns of *S. volkensii*, *S. powelli*, *S. robusta* and *S. arborescens*. This would assist in careful documentation on when the plants flower, fruit, agents of dispersal, longevity of flower buds and fruits on the plant. Growth of new leaves of different *Sansevieria* species under different growth environments over a period of twelve months was observed (Table 4.1).

Table 4.1: Growth of new leaves under different environmental conditions

<i>Sansevieria</i> species	Number of new leaves		
	Natural environment	Green house	Average growth rate
<i>S. arborescens</i>	7	8	7.5
<i>S. volkensii</i>	4	8	6
<i>S. powelli</i>	5	9	7
<i>S. robusta</i>	3	6	4.5

4.1.2 Floral Phenology of different *sansevieria* species

Observations of *Sansevieria* species flowering calendar, intensity colour of berries were done over a period of twelve months and the dates were recorded (Table 4.2).

Table 4.2: Flowering calendar and percentage for the lowland *sansevieria* species

Species of <i>sansevieria</i>	Month of flowering	% Flowering	Colour of flower	Colour of berries before ripening	Colour of berries after ripening
<i>S. volkensii</i>	Feb/March	60	Yellow	Green	Yellow
<i>S. robusta</i>	Feb/March	90	White	Green	Yellow
<i>S. powelli</i>	Feb/March	80	White	Green	Yellow
<i>S. arborescens</i>	April/May	70	Yellow	Green	Yellow

Flowering of most of the *Sansevieria* species were often heavy, especially during the onset of rains (Table 4.2). *S. volkensii* (Plate 4.1) produced heavy inflorescence with 60% of the plants in flower. Flowering for this species took place in the months of February and March (Table 4.2) after which the plant formed green berries which rarely reached maturity due to being eaten by birds. *S. robusta* (Plate 4.2) had the highest flowering percentage (90%) (Plate 4.3) in the months of February and March. It produced whitish flowers from its long inflorescence. This also applied to *S. powelli* (80% flower) (Table 4.2) and the two taxa produced green berries, which turned yellow upon maturity (Plate 4.3) attracting some birds, and within days the berries were eaten. This explains why it is often difficult to propagate lowland *Sansevieria* species through seeds. *S. arborescens* had 70% (Table 4.2) of its plants in flower during the months of April and May. The whitish flowers developed within three weeks to form green berries, which later turned yellow upon maturity and were equally eaten by birds.

Cross-pollination within and between the plants were probably done by the black desert ants, bees, moths and beetles which were found sucking nectar from the flowers. These agents were often encountered in almost all the species that were under investigation in the lowlands especially *S. powelli*. A similar finding was also reported by Newton (2004).

Plate 4.1: *S. volkensis* at flowering stage

Plate 4.2: *S. robusta* at flowering stage



Plate 4.1: *S. volkensis* at flowering stage

Plate 4.2: *S. robusta* at flowering stage



Plate 4.3: Green and Yellow berries of *S. powelli*

The viability of the seeds of *Sansevieria* taxa from lowland coastal areas of Kenya is yet to be studied. The unavailability of seeds germinating from the wild from these species could be explained by the danger ASAL ecosystems pose to these succulent berries, which upon production are eaten before seed form. This has confined the species propagation to rhizomes although birds also disperse them (Newton, 1994). This further explains why the species only appears in clusters within a given ecological region. The rhizomes develop slowly and their spread is limited by the low precipitation in these areas. Birds can disperse the berries, a phenomenon, which was recorded in Makindu area of Makueni District, Kenya, where a cluster of *Sansevieria* plants were patched on top of a baobab tree *Adansonia digitata* (Plate 4.4).



Plate 4.4: *Sansevieria* seeds dispersed by birds: Growing on *Adansonia digitata*

4.2 Uses of Lowland species of *Sansevieria*

The second objective of this study was to come up with a detailed account on uses of *S. volkensii*, *S. robusta*, *S. powelli* and *S. arborescens*. All the respondents' (258) interviewed could not differentiate morphologically, the difference between *S. robusta* and *S. powelli* due to their general similarities. Therefore in their responses they treated the two species as similar and used same vernacular name "madango" (Giriama) meaning the bigger *Sansevieria*, while "idango" (Taita) the smaller *Sansevieria* referred to *S. volkensii*. "Ikonge" (Taita) was the vernacular name for *S. arborescens*.

Lowland *Sansevieria* species have reportedly been used in cortege industries as substitutes. The fineness, strength, uniformity and quality of the fibres vary with the individual species and with particular conditions of growth and preparations (Joyner *et. al.*, 1951). Other reported uses of the species include food for wild animals, fencing, treatment for aches, fodder, ornamental, and boundary planting (Kokwaro,1993).

4.2.1 Gender and educational characteristics of the respondents

The respondents ages range between 21 – 40 years. The average age of the male respondents was 45 years while for female respondents was 35 years. Table 4.3 below indicates that 49.6% had no formal education.

Table 4.3: Respondents gender and educational level

Gender of respondents	% Educational level of respondents				
	Illiterate	Primary	Secondary	Tertiary	Total
Male	17.4	23.6	2.7	0	43.7
Female	32.2	21.7	2.4	0	56.3
Total	49.6	45.3	5.1	0	100

There were more female respondents (32.2%) with no formal education as compared to male respondents (17.4%). There were 45.3% of the respondents with primary education while only 5.1% had secondary education. None of the respondents had tertiary education. Of the respondents interviewed, 56.3% were females and 43.7% males. Gender separation was important in order to establish the role played by different sexes in conservation and dissemination of traditional knowledge, (Suda 1992).

4.2.2 Uses of *S. volkensis*, *S. robusta*, *S. powelli* and *S. arborescens*

Respondents were asked to indicate, in their own view, the uses of *Sansevieria* plants.

As shown on Table 4.4, majority of the respondents reported that *Sansevieria* species are food for wild animals while a smaller number reported using it as strings for both tying and weaving. The frequencies of the respondents (258) were as presented in Appendix 3.

Table 4.4: Descriptive analysis of uses of the four *Sansevieria* Species

Uses	<i>S. volkensis</i> %	<i>S. powelli/robusta</i> %	<i>S. arborescens</i> %	% average
Food for wild animals	29.1	35.7	18.6	27.8
Strings for tying	25.2	34.1	7.0	22.1
Fencing	23.3	28.7	10.5	20.83
Treatment of aches (ear, tooth, stomach-ache)	22.5	15.1	6.2	14
Treatment of poisonous bites/wounds	6.2	20.2	4.3	10
Keeping away evil spirits	5.0	7.8	15.5	9
Boundary planting	9.7	12.0	3.5	8
Fodder	9.7	12.0	2.7	8
Snakes scare	5.4	6.2	10.9	7
Ornamental	5.8	6.2	3.5	5
Treatment of poultry pests and diseases	3.9	8.5	2.3	4.9
Strings for weaving	4.3	3.1	4.7	4
Strings for both tying and weaving	1.2	1.2	4.7	2.36

The results in the above table (Table 4.4) was subjected to Mann-Whitney 'u' test for determination of the ranks (Table 4.5 and Appendix 2).

Table 4.5: Ranking using Mann -Whitney 'u' test

	Uses	Group A (Yes) scores	Ranking	Group B (No) scores	Ranking
1	Food for wildlife	215	20	43	5
2	String for tying	171	15	87	10
3	Fencing	161	14	97	11
4	Treatment ache (ear, tooth, stomach)	113	12	145	13
5	Treatment of poisonous bites & wounds	79	9	179	16
6	Keeping away evil spirit	73	8	185	17
7	Boundary planting	65	7	193	18
8	Fodder	63	6	195	19
9	Ornamental	40	4	218	21
10	Treatment of poultry pest & diseases	38	3	220	22
11	Strings for weaving	31	2	227	23
12	Strings both for tying & weaving	18	1	240	24

The results from the MANN U-TEST were as follows: -

$$\left. \begin{array}{l} \text{Calculated} \\ \text{'u' value} \end{array} \right\} = 23$$

$$\text{Tabulated 'U' at n 12} = 37$$

The scores from group A in table 4.5 have the values of 'u' being 23. Calculated 'U' from group A (23) was lower than the tabulated 'U' (37), indicating that the ranking in table 4.5 was significant.

The study rejects the null hypothesis and concludes that there is a significant difference between the two groups in respect to their user scores.

4.2.2.1 Uses of *sansevieria* as food for wild animals

Sansevieria species are mainly used as food for wild animals and are consumed by baboons, hippos, rhinos and squirrels in the wild. Table 4.4 shows that *S. powelli/robusta* (35.7%) are more preferred to *S. volkensii* (29.1%) and *S. arborescens* (18.6%). This is because *S. powelli/robusta* have more succulent rhizomes which contain more juice thus acting more as a thirst quencher than the other two species of *Sansevieria* (Plates 4.5a and 4.5b). During the dry season the lowland Coastal areas become very dry with almost all watering points drying up and the only alternative for these animals are the succulent rhizomes and the fleshy leaves of *Sansevieria* species. This finding confirms an earlier report by Newton and Mbugua (1992) that leaves of *S. volkensii* have also been used as thirst quencher by baboons during dry season. Smaller animals such as baboons chew the leaves to extract juice while the bigger ones (rhinos and elephants) chew the whole plant. Rodents and squirrels gnaw the plant parts.



Plate 4.5a: *Sansevieria* plant leaf gnawed by wild animals

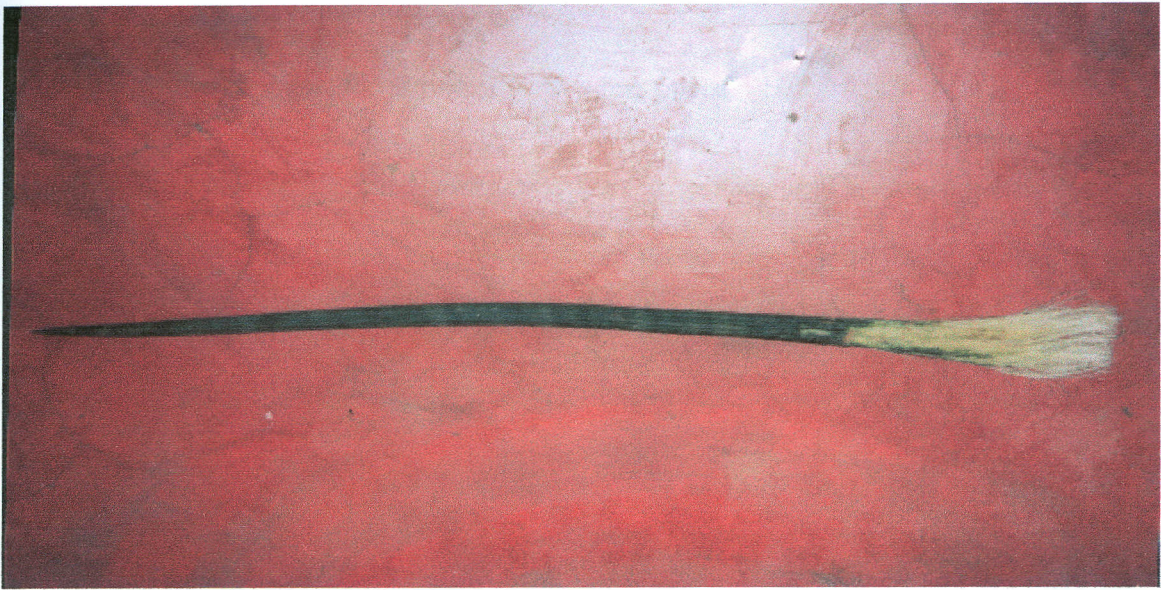


Plate 4.5b: Exposed *Sansevieria* fibre at leaf base by the baboons

4.2.2.2 Uses of *Sansevieria* plants as source of strings for tying

A good number of respondents interviewed (66.3%) reported splitting *Sansevieria* leaves to obtain strings (Table 4.4) and a relatively low proportion (33.7%) had no knowledge of the use of *Sansevieria* for strings. *Sansevieria powelli/robusta* were more preferred (34.1%) as a source of strings for tying as opposed to *S. arborescens* (7.0%). This is due to the fact that *S. powelli/robusta* has larger and stronger leaves which produce larger strings which are convenient for tying than the short leaves of *S. arborescens*. *S. volkensii* has average leaf length and was therefore preferred by 25.2% of the respondents. Watts (1962) reported similar findings.

4.2.2.3 Use of *Sansevieria* plants for fencing purposes

The data showed that live *Sansevieria* plants were being used for fencing as live hedges. The study showed that the most preferred *Sansevieria* plants as live hedge were *S. powelli/robusta* (Table 4.4). This was generally due to their long leaves and sharp prickles. *S. arborescens* were least preferred for fencing due to the fact that the plants are relatively smaller as compared to the rest under study. It was noted that these plants were normally planted as a buffer around farms in order to protect crops from destruction by wild animals. They also act as thirst quencher and food for the animals in the buffer zones as previously reported by Newton and Mbugua (1992).

4.2.2.4 Uses of *Sansevieria* plants for the treatment of ear, tooth and stomach ache.

The study established that *Sansevieria* species are used to treat aches (ear, tooth and stomach). However, this knowledge was normally confined to a few individuals who regarded it as a secret and could only use it for commercial purposes (Personal communication with the respondents). Conservative nature of traditional healers and medicine men makes dissemination of traditional knowledge quite difficult. *Sansevieria volkensii* had the highest frequency for being used to heal ear, tooth and stomach ache (Table 4.4). The respondents reported that the species leaves are boiled to extract the concoction for treatment of stomach-ache that normally results after birth in newly lactating mothers. Its concoction can also be extracted by squeezing and is used to treat ear-ache and tooth-ache. Similarly, the latter applies to *S. robusta/powellii* and *S. arborescens*. Some respondents (44%) interviewed knew the importance of *Sanseveiria* for the treatment for aches.

4.2.2.5 Uses of *Sansevieria* plant for the treatment of poisonous bites (snake bites)

and wounds

Sansevieria species juice could be used to treat poisonous bites and wounds. Unfortunately, the knowledge is possessed by very few people especially the elderly who view it as sacred and cannot be exchanged with monetary benefits (personal communication). Even in such cases they would only use the knowledge to treat the patient but not reveal the treatment procedures in its entirety. Wounds from cuts are mainly treated using *S. powelli/robusta* and *S. arborescens* while snake and scorpion bites are treated using *S. volkensis* juice (Table 4.4). The juice is extracted by squeezing or pounding depending on the stiffness of the leaves. The extracted fresh juice is generally rubbed or poured on the infected area (personal observation).

4.2.2.6 Uses of *Sansevieria* plant for keeping away evil spirits

Information on spirit underworld is normally secret and held by few individuals in any society. The knowledge is generally treated as classified material and meant to bring about certain mythical mysteries in day-to-day life. The myths could benefit the society as a whole or could at times spell doom to the disobedient. As such the donors of such mystics are normally regarded with awe and sanctity. *S. arborescens* is believed to invigorate pigeon pea growth in cases where the goddess of the earth refuses its cultivation (personal communication). The leaves of the species are normally placed in the crop field of pigeon pea after which the plant would vegetate heavily. It is believed that *S. arborescens* leaves atone the earth goddess who may have been unhappy for unknown reasons. *S. volkensis* and *S. powelli/robusta* is believed to grow well in sacred groves where the local people offer sacrifices to the ancestors. The *Sansevieria* species

are normally associated with ability to keep away bad omen, which would otherwise inflict harm to the society members (unpublished information from the respondents).

4.2.2.7 Uses of *Sansevieria* plant as boundary planting

Boundary planting compliments roles played by *Sansevieria* species as live hedge. Some respondents use the various species of *Sansevieria* as boundary markers on the farms in addition to acting as wild animal scare (Table 4.4). However, the use of *S. arborescens* is low here because of its size and the fact that it grows slowly.

4.2.2.8 Uses of *Sansevieria* plant as fodder

Some of the interviewees (24%) reported that *Sansevieria* species could be used as fodder. Of notable frequencies (12%) were *S. powelli/robusta* and *S. volkensii* (Table 4.4). This is attributed to their succulent rhizomes and fleshy leaves, which contain a lot of juice. It was reported that *Sansevieria* juice is salty and therefore compliments salt licks. These rhizomes and leaves are chopped and mixed with nappier grass or molasses and then fed to the animals directly for either milk or beef production. The species could also provide alternative feed to browsing animals like goats and sheep during dry seasons.

4.2.2.9 Uses of *Sansevieria* plant as snakes scare

Some respondents (22%) reported that *Sansevieria* species could be used to scare snakes. It was recorded that *S. arborescens* (10.9%) was most preferred as snakes scare (Table 4.4) due to its sharp pricks followed by *S. powelli*, *S. robusta* and *S. volkensii* in that order. This finding can enhance the conservation of the species if it could be planted along the coastal strip of Kenya.

4.2.2.10 Uses of *Sansevieria* plant as Ornamental

The study revealed that about 16% of the respondents use *Sansevieria* plants as indoor and outdoor ornamental plants (Table 4.4). They argued that *Sansevieria* plants clean the room of emitted polluted air and therefore help to create fresh air. The outdoor plants have been used to create scenic beauty, which is an opportunity for conservation. Kokwaro, (1993) reported similar findings.

4.2.2.11 Uses of *Sansevieria* plant for treatment of poultry pests and diseases

Fifteen percent of the respondents had knowledge that *Sansevieria* species are used to treat New Castle disease and flea attack in poultry. Interesting revelation was that *S. powelli/robusta* (Table 4.4) was so efficacious that it could clear pathogen and parasite infection in poultry within a couple of hours. *S. volkensii* and *S. arborescens* was reported also to treat poultry pests and diseases. This finding if exploited also will greatly enhance future conservation of the species.

4.2.2.12 Uses of *Sansevieria* plant as strings for weaving and tying.

Few respondents (7%) use *Sansevieria* for tying and weaving (Table 4.4). Those who use the fibre for weaving reported that the products had fine weave which never caused wearing out of linen.

4.3 Conservation threats to lowland *Sansevieria* species

Lowland *Sansevieria* plants have been threatened by wild animals, which use their succulent leaves and rhizomes to quench thirst (Newton, 1994). The plants are disappearing and therefore there is need to conserve them. The third objective of the

study was to investigate the major threats that hinder conservation of lowland *Sansevieria* in their natural environment. The study noted that indeed the population of *Sansevieria* had been decreasing over the years (Walter, 1995).

The abundance of the various species as shown in Table 4.6 reveal that a number of plant species associate with the lowland *Sansevieria* species. *Acalypha fruticosa* associate (19.3%) with the *S. volkensisii*, while *Eurphorbia nyikae* commonly grow in association with *S. robusta*, *S. powelli* and *S. arborescens* (19.1%, 19.1% and 22.6% respectively). These species are major indicators of availability of *Sansevieria* species in their localities. The disappearance of these indicator species implies that the *Sansevieria* species are also disappearing since they grow under the shade of the indicators (personal observation). It was observed that *Sansevieria* plants grow better under shade of these species than in the open.

Table 4.6: Percentage Abundance of Major Associating Species

Associating species	% Association with <i>Sansevieria</i> species			
	<i>S. volkensisii</i>	<i>S. robusta</i>	<i>S. powelli</i>	<i>S. arborescens</i>
<i>Euphorbia nyikae</i>	5.3	19.1	19.1	22.6
<i>Terminalia spinosa</i>	10.5	8	8	17.7
<i>Euphorbia nyikae</i>	5.6	9.9	9.9	6.9
<i>Fluggia virosa</i>	15.8	14.9	14.9	13
<i>Givotia gosai</i>	5.2	9.7	9.7	4.8
<i>Combretum spp</i>	8.2	1.3	1.3	0
<i>Acacia nilotica</i>	1.7	5	5	6.6
<i>Aloe spp.</i>	1.7	1.8	1.8	2.7
<i>Cissurs quadrangularis</i>	14.5	14.7	14.7	15.5
<i>Euphorbia cryptospinosa</i>	12.2	7.2	7.2	7.8
<i>Acalypha fruticosa</i>	19.3	8.4	8.4	2.4

Conservation threats to lowland *Sansevieria* plants were also elicited by the *Sansevieria* species composition and cover estimate (Table 4.7). These percentages were arrived at

after categorisation of young medium and mature plants, basing on height. Percentage of each category was computed out of the total population.

Table 4.7: Composition and Cover Estimate of *Sansevieria* species

<i>Sansevieria</i> Species	Species composition (%)			Cover Estimate % of the total population
	Young plants	Medium plants	Mature plants	
<i>Sansevieria volkensii</i>	7	30	63	13
<i>Sansevieria powellii</i>	11	25	64	12
<i>Sansevieria robusta</i>	9	38	53	12
<i>Sansevieria arborescens</i>	19	29	52	14
Average cover estimate for the <i>sansevieria</i> species				12.75

Table 4.7 shows that there are very few young *Sansevieria* plants while mature plants are the majority. Medium plants are the volkensiite in all the species. This scenario presents a threat to the lowland *Sansevieria* species in that at one given time, the species would undergo extinction since there would be no recruitment of new individuals taking place; that is, when mature plants die, there would be no young ones to replace them.

Percentage cover estimate (Table 4.7) is relatively low for all the four *Sansevieria* plants under study. The low percentage cover indicates that the species are under great threat in their locality and may soon be wiped out. This is a serious state of affairs for the lowland species of *Sansevieria*. During the study certain major agents were cited by participants as major threats to conservation of lowland *Sansevieria* plants (Table 4.8).

Table 4.8: Major threats to conservation of *Sansevieria*

Threats	Frequency (Respondents)	Percentage (%)
Destruction by both man and wildlife	130	50.5
Destruction by wildlife	92	35.6
Destruction by man	36	13.9
Total	258	100

4.3.1 Destruction by wildlife

During the study it was found out that (Table 4.8) wildlife plays a major role in destruction of *Sansevieria* plants (Plate 4.6). The animals cited in focused group discussions (Plate 4.7) were elephants, rhinoceros, baboons, squirrels and kudus. These animals eat the plant leaves and whole rhizomes or chew parts of it in search of juice to quench their thirst. In the process they cause a lot of damage through uprooting and trampling. Due to the slow growth of the species, succession becomes slow and the plant population eventually reduce. As the plant numbers decline, especially during the time of drought, the wild animals migrate from the Parks and cause further damage to *Sansevieria* clusters that are outside the protected areas.

The ever increasing human population has been a major hindrance to conservation of fragile ecosystems. Fourteen percent of respondents (Table 4.8) cited man as a major threat to conservation of *Sansevieria* species in their natural environment. Human agricultural activities (Plate 4.8) have contributed to destruction of type localities of *Sansevieria* plants. The ever-increasing human population, creating immense pressure on land, has created this trend. Since *Sansevieria* plants niche have been associated with fertile soils, farmers rush to such sites for better yields. Charcoal burners were also mentioned as serious threats to conservation of *Sansevieria* plants e.g. at Rabai. It was

reported that they indiscriminately clear *Sansevieria* plants in order to gain access to their preferred trees for charcoal burning (Plate 4.9)

Majority of the respondents (50.5%) chose 4. A-ched both man and wildlife as major



Plate 4.6: *Sansevieria* destroyed by wild animals, Maungu, Taita Taveta

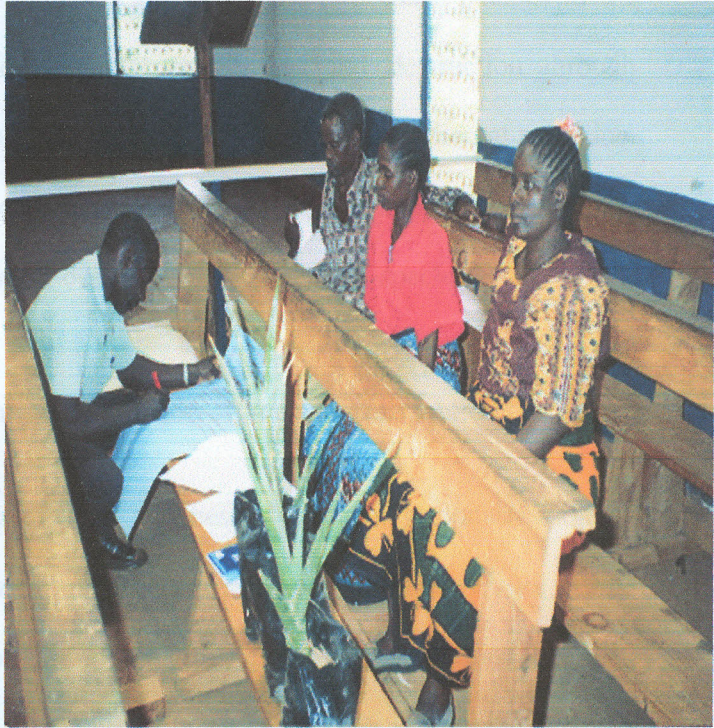


Plate 4.7: Group discussion on conservation of *sansevieria* plants in Maungu, Taita Taveta

Table 4.9: Suggested options for conserving *Sansevieria* plants by the respondents



Plate: 4.8: *Sansevieria* type locality replaced by fruit crops in Maungu, Taita Taveta



Plate: 4.9: Destruction of *Sansevieria* by human being: charcoal burning sites in Maungu, Taita

4.3.3 Destruction by both man and wildlife

Majority of the respondents (50.5%) (Table 4.8) cited both man and wildlife as major agents in *Sansevieria* destruction (Plates 4.8 and 4.9). The two cause patches in the forest areas through twin activities of charcoal burning and destruction through uprooting. Man goes further and clears *Sansevieria* plants in search of herbal medicine. This poses serious danger in the species conservations and unless appropriate measures are put in place, it would result in further destruction of *sansevieria* species.

4.4 Suggested avenues for enhancing conservation of *Sansevieria* species

Objective four of this study was to find avenues of enhancing conservation of *Sansevieria* plants in their natural environment. Of the respondents interviewed, (Table 4.9), 59% were for conservation of *Sansevieria* species through awareness creation, while 2.5% were for more research to be carried out on the plants in order to discover their potential.

Table 4.9: Suggested options for conserving *Sansevieria* plants by the respondents

Conservation avenue	Frequency	Percentage (%)
Awareness creation	152	59
Planting more	75	28.9
Enforce conservation laws	25	9.6
More research	6	2.5
Total	258	100

From the results (Table 4.9), the following specific conservation options were suggested to curb destruction of *Sansevieria* plants in their natural environment:

1. Awareness creation on the plant species was suggested by 59% of the respondents (Table 4.9). This is particularly important to the majority who do not know the specific benefits of the plant. The plant has numerous benefits (Table 4.4) which most of the farmers and other users are not conversant with. The ability of the plant to decay fast enhances nutrient cycling (Personal observation) which results into agriculturally rich soils. The study noted that if people whose settlements are within main localities of the *Sansevieria* plants could be educated on the plants usefulness, then they would see the need of conserving it.
2. Other respondents suggested increasing *Sansevieria* population through planting (28.9%) (Table 4.9) to enhance conservation of the species. The study noted that farmers should plant the species around their farms and wastelands to prevent encroachment by elephants and other marauding wild life. In this case, it was noted, *Sansevieria* plants would increase in number and farms would be protected. Further to this, users would not destroy *Sansevieria* niche in the wild as they search for the plants for other uses because the plants would be readily available. The other uses include brick reinforcement for house construction thereby saving wood for brick kilning.
3. Enforcement of conservation laws (Table 4.9) was yet another suggestion for enhancing conservation of *Sansevieria* plants. Respondents were of the view that existing conservation laws should be re-visited and followed to the letter by implementing agencies. The study noted that such action would discourage people from wanton destruction of this natural resource. For the wild animals, the study revealed that the onus lies with the Kenya Wildlife Service of Kenya, which should see to it that animals are restricted within their designated areas.

4. Carrying out more research as suggested by (2.5%) of the respondents (Table 4.9) as an avenue option that could enhance conservation of *Sansevieria* plants. The study noted that *Sansevieria* are potential medicinal plants, and therefore more research should be carried out on them. It was noted that more discoveries could create public appreciation of the plant species and in turn would enhance its conservation.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

In an attempt to study the phenology, ethnobotany and conservation of lowland *Sansevieria* plants, 258 small scale plant users were interviewed, a twelve month plant growth observation was done in a green house, focused group discussions were held, a diversity of photographs were taken, many plant species collected and direct observations made. Data gathered were analysed and yielded striking findings. Based on these findings, conclusions were drawn and recommendations made on sustainable use and conservation of the 4 lowland *Sansevieria* species.

5.2 Conclusion

Objective one of the study was to document the phenological patterns of *S. volkensii*, *S. powelli*, *S. robusta* and *S. arborescens*. The study has noted that *Sansevieria* taxa have relatively slow growth, which is brought about by low precipitation and severe drought in their main localities. It was noted that rhizome development virtually ceases during dry season. Flowering of lowland *Sansevieria* species normally occurred during the long rains. All the species studied produced whitish/greyish flowers and green berries, which turned yellow upon ripening. It was observed that the interval between flowering and fruiting was three weeks and that between fruit formation and maturity was four weeks. It was also observed that flowering and successful fruit formation depended more on available precipitation. Dry weather caused heavy abortion of flowers (about 70%). The major dispersal agents for the plants are the birds, which feed on the berries and other

wild animals, which uproot the rhizomes and scatter them from their original areas of growth.

- The study concluded that *Sansevieria* plants are mainly used as food by wildlife. Other uses are for tying, fencing, treatment of aches, treatment of poisonous bites/wounds, keeping away evil spirits, boundary marking, fodder, snakes scare, ornamental, treatment of poultry pests and diseases, strings for weaving and strings for both tying and weaving. Indigenous knowledge on conservation is threatened in the areas that were studied. The uses are not recorded anywhere and only a few people possess the indigenous knowledge. Medicinal knowledge is generally difficult to access since the respondents treat it as confidential.
- The study concluded that the population of *Sansevieria* has decreased for the last five years due to the combined effects of human and animal destruction (50.5%), destruction by wildlife (35.6%) and destruction by man (13.9%). The study also revealed that there are more mature plants of *Sansevieria* than young ones leading to low recruitment, a condition that threatens the species with extinction. Cover estimate of lowland *Sansevieria* species was generally low (12.75%), and this shows that secondary plants are colonising main localities of lowland *Sansevieria* plants. It was also noted that farmers clear these species for either direct use or to create space for agricultural purposes.
- On the avenues to enhance conservation of *Sansevieria* plants in their natural environment, the study noted that awareness creation ranked first followed by increasing population of *Sansevieria* through planting (28.9%). Conservation through law enforcement (9.6%) and carrying out more research (2.5%) ranked

third and fourth respectively. It was respondents' view that the benefits that accrue from the plant need to be known first before any intervention on conservation is done.

- It can be concluded that *Sansevieria* plants vegetate or reproduce by flowering well during the months when moisture content of the soil increased; notably during short rains (October / November) and long rains (February / May). During this period, leaf elongation and enlargement, leaf multiplication and rhizome development are at their peaks. New suckers emerge from the rhizomes during this period and generally the plants are at their "greening" stage. Budding and flowering are mostly successful during the long rains (February to May) as opposed to short rainy season when about 95% of the flowers aborts due to moisture scarcity. Green berries develop approximately three weeks after flowering and yellow fruits follow this within a period of four weeks.
- Lowland *Sansevieria* plants have varied number of uses. These include food for wild animals, fodder, and use of their strings and fibres for tying and weaving respectively. The plants were found to occupy a special niche in herbal medicine world. Various treatments were listed and these included treatment of poisonous bites/wounds, treatment of aches (ear, tooth and pains from after births) and treatment of poultry pests and diseases. The plants were found to be good indoor and outdoor ornamentals. They purify air by cleaning the indoor environment of unpurified air and thus acting as sinks. It was also elucidated that the plants, especially *S. arborescens*, acts as snakes scare due to their sharp pricks. It was generally noted that areas colonised by these plants are a no-go zone for

camouflaging snakes. In the traditional under-world, *S. arborescens* was reported to play an important role in rejuvenating pigeon-pea growth.

- Demonstrations were carried out on the ability of *Sansevieria* fibres in reinforcing bricks. It was realised that *Sansevieria* fibre-reinforced bricks were stronger and resistant to abrasion than non-fibre reinforced ones. The fibres held the loose clay together and the roughness that resulted on the surface of the bricks were useful in holding cement and sand together during plastering this is since fibres act as good soil binders in brick making just like straw.
- The study has established that the most noted threats to lowland *Sansevieria* are the wild animals. Animals are a real menace to the succulent plants during the dry season. They quench their thirst through chewing of the rhizomes and leaves of *Sansevieria* plants. Through these activities, they really destroy the plants, which are already endangered. Notable animals here are the elephants, rhinoceroses, baboons and zebras. Human being rank second on the list of agents that are major threats to lowland *Sansevieria* plants. Human populations continue to increase and thus create pressure on agricultural land. Since *Sansevieria* plants are fertility indicators, farmers prefer clearing them to create room for cultivation. The combined actions of man and wild animals on lowland *Sansevieria* was found to be a major threat in the rangelands where man destroys *Sansevieria* plants to gain accessibility to trees for charcoal burning. Wild animals in turn uproot the already exposed rhizomes and chew them to obtain water.

5.3 Recommendations

1. A participatory and consultative approach that caters for all actors and interests such as, UN agencies, women, children, communities, NGOs', and the public sector in the conservation should be adopted. The government and the community should form a joint co-operation by introducing participatory indigenous plant conservation strategy with clearly defined strategies. For effective indigenous plant management and conservation, plant managers need to establish village organisations or village clusters to protect the plants. The local community for example, can be charged with policing the type – localities and apprehending illegal users. This can be achieved by forming informer groups among the community members.
2. The plant users can participate by reporting all the criminals and unearthing syndicates that are now responsible for wanton destruction of *Sansevieria* plants.
3. Participation of the private sector in indigenous plant management is crucial. The sector, for example, can assist in training and education, monitoring and reinforcement, research and extension, export and marketing services of some of the *Sansevieria* products. Specifically, pharmaceutical companies can help the establishment of plantations of the highly threatened lowland medicinal *Sansevieria* plants that are known to be useful.
4. At the planning level proper co-ordination and linkages should be established between indigenous plant resources, land use / urban development, environmental protection, among others. Management planning should be based

on the principle of multiple use, embracing both conservation and sustainable utilization to achieve an optimum combination of benefits from the rangelands. The study also noted that part of the mismanagement of the indigenous plants in the reserve is due to lack of clear guidelines on the species exploitation by the users. There is need for the community to know the dos and the don'ts concerning medicine, fodder and fuel collection from the rangelands. This can help conserve the endangered plants for continued productivity.

5. Renewed awareness of the current status and value of indigenous plants is necessary because most of those who destroy indigenous plants, do not know their social – cultural values as well as the dangers posed by over exploitation. Village seminars, training on roles and conservation leadership skills should be considered. Training on the value and use by small-scale users, extension agents and administrators guarding natural ecosystems is crucial because they come from diverse backgrounds.
6. In the case of lowland *Sansevieria* species main localities, it is unlikely that efforts at the national or institutional level can save the *Sansevieria* plants from extinction unless the plants are gazetted as endangered species. Timely grassroots action of fully involving the community, can help preserve the indigenous plants for future generations while providing a model for community based plant conservation in other areas of Kenya.

5.3.1 Areas for further study

In studying the phenology, ethnobotany and conservation of lowland *Sansevieria* plants, the study found that:

1. There is a link between *Sansevieria* species consumed by wild animals and those used by the communities around as herbal medicines. Ecological survey is necessary to determine the abundance of these species in order to check on their possible over- exploitation.
2. The use of fibres from *Sansevieria* plants as reinforcement in bricks throws some light in the corridors of construction industry. More research needs to be done to ascertain the physical properties of the fibres that are actually responsible for the binding effect in clay soils. Such tests should include absorption tests, modulus of elasticity of fibres and density determination of fibres.
3. Population increase has resulted in clearing of *Sansevieria* niche in order to create room for cultivation agriculture. A study is therefore suggested on the impact of Agriculture on *sansevieria* plants' conservation.

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APPENDICES

Appendix 1: Questionnaire on utilization and conservation of *Sansevieria* plants

This questionnaire is part of an ongoing research finding out how people in your area have been using *Sansevieria* plants. You are requested to answer to the best of your ability. Any information you give will be treated in confidence.

Q-1 Your name Date

Q-2 Your age

Q-3. What is your educational background?

1. Did not attend school
2. Primary
3. Secondary
4. Post secondary training
5. Diploma / University

Q-4. Who is the head of your household?

- Gender
- 1- Male
 - 2 – Female

Q-5 What is the size of your family?

1. Children
2. Adults
3. Total

Q-6 For how long have you been living in this area?

Q-7 Where did you originally come from?

Q-8 What is your source of income?

1. Farmer
2. Livestock keeping
3. Salaried employment
4. Business
5. Others (specify)

Q-9 What is the approximate size of your farm?

Q-10 Do you have any livestock?

1. Yes
2. No

Q-11 If yes what animals do you keep?

ANIMALS	NUMBER

Q-12 How do you feed you animals?

1. Zero grazing
2. Near homestead
3. From the forest
4. Others (specify)

Q-13 Do you know the names of *Sansevieria* growing in this place?

1. Yes
2. No

Q-14 What colour(s) are *Sansevieria* flowers?

1. Purple
2. Red
3. White
4. Yellow
9. DK

Q-15 What agents are destroying *Sansevieria* in this area?

1. Human
2. Animals
3. Wildlife
4. Nothing
5. DK

Q- 16 What can you do to conserve this plants for future generation?

1. Create awareness
2. Plant on our land
3. More research

Q-17 What are some of the uses of *Sansevieria* in your community?

USE	Name of ssp 1. <i>S. powellii</i> /robusta 2. <i>S. volkensii</i>	YES – 1 NO – 2 DK – 9	Methods of extraction where applicable 1. Squeeze, 2. Boil 3. Pound 4. Split 5. Others (specify) 9. DK	Plant part used and quantity where applicable 1. Leaves 2. Stem 3. Rhizome 4. Flower 5. Seed 9. DK
Fencing				
Strings				
Food-fruits				
Keep away snakes				
Keep away bad omen				
Ear-ache				
Tooth-ache				
Stomach-ache				
Lung diseases				
Trypanosomiasis				
Gout				
Skin				
Wounds				
Ulcers				
Ornamental				
Ties sacks				
Ties vegetables				
Kikuyu kiondo				
Whips				
Ties firewood				
Ties tomatoes				
Ropes				
Fodder				
Construction				
Digestion-paper				
De-wormer				

Q-18 Has any government officer ever told you to conserve this plant?

1. Yes
2. No

Q-19 where did you get this knowledge about *Sansevieria* species?

1. Father
2. Mother
3. Grandparents
4. Observation
5. Others (specify)
- 9 DK

Q-20 What are the taboos associated with these plants?

- | | | |
|-----------------------|-------------------------------|-------|
| 1. Keep away bad omen | 2. Keep away the evil spirits | |
| 3. Keep away snakes | 4. Any other (specify) | 9. DK |

Q-21 What do you use for cooking?

- | | | |
|-----------------|-------------|---------------------|
| 1. Charcoal | 2. Fuelwood | |
| 3. Crop residue | 4. Paraffin | 5. Others (specify) |

Q-22 Where do you get charcoal/firewood?

- | | |
|-----------|---------------------|
| 1. Market | 2. Forest |
| 3. Shamba | 4. Others (specify) |

Q-23 If your answer is 2-above (22), how far is the source of firewood from your residence?

Q-24 How many head loads of firewood do you use per week?

Q-25 How much time do you spend to collect one head load of firewood?

Q-26 Do you ever use farm residue as a source of energy?

1. Yes
2. No

Q-27 If yes for the above question, when is this done?

1. During harvesting season
2. Throughout the year
3. Others (specify) 9-DK

Q-28 Do you use energy saving jikos?

1. Yes
2. No

Q-29 Do you use briquettes as a source of energy?

1. Yes
2. No

Q-30 Have you ever-used *Sansevieria* briquettes for cooking?

1. Yes
2. No

Q-31 Do you have some plants of *Sansevieria* on your farm?

1. Yes
2. No

APPENDIX 2 Mann-Whitney 'u' test

In this test the scores from the combined samples were arranged in order i.e. the lowest score got rank 1 the next lower got 2.

Assumption: The underlying variable (use) in which group A & B are compared is continuously distributed.

Ho: The two groups of scores A & B for the various uses are identical

Scores	Group	Ranking
18	A	1
31	A	2
38	A	3
40	A	4
43	B	5
63	A	6
65	A	7
73	A	8
79	A	9
87	B	10
97	B	11
113	A	12
145	B	13
161	A	14
171	A	15
179	B	16
185	B	17
193	B	18
195	B	19
215	A	20
218	B	21
220	B	22
227	B	23
240	B	24

$$U = \frac{N_1 N_2 + N_1 (N_1 + 1)}{2} - T_1$$

Where T_1 is the sum of the ranks associated with observation in sample 1.

$$U = \frac{12(12) + 12(12+1)}{2} - 101$$

$$= \frac{144 + 78}{2} - 101$$

$$= 121$$

The resulting U is larger than $N1N2/2$, then we take,

$$\begin{aligned}
 U' &= N1N2 - U \\
 &= 144/2 - 101 \\
 &= 23
 \end{aligned}$$

APPENDIX 3: Age group of respondents

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Under 20yrs	26	10.1	10.1	10.1
	21 - 40yrs	119	46.1	46.1	56.2
	41 – 60yrs	82	31.8	31.8	88.0
	Over 60yrs	31	12.0	12.0	100.0
Total		258	100.0	100.0	

Gender of respondents *Education level Cross-tabulation Count

		Education Level			Total
		Illiterate	Primary	Secondary	
Gender or respondents	Male	45	61	7	113
	Female	83	56	6	145
Total		128	117	13	258

Agents destroying *Sansevieria*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Wild animals	169	65.5	65.5	65.5
	Man	56	21.7	21.7	87.2
	Both man and wild animals	17	6.6	6.6	93.8
	Agents not known	16	6.2	6.2	100.0
Total		258	100.0	100.0	

Agents destroying *Sansevieria* *Species of *Sansevieria* Cross-tabulation

		Species of <i>Sansaviera</i>				Total
		<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>		
Agents destroying <i>Sansevieria</i>	Wild animals	Count	59	62	48	169
		% within agents destroying <i>Sansevieria</i>	34.9%	36.7%	28.4%	100.0
		% within species of <i>Sansevieria</i>	66.3%	57.9%	77.4%	65.5
		% of total	22.9%	24.0%	18.6%	65.5
	Man	Count	23	29	4	56
		% within agents destroying <i>Sansevieria</i>	41.1%	51.8%	7.1%	100.0
		% within species of <i>Sansevieria</i>	25.8%	27.1%	6.5%	21.7
		% of total	8.9%	11.2%	1.6%	21.7
	Both Man and Wild Animals	Count	5	7	5	17
		% within agents destroying <i>Sansevieria</i>	29.4%	41.2%	29.4%	100.0
		% within species of <i>Sansevieria</i>	5.6%	6.5%	8.1%	6.6%
		% of total	1.9%	2.7%	1.9%	6.6
	Total	Count	89	107	62	258
% within agents destroying <i>Sansevieria</i>		34.5%	41.5%	24.0%	100.0	
% within species of <i>Sansevieria</i>		100.0%	100.0%	100.0%	100.0	
% of total		34.5%	41.5%	24.0%	100.0	

Whether *Sansevieria* is used for fencing

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	161	62.2	62.4	62.4
	No	97	37.6	37.6	100.0
	Total	258	100.0	100.0	

***Sansevieria* juice for treatment of poultry pests and diseases**

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	38	14.7	14.7	14.7
	No	220	85.3	85.3	100.0
	Total	258	100.0	100.0	

***Sansevieria* juice for treatment of aches (ear, stomach, tooth)**

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	113	43.8	43.8	43.8
	No	145	56.2	56.2	100.0
	Total	258	100.0	100.0	

***Sansevieria* for keeping away evil spirits**

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	73	28.3	28.3	28.3
	No	185	71.7	71.7	100.0
	Total	258	100.0	100.0	

***Sansevieria* as snakes scare**

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	58	22.5	22.5	22.5
	No	200	77.5	77.5	100.0
	Total	258	100.0	100.0	

Sansevieria as food for wild animals (baboons, hippos, rhinos, squirrels)

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	215	83.3	83.3	83.3
	No	43	16.7	16.7	100.0
	Total	258	100.0	100.0	

Sansevieria used to obtain strings

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	213	82.6	82.6	82.6
	No	45	17.4	17.4	100.0
	Total	258	100.0	100.0	

Whether Sansevieria is used for fencing *Species of Sansevieria Cross-tabulation

			Species of <i>Sansevieria</i>			Total
			<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>	
Whether Sansevieria is used for fencing	Yes	Count	60	74	27	161
		% within whether <i>Sansevieria</i> is used for fencing	37.3%	46.0%	16.8%	100.0
		% within Species of <i>Sansevieria</i>	67.4%	69.2%	43.5%	62.4
		% of total	23.3%	28.7%	10.5%	62.4
	No	Count	29	33	35	97
		% within whether <i>Sansevieria</i> is used for fencing	29.9%	34.0%	36.1%	100.0
		% within Species of <i>Sansevieria</i>	32.6%	30.8%	56.5%	37.6
		% of total	11.2%	12.8%	13.6%	37.6
		Count	89	107	62	258
Total	% within whether <i>Sansevieria</i> is used for fencing	34.5%	41.5%	24.0%	100.0	
	% within Species of <i>Sansevieria</i>	100.0%	100.0%	100.0%	100.0	
	% of total	34.5%	41.5%	24.0%	100.0	

**Sansevieria juice for treatment of poultry pests and diseases *Species of Sansevieria
Crosstabulation**

			Species of <i>Sansevieria</i>			Total
			<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>	
Sansevieria juice for treatment of poultry pests and diseases	Yes	Count	10	22	6	33
		% within <i>Sansevieria</i> juice for treatment of pests and diseases	26.3%	57.9%	15.8%	100.0
		% within Species of <i>Sansevieria</i>	11.2%	20.6%	9.7%	14.7
		% of total	3.9%	8.5%	2.3%	14.7
	No	Count	79	85	56	220
		% within <i>Sansevieria</i> juice for treatment of pests and diseases	35.9%	38.6%	25.5%	100.0
		% within Species of <i>Sansevieria</i>	88.8%	79.4%	90.3%	85.3
		% of total	30.6%	32.9%	21.7%	85.3
Total	Count	89	107	62	258	
	% within <i>Sansevieria</i> juice for treatment of pests and diseases	34.5%	41.5%	24.0%	100.0	
	% within Species of <i>Sansevieria</i>	100.0%	100.0%	100.0%	100.0	
	% of total	34.5%	41.5%	24.0%	100.0	

**Sansevieria juice for treatment of poultry pests and diseases *Species of Sansevieria
Crosstabulation**

			Species of <i>Sansevieria</i>			Total
			<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>	
Sansevieria juice used for treatment of poisonous bites/wounds	Yes	Count	16	52	11	79
		% within <i>Sansevieria</i> juice used for treatment of poisonous bites/wounds	20.3%	65.8%	13.9%	100.0
		% within Species of <i>Sansevieria</i>	18.0%	48.6%	17.7%	30.6
		% of total	6.2%	20.2%	4.3%	30.6
	No	Count	73	55	51	179
		% within <i>Sansevieria</i> juice used for treatment of poisonous bites/wounds	40.8%	30.7%	28.5%	100.0
		% within Species of <i>Sansevieria</i>	82.0%	51.4%	82.3%	69.4
		% of total	28.3%	21.3%	19.8%	69.4
Total	Count	89	107	62	258	
	% within <i>Sansevieria</i> juice used for treatment of poisonous bites/wounds	34.5%	41.5%	24.0%	100.0	
	% within Species of <i>Sansevieria</i>	100.0%	100.0%	100.0%	100.0	
	% of total	34.5%	41.5%	24.0%	100.0	

Sansevieria juice for treatment of aches (ear, stomach, tooth) *Species of Sansevieria Crosstabulation

		Species of <i>Sansevieria</i>			Total %	
		<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>		
Sansevieria juice for treatment of aches (ear, stomach, tooth)	Yes	Count	58	39	16	11
		% within <i>Sansevieria</i> juice for treatment of aches (ear, stomach, tooth)	51.3%	34.5%	14.2%	100.0
		% within Species of <i>Sansevieria</i>	65.2%	36.4%	25.8%	43.8
		% of total	22.5%	15.1%	6.2%	43.8
	No	Count	31	68	46	145
		% within <i>Sansevieria</i> juice for treatment of aches (ear, stomach, tooth)	21.4%	46.9%	31.7%	100.0
		% within Species of <i>Sansevieria</i>	34.8%	63.6%	74.2%	56.2
		% of total	12.0%	26.4%	17.8%	56.2
		Count	89	107	62	258
Total	% within <i>Sansevieria</i> juice for treatment of aches (ear, stomach, tooth)	34.5%	41.5%	24.0%	100.0	
	% within Species of <i>Sansevieria</i>	100.0%	100.0%	100.0%	100.0	
	% of total	34.5%	41.5%	24.0%	100.0	

Sansevieria for keeping away evil spirits *Species of Sansevieria Crosstabulation

		Species of <i>Sansevieria</i>			Total %	
		<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>		
Sansevieria for away evil spirits	Yes	Count	13	20	40	73
		% within <i>Sansevieria</i> for keeping away evil spirits	17.8%	27.4%	54.8%	100.0
		% within Species of <i>Sansevieria</i>	14.6%	18.7%	64.5%	28.3
		% of total	5.0%	7.8%	15.5%	28.3
	No	Count	76	87	22	185
		% within <i>Sansevieria</i> for keeping away evil spirits	41.1%	47.0%	11.9%	100.0
		% within Species of <i>Sansevieria</i>	85.4%	81.3%	35.5%	71.7
		% of total	29.5%	33.7%	8.5%	71.7
		Count	89	107	62	258
Total	% within <i>Sansevieria</i> for keeping away evil spirits	34.5%	41.5%	24.0%	100.0	
	% within Species of <i>Sansevieria</i>	100.0%	100.0%	100.0%	100.0	
	% of total	34.5%	41.5%	24.0%	100.0	

Sansevieria as snakes scare *Species of Sansevieria Crosstabulation

			Species of <i>Sansevieria</i>			Total %
			<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>	
Sansevieria as snakes scare	Yes	Count	14	16	28	58
		% within <i>Sansevieria</i> as snakes scare	24.1%	27.6%	48.3%	100.0
		% within Species of <i>Sansevieria</i>	15.7%	15.0%	45.2%	22.5
		% of total	5.4%	6.2%	10.9%	22.5
	No	Count	75	91	34	200
		% within <i>Sansevieria</i> as snakes scare	37.5%	45.5%	17.0%	100.0
		% within Species of <i>Sansevieria</i>	84.3%	85.0%	54.8%	77.5
		% of total	29.1%	35.3%	13.2%	77.5
		Count	89	107	62	258
Total	% within <i>Sansevieria</i> as snakes scare	34.5%	41.5%	24.0%	100.0	
	% within Species of <i>Sansevieria</i>	100.0%	100.0%	100.0%	100.0	
	% of total	34.5%	41.5%	24.0%	100.0	

Sansevieria as food for wild animals (baboons, rhinos, squirrels) *Species of Sansevieria Crosstabulation

			Species of <i>Sansevieria</i>			Total %
			<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>	
Sansevieria as food for wild animals (baboons, rhinos, squirrels)	Yes	Count	75	92	48	215
		% within <i>Sansevieria</i> as food for wild animals (baboons, rhinos, squirrels)	34.9%	42.8%	22.3%	100.0
		% within Species of <i>Sansevieria</i>	84.3%	86.0%	77.4%	83.3
		% of total	29.1%	35.7%	18.6%	83.3
	No	Count	14	15	14	43
		% within <i>Sansevieria</i> as food for wild animals (baboons, rhinos, squirrels)	32.6%	34.9%	32.6%	100.0
		% within Species of <i>Sansevieria</i>	15.7%	14.0%	22.6%	16.7
		% of total	5.4%	5.8%	5.4%	16.7
		Count	89	107	62	258
		Total	% within <i>Sansevieria</i> as food for wild animals (baboons, rhinos, squirrels)	34.5%	41.5%	24.0%
% within Species of <i>Sansevieria</i>	100.0%		100.0%	100.0%	100.0	
% of total	34.5%		41.5%	24.0%	100.0	

Sansevieria used to obtain strings *Species of *Sansevieria* Crosstabulation

			Species of <i>Sansevieria</i>			Total %
			<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>	
<i>Sansevieria</i> used to obtain strings	Yes	Count	71	100	42	215
		% within <i>Sansevieria</i> used to obtain strings	33.3%	46.9%	19.7%	100.0
		% within Species of <i>Sansevieria</i>	79.8%	93.5%	67.7%	82.6
		% of total	27.5%	38.8%	16.3%	82.6
	No	Count	18	7	20	45
		% within <i>Sansevieria</i> used to obtain strings	40.0%	15.6%	44.4%	100.0
		% within Species of <i>Sansevieria</i>	20.2%	6.5%	32.3%	17.4
		% of total	7.0%	2.7%	7.8%	17.4
	Total	Count	89	107	62	258
% within <i>Sansevieria</i> used to obtain strings		34.5%	41.5%	24.0%	100.0	
% within Species of <i>Sansevieria</i>		100.0%	100.0%	100.0%	100.0	
% of total		34.5%	41.5%	24.0%	100.0	

What *Sansevieria* fibres are used for *Species of *Sansevieria* Crosstabulation

			Species of <i>Sansevieria</i>			Total %
			<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>	
What <i>Sansevieria</i> fibres are used for	Tying	Count	65	88	18	171
		% within what <i>Sansevieria</i> fibres are used for	38.0%	51.5%	10.5%	100.0
		% within Species of <i>Sansevieria</i>	73.0%	82.2%	29.0%	66.3
		% of Total	25.2%	34.1%	7.0%	66.3
	Weaving	Count	11	8	12	31
		% within what <i>Sansevieria</i> fibres are used for	35.5%	25.8%	38.7%	100.0
		% within Species of <i>Sansevieria</i>	12.4%	7.5%	19.4%	12.0
		% of Total	4.3%	3.1%	4.7%	12.0
	Both Tying and Weaving	Count	3	3	12	18
		% within what <i>Sansevieria</i> fibres are used for	16.7%	16.7%	66.7%	100.0
		% within Species of <i>Sansevieria</i>	3.4%	2.8%	19.4%	7.0
		% of Total	1.2%	1.2%	4.7%	7.0
	Both Tying and Weaving	Count	3	3	12	18
		% within what <i>Sansevieria</i> fibres are used for	16.7%	16.7%	66.7%	100.0
		% within Species of <i>Sansevieria</i>	3.4%	2.8%	19.4%	7.0
		% of Total	1.2%	1.2%	4.7%	7.0
	Use not known	Count	10	8	20	38
		% within what <i>Sansevieria</i> fibres are used for	26.3%	21.1%	52.6%	100.0
		% within Species of <i>Sansevieria</i>	11.2%	7.5%	32.3%	14.7
		% of Total	3.9%	3.1%	7.8%	14.7
	Total	Count	89	107	62	258
% within what <i>Sansevieria</i> fibres are used for		34.5%	41.5%	24.0%	100.0	
% within Species of <i>Sansevieria</i>		100.0%	100.0%	100.0%	100.0	
% of Total		34.5%	41.5%	24.0%	100.0	

Colour of *Sansevieria* flowers *Species of *Sansevieria* Crosstabulation

			Species of <i>Sansevieria</i>			Total %
			<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>	
Colours of <i>Sansevieria</i> flowers	Red	Count	16	24	3	43
		% within colour of <i>Sansevieria</i> flowers	37.2%	55.8%	7.0%	100.0
		% within Species of <i>Sansevieria</i>	18.0%	22.4%	4.8%	16.7
		% of Total	6.2%	9.3%	1.2%	16.7
	White	Count	6	12	33	51
		% within colour of <i>Sansevieria</i> flowers	11.8%	23.5%	64.7%	100.0
		% within Species of <i>Sansevieria</i>	6.7%	11.2%	53.2%	19.8
		% of Total	2.3%	4.7%	12.8%	19.8
	Yellow	Count	47	46	4	97
		% within colour of <i>Sansevieria</i> flowers	48.5%	47.4%	4.1%	100.0
		% within Species of <i>Sansevieria</i>	52.8%	43.0%	6.5%	37.6
		% of Total	18.2%	17.8%	1.6%	37.6
	Use not known	Count	20	25	22	67
		% within colour of <i>Sansevieria</i> flowers	29.9%	37.3%	32.8%	100.0
		% within Species of <i>Sansevieria</i>	22.5%	23.4%	35.5%	26.0
		% of Total	7.8%	9.7%	8.5%	26.0
Total	Count	89	107	62	258	
	% within colour of <i>Sansevieria</i> flowers	34.5%	41.5%	24.0%	100.0	
	% within Species of <i>Sansevieria</i>	100.0%	100.0%	100.0%	100.0	
	% of Total	34.5%	41.5%	24.0%	100.0	

Purification and extraction of *Sansevieria* juice *Species of *Sansevieria*
Crosstabulation

			Species of <i>Sansevieria</i>			Total %
			<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>	
Purification and extraction of <i>Sansevieria</i> juice	Squeezed	Count	54	46	18	118
		% within purification and extraction of <i>Sansevieria</i> juice	45.8%	39.0%	15.3%	100.0
		% within Species of <i>Sansevieria</i>	60.7%	43.0%	29.0%	45.7
		% of Total	20.9%	17.8%	7.0%	45.7
	Boiled	Count	20	36	1	57
		% within purification and extraction of <i>Sansevieria</i> juice	35.1%	63.2%	1.8%	100.0
		% within Species of <i>Sansevieria</i>	22.5%	33.6%	1.6%	22.1
		% of Total	7.8%	14.0%	0.4%	22.1
	Pounded	Count	4	1	10	15
		% within purification and extraction of <i>Sansevieria</i> juice	26.7%	6.7%	66.7%	100.0
		% within Species of <i>Sansevieria</i>	4.5%	0.9%	16.1%	5.8
		% of Total	1.6%	0.4%	3.9%	5.8
	Use not known	Count	11	24	33	68
		% within purification and extraction of <i>Sansevieria</i> juice	16.2%	35.3%	48.5%	100.0
		% within Species of <i>Sansevieria</i>	12.4%	22.4%	53.2%	26.4
		% of Total	4.3%	9.3%	12.8%	26.4
Total	Count	89	107	62	258	
	% within purification and extraction of <i>Sansevieria</i> juice	34.5%	41.5%	24.0%	100.0	
	% within Species of <i>Sansevieria</i>	100.0%	100.0%	100.0%	100.0	
	% of Total	34.5%	41.5%	24.0%	100.0	

What *Sansevieria* fibres are used for?

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Tying	171	66.3	66.3	66.3
	Weaving	31	12.0	12.0	78.3
	Both tying and weaving	18	7.0	7.0	85.3
	Use not known	38	14.7	14.7	100.0
Total		258	100.0	100.0	

Sansevieria used to obtain strings

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	213	82.6	82.6	82.6
	No	45	17.4	17.4	100.0
	Total	258	100.0	100.0	

Purification and extraction of *Sansevieria* juice

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Squeezed	118	45.7	45.7	45.7
	Boiled	57	22.1	22.1	67.8
	Pounded	15	5.8	5.8	73.6
	Not known	68	26.4	26.4	100.0
	Total	258	100.0	100.0	

Sansevieria used as fodder

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	195	75.6	75.6	75.6
	No	63	24.4	24.4	100.0
	Total	258	100.0	100.0	

Sansevieria used as boundary planting

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	193	74.8	74.8	74.8
	No	65	25.2	25.2	100.0
	Total	258	100.0	100.0	

Sansevieria used as ornamental

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	218	84.5	84.5	84.5
	No	40	15.5	15.5	100.0
	Total	258	100.0	100.0	

Sansevieria with no use

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	166	64.3	64.3	64.3
	No	92	35.7	35.7	100.0
	Total	258	100.0	100.0	

Control of *Sansevieria* removal from niche

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Government	44	17.1	17.1	17.1
	Elders	40	15.5	15.5	32.6
	Anybody	168	65.1	65.1	97.7
	Not known	6	2.3	2.3	100.0
	Total	258	100.0	100.0	

Consent to control the use of *Sansevieria*

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	161	62.4	62.4	62.4
	No	86	33.3	33.3	95.7
	3	11	4.3	4.3	100
Total		258	100.0	100.0	

Suggestion to conserve *Sansevieria* for

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Enforce conservation penalties	47	18.2	18.2	18.2
	Plant more	108	41.9	41.9	60.1
	Plant more	103	39.9	39.9	100.00
Total		258	100.0	100.0	

Whether extension officers extend *Sansevieria*

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	11	4.3	4.3	4.3
	No	247	95.7	95.7	100.0
Total		258	100.0	100.0	

Conserve *Sansevieria* through more research

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Not applicable	224	86.8	86.8	86.8
	Application	34	13.2	13.2	100.0
Total		258	100.0	100.0	

Conserve *Sansevieria* both through awareness creation and research

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Not applicable	249	96.5	96.5	96.5
	Applicable	9	3.5	3.5	100.00
Total		258	100.0	100.0	

Conserve *Sansevieria* through awareness creation

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Not applicable	48	18.6	18.6	18.6
	Applicable	210	81.4	81.4	100.00
Total		258	100.0	100.0	

Crosstabs

Sansevieria used as fodder *Species of *Sansevieria* Crosstabulation

			Species of <i>Sansevieria</i>			Total %
			<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>	
<i>Sansevieria</i> used as fodder	No	Count	64	76	55	195
		% within <i>Sansevieria</i> used as fodder	32.8%	39.0%	28.2%	100.0
		% within Species of <i>Sansevieria</i>	71.9%	71.0%	88.7%	75.6
		% of Total	24.8%	29.5%	21.3%	75.6
	Yes	Count	25	31	7	63
		% within <i>Sansevieria</i> used as fodder	39.7%	49.2%	11.1%	100.0
		% within Species of <i>Sansevieria</i>	28.1%	29.0%	11.3%	24.4
		% of Total	9.7%	12.0%	2.7%	24.4
		Total	Count	89	107	62
	% within <i>Sansevieria</i> used as fodder	34.5%	41.5%	24.0%	100.0	
	% within Species of <i>Sansevieria</i>	100.0%	100.0%	100.0%	100.0	
	% of Total	34.5%	41.5%	24.0%	100.0	

Sansevieria used as boundary planting *Species of *Sansevieria* Crosstabulation

			Species of <i>Sansevieria</i>			Total %
			<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>	
<i>Sansevieria</i> used as boundary planting	No	Count	64	76	53	193
		% within <i>Sansevieria</i> used as boundary planting	33.2%	39.4%	27.5%	100.0
		% within Species of <i>Sansevieria</i>	71.9%	71.0%	85.5%	74.8
		% of Total	24.8%	29.5%	20.5%	74.8
	Yes	Count	25	31	9	65
		% within <i>Sansevieria</i> used as boundary planting	38.5%	47.7%	13.8%	100.0
		% within Species of <i>Sansevieria</i>	28.1%	29.0%	14.5%	25.2
		% of Total	9.7%	12.0%	3.5%	25.2
		Total	Count	89	107	62
	% within <i>Sansevieria</i> used as boundary planting	34.5%	41.5%	24.0%	100.0	
	% within Species of <i>Sansevieria</i>	100.0%	100.0%	100.0%	100.0	
	% of Total	34.5%	41.5%	24.0%	100.0	

Sansevieria used as ornamental *Species of Sansevieria Crosstabulation

			Species of Sansevieria			Total %
			<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>	
Sansevieria used as ornamental	No	Count	74	91	53	218
		% within Sansevieria used as ornamental	33.9%	41.7%	24.3%	100.0
		% within Species of Sansevieria	83.1%	85.0%	85.5%	84.5
		% of Total	28.7%	35.3%	20.5%	84.5
	Yes	Count	15	16	9	40
		% within Sansevieria used as ornamental	37.5%	40.0%	22.5%	100.0
		% within Species of Sansevieria	16.9%	15.0%	14.5%	15.5
		% of Total	5.8%	6.2%	3.5%	15.5
	Total	Count	89	107	62	258
% within Sansevieria used as ornamental		34.5%	41.5%	24.0%	100.0	
% within Species of Sansevieria		100.0%	100.0%	100.0%	100.0	
% of Total		34.5%	41.5%	24.0%	100.0	

Control of *Sansevieria* removal from niche *Species of *Sansevieria* Crosstabulation

			Species of <i>Sansevieria</i>			Total %
			<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>	
Control of <i>Sansevieria</i> removal from niche	Government	Count	8	9	27	44
		% within Control of <i>Sansevieria</i> removal from niche	18.2%	20.5%	61.4%	100.0
		% within Species of <i>Sansevieria</i>	9.0%	8.4%	43.5%	84.5
		% of Total	3.1%	3.5%	10.5%	17.1
	Elders	Count	18	21	1	40
		% within Control of <i>Sansevieria</i> removal from niche	45.0%	52.5%	2.5%	100.0
		% within Species of <i>Sansevieria</i>	20.2%	19.6%	1.6%	15.5
		% of Total	7.0%	8.1%	0.4%	15.5
	Anybody	Count	61	73	34	168
		% within Control of <i>Sansevieria</i> removal from niche	36.3%	43.5%	20.2%	100.0
		% within Species of <i>Sansevieria</i>	68.5%	68.2%	54.8%	65.1
		% of Total	23.6%	28.3%	13.2%	65.1
	Not known	Count	2	4		6
% within Control of <i>Sansevieria</i> removal from niche		33.3%	66.7%		100.0	
% within Species of <i>Sansevieria</i>		2.2%	3.7%		15.5	
	% of Total	0.8%	1.6%		2.3	
Total	Count	89	107	62	258	
	% within Control of <i>Sansevieria</i> removal from niche	34.5%	41.5%	24.0%	100.0	
	% within Species of <i>Sansevieria</i>	100.0%	100.0%	100.0%	100.0	
	% of Total	34.5%	41.5%	24.0%	100.0	

Consent to control the use of *Sansevieria* *Species of *Sansevieria* Crosstabulation

			Species of <i>Sansevieria</i>			Total %	
			<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>		
Consent to control the use of <i>Sansevieria</i>	Yes	Count	51	57	53	161	
		% within Consent to control the use of <i>Sansevieria</i>	31.7%	35.4%	32.9%	100.0	
		% within Species of <i>Sansevieria</i>	57.3%	53.3%	85.5%	62.4	
		% of Total	19.8%	22.1%	20.5%	62.4	
	No	Count	35	43	8	86	
		% within Consent to control the use of <i>Sansevieria</i>	40.7%	50.0%	9.3%	100.0	
		% within Species of <i>Sansevieria</i>	39.3%	40.2%	12.9%	33.3	
		% of Total	13.6%	16.7%	3.1%	33.3	
		3	Count	3	7	1	11
			% within Consent to control the use of <i>Sansevieria</i>	27.3%	63.6%	9.1%	100.0
	% within Species of <i>Sansevieria</i>		3.4%	6.5%	1.6%	4.3	
	Total	Count	89	107	62	258	
% within Consent to control the use of <i>Sansevieria</i>		34.5%	41.5%	24.0%	100.0		
% within Species of <i>Sansevieria</i>		100.0%	100.0%	100.0%	100.0		
% of Total		34.5%	41.5%	24.0%	100.0		

**Population of *Sansevieria* for the last 5 years *Species of *Sansevieria*
Crosstabulation**

			Species of <i>Sansevieria</i>			Total %
			<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>	
Population of <i>Sansevieria</i> for the last 5 years	Increasing	Count	47	48	43	138
		% within Population of <i>Sansevieria</i> for the last 5 years	34.1%	34.8%	31.2%	100.0
		% within Species of <i>Sansevieria</i>	52.8%	44.9%	69.4%	62.4
		% of Total	18.2%	18.6%	16.7%	53.5
	Decreasing	Count	39	50	15	104
		% within Population of <i>Sansevieria</i> for the last 5 years	37.5%	48.1%	14.4%	100.0
		% within Species of <i>Sansevieria</i>	43.8%	46.7%	24.2%	40.3
		% of Total	15.1%	19.4%	5.8%	40.3
	Constant	Count	3	9	4	16
		% within Population of <i>Sansevieria</i> for the last 5 years	18.8%	56.3%	25.0%	100.0
		% within Species of <i>Sansevieria</i>	3.4%	8.4%	6.5%	6.2
		% of Total	1.2%	3.5%	1.6%	6.2
Total	Count	89	107	62	258	
	% within Population of <i>Sansevieria</i> for the last 5 years	34.5%	41.5%	24.0%	100.0	
	% within Species of <i>Sansevieria</i>	100.0%	100.0%	100.0%	100.0	
	% of Total	34.5%	41.5%	24.0%	100.0	

Suggestion to conserve *Sansevieria* *Species of *Sansevieria* Crosstabulation

			Species of <i>Sansevieria</i>			Total %
			<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>	
Suggestion to conserve <i>Sansevieria</i>	Enforce conservation penalties	Count	12	17	18	47
		% within Suggestion to conserve <i>Sansevieria</i>	25.5%	36.2%	38.3%	100.0
		% within Species of <i>Sansevieria</i>	13.5%	15.9%	29.0%	18.2
		% of Total	4.7%	6.6%	7.0%	18.2
	Plant more	Count	36	48	24	108
		% within Suggestion to conserve <i>Sansevieria</i>	33.3%	44.4%	22.2%	100.0
		% within Species of <i>Sansevieria</i>	40.4%	44.9%	38.7%	41.9
		% of Total	14.0%	18.6%	9.3%	41.9
	Plant more	Count	41	42	20	103
		% within Suggestion to conserve <i>Sansevieria</i>	39.8	40.8%	19.4%	100.0
		% within Species of <i>Sansevieria</i>	46.1%	39.3%	32.3%	39.9
		% of Total	15.9%	16.3%	7.8%	39.9
	Total	Count	89	107	62	258
		% within Suggestion to conserve <i>Sansevieria</i>	34.5%	41.5%	24.0%	100.0
		% within Species of <i>Sansevieria</i>	100.0%	100.0%	100.0%	100.0
% of Total		34.5%	41.5%	24.0%	100.0	

Conserve *Sansevieria* through awareness creation *Species of *Sansevieria*
Crosstabulation

			Species of <i>Sansevieria</i>			Total %	
			<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>		
Conserve <i>Sansevieria</i> through awareness creation	Not applicable	Count	13	18	17	48	
		% within Conserve <i>Sansevieria</i> through awareness creation	27.1%	37.5%	35.4%	100.0	
		% within Species of <i>Sansevieria</i>	14.6%	16.8%	27.4%	18.6	
		% of Total	5.0%	7.0%	6.6%	18.6	
	Applicable	Count	76	89	45	210	
		% within Conserve <i>Sansevieria</i> through awareness creation	36.2%	42.4%	21.4%	100.0	
		% within Species of <i>Sansevieria</i>	85.4%	83.2%	72.6%	81.4	
		% of Total	29.5%	34.5%	17.4%	81.4	
		Total	Count	89	107	62	258
			% within Conserve <i>Sansevieria</i> through awareness creation	34.5%	41.5%	24.0%	100.0
% within Species of <i>Sansevieria</i>	100.0%		100.0%	100.0%	100.0		
% of Total	34.5%		41.5%	24.0%	100.0		

Conserve *Sansevieria* through more research *Species of *Sansevieria*
Crosstabulation

			Species of <i>Sansevieria</i>			Total %	
			<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>		
Conserve <i>Sansevieria</i> through more research	Not applicable	Count	80	95	49	224	
		% within Conserve <i>Sansevieria</i> through more research	35.7%	42.4%	21.9%	100.0	
		% within Species of <i>Sansevieria</i>	89.9%	88.8%	79.0%	86.8	
		% of Total	31.0%	36.8%	19.0%	86.8	
	Applicable	Count	9	12	13	34	
		% within Conserve <i>Sansevieria</i> through more research	26.5%	35.3%	38.2%	100.0	
		% within Species of <i>Sansevieria</i>	10.1%	11.2%	21.0%	13.2	
		% of Total	3.5%	4.7%	5.0%	13.2	
		Total	Count	89	107	62	258
			% within Conserve <i>Sansevieria</i> through more research	34.5%	41.5%	24.0%	100.0
% within Species of <i>Sansevieria</i>	100.0%		100.0%	100.0%	100.0		
% of Total	34.5%		41.5%	24.0%	100.0		

Conserve *Sansevieria* both through awareness creation and research *Species of *Sansevieria* Crosstabulation

			Species of <i>Sansevieria</i>			Total %	
			<i>S. Volkensii</i>	<i>S. Powellii/Robusta</i>	<i>S. Arborescens</i>		
Conserve <i>Sansevieria</i> both through awareness creation and research	Not applicable	Count	85	106	58	249	
		% within Conserve <i>Sansevieria</i> both through awareness creation and research	34.1%	42.6%	23.3%	100.0	
		% within Species of <i>Sansevieria</i>	95.5%	99.1%	93.5%	96.5	
		% of Total	32.9%	41.1%	22.5%	96.5	
	Applicable	Count	4	1	4	9	
		% within Conserve <i>Sansevieria</i> both through awareness creation and research	44.4%	11.1%	44.4%	100.0	
		% within Species of <i>Sansevieria</i>	4.5%	0.9%	6.5%	3.5	
		% of Total	1.6%	0.4%	1.6%	3.5	
		Total	Count	89	107	62	258
			% within Conserve <i>Sansevieria</i> both through awareness creation and research	34.5%	41.5%	24.0%	100.0
% within Species of <i>Sansevieria</i>	100.0%		100.0%	100.0%	100.0		
% of Total	34.5%		41.5%	24.0%	100.0		

Whether *Sansevieria* is used for fencing

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	161	62.4	62.4	62.4
	No	97	37.6	37.6	95.7
	Total	258	100.0	100.0	

***Sansevieria* juice for treatment of poultry pests and diseases**

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	38	14.7	14.7	14.7
	No	220	85.3	85.3	100.0
	Total	258	100.0	100.0	

***Sansevieria* juice used for treatment of poisonous bites/wounds**

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	79	30.6	30.6	30.6
	No	179	69.4	69.4	100.0
	Total	258	100.0	100.0	

***Sansevieria* juice for treatment of aches (ear, stomach, tooth)**

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	113	43.8	43.8	43.8
	No	145	56.2	56.2	100.0
	Total	258	100.0	100.0	

***Sansevieria* for keeping away evil spirits**

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	73	28.3	28.3	28.3
	No	185	71.7	71.7	100.0
	Total	258	100.0	100.0	

***Sansevieria* as snake scare**

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	58	22.5	22.5	22.5
	No	200	77.5	77.5	100.0
	Total	258	100.0	100.0	

***Sansevieria* as food for wild animals (baboons, hippos, rhinos, squirrels)**

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	215	83.3	83.3	83.3
	No	43	16.7	16.7	100.0
	Total	258	100.0	100.0	

Sansevieria used to obtain strings

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	213	82.6	82.6	82.6
	No	45	17.4	17.4	100.0
	Total	258	100.0	100.0	

What Sansevieria fibres are used for?

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Tying	171	66.3	66.3	66.3
	Weaving	31	12.0	12.0	78.3
	Both tying and weaving	18	7.0	7.0	85.3
	Use not known	38	14.7	14.7	100.0
	Total	258	100.0	100.0	

Colour of Sansevieria flowers

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Red	43	16.7	16.7	16.7
	White	51	19.8	19.8	36.4
	Yellow	97	37.6	37.6	74.0
	Colour not known	67	26.0	26.0	100.0
	Total	258	100.0	100.0	

Agents destroying Sansevieria

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Wild animals	169	65.5	65.5	65.5
	Man	56	21.7	21.7	87.2
	Both man and wild animals	17	6.6	6.6	93.8
	Agents not known	16	6.2	6.2	100.0
	Total	258	100.0	100.0	

Agents destroying Sansevieria

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Wild animals	169	65.5	65.5	65.5
	Man	56	21.7	21.7	87.2
	Both man and wild animals	17	6.6	6.6	93.8
	Agents not known	16	6.2	6.2	100.0
	Total	258	100.0	100.0	

Agents destroying Sansevieria

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Wild animals	169	65.5	65.5	65.5
	Man	56	21.7	21.7	87.2
	Both man and wild animals	17	6.6	6.6	93.8
	Agents not known	16	6.2	6.2	100.0
	Total	258	100.0	100.0	

Purification and extraction of *Sansevieria* juice

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Squeezed	118	45.7	45.7	45.7
	Boiled	57	22.1	22.1	67.8
	Pounded	15	5.8	5.8	73.6
	Not known	68	26.4	26.4	73.6
	Total	258	100.0	100.0	

***Sansevieria* used as fodder**

		Frequency	Percent	Valid percent	Cumulative percent
Valid	No	195	75.6	75.6	75.6
	Yes	63	24.4	24.4	100.0
	Total	258	100.0	100.0	

***Sansevieria* used as boundary planting**

		Frequency	Percent	Valid percent	Cumulative percent
Valid	No	193	74.8	74.8	74.8
	Yes	65	25.2	25.2	100
	Total	258	100.0	100.0	

***Sansevieria* used as ornamental**

		Frequency	Percent	Valid percent	Cumulative percent
Valid	No	218	84.5	64.3	64.3
	Yes	40	15.5	15.5	100
	Total	258	100.0	100.0	

***Sansevieria* with no use**

		Frequency	Percent	Valid percent	Cumulative percent
Valid	No	166	64.3	64.3	64.3
	Yes	92	35.7	35.7	100
	Total	258	100.0	100.0	

Control of *Sansevieria* removal from niche

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Government	44	17.1	17.1	17.1
	Elders	40	15.5	15.5	32.6
	Anybody	168	65.1	65.1	97.7
	Not known	6	2.3	2.3	100.0
	Total	258	100.0	100.0	

Consent to control the use of *Sansevieria*

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	161	62.4	62.4	62.4
	No	89	34.5	34.5	96.9
	3	8	3.1	3.1	100.00
Total		258	100.0	100.0	

Population of *Sansevieria* for the last 5 years

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Increasing	138	53.5	53.5	53.5
	Decreasing	104	40.3	40.3	93.8
	Constant	16	6.2	6.2	100.0
Total		258	100.0	100.0	

Suggestion to conserve *Sansevieria*

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Enforce conservation penalties	47	18.2	18.2	18.2
	Plant more	108	41.9	41.9	60.1
	Plant more	103	39.9	39.9	100.0
Total		258	100.0	100.0	

Whether extension officers extend *Sansevieria*

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Yes	11	4.3	4.3	4.3
	No	247	95.7	95.7	100
Total		258	100.0	100.0	

Conserve *Sansevieria* through awareness creation

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Not applicable	48	86.8	86.8	86.8
	Applicable	210	81.4	81.4	100.0
Total		258	100.0	100.0	

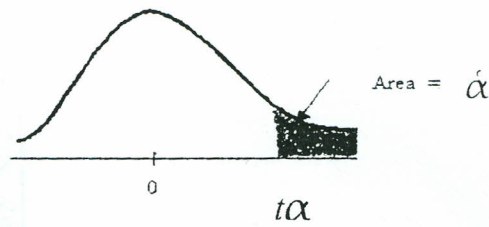
Conserve *Sansevieria* through more research

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Not applicable	224	86.8	86.8	86.8
	Applicable	34	13.2	13.2	100.0
Total		258	100.0	100.0	

Conserve *Sansevieria* both through awareness creation and research

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Not applicable	249	96.5	96.5	96.5
	Applicable	9	3.5	3.5	100.0
Total		258	100.0	100.0	

Student *t* distribution



The following table provides the values of t_{α} that correspond to a given upper-tail Area α and a specified number of degrees of freedom

Upper-Tail Area α

Degree of freedom	0.4	0.25	0.1	0.05	0.025	0.01	0.005	0.0025	0.001	0.0005
1	0.325	1.000	3.078	6.314	12.706	31.821	63.657	127.320	318.310	636.620
2	0.289	0.816	1.886	2.920	4.303	6.965	9.925	14.089	22.327	31.598
3	0.277	0.765	1.638	2.353	3.182	4.541	5.841	7.453	10.214	12.924
4	0.271	0.741	1.533	2.132	2.776	3.747	4.604	5.598	7.173	8.610
5	0.267	0.727	1.476	2.015	2.571	3.365	4.032	4.773	5.893	6.869
6	0.265	0.718	1.440	1.943	2.447	3.143	3.707	4.317	5.208	5.959
7	0.263	0.711	1.415	1.895	2.365	2.998	3.499	4.029	4.785	5.408
8	0.262	0.706	1.397	1.860	2.306	2.896	3.355	3.833	4.501	5.041
9	0.261	0.703	1.383	1.833	2.262	2.821	3.250	3.690	4.297	4.781
10	0.260	0.700	1.372	1.812	2.228	2.764	3.169	3.581	4.144	4.587
11	0.260	0.697	1.363	1.769	2.201	2.718	3.106	3.497	4.025	4.437
12	0.259	0.695	1.356	1.782	2.179	2.681	3.055	3.528	3.930	4.318
13	0.259	0.694	1.350	1.771	2.160	2.650	3.012	3.372	3.852	4.221
14	0.258	0.692	1.345	1.761	2.145	2.624	2.977	3.326	3.787	4.140
15	0.258	0.691	1.341	1.753	2.131	2.602	2.947	3.286	3.733	4.073
16	0.258	0.690	1.337	1.746	2.120	2.583	2.921	3.252	3.686	4.015
17	0.257	0.689	1.333	1.740	2.110	2.567	2.898	3.222	3.646	3.965
18	0.257	0.688	1.330	1.734	2.101	2.552	2.878	3.197	3.610	3.922
19	0.257	0.688	1.328	1.729	2.093	2.539	2.861	3.174	3.579	3.883
20	0.257	0.687	1.325	1.725	2.086	2.528	2.845	3.153	3.552	3.850
21	0.257	0.686	1.323	1.721	2.080	2.518	2.831	3.135	3.527	3.819
22	0.256	0.686	1.321	1.717	2.074	2.508	2.819	3.119	3.505	3.729
23	0.256	0.685	1.319	1.714	2.069	2.500	2.807	3.104	3.485	3.767
24	0.256	0.685	1.318	1.711	2.064	2.492	2.797	3.091	3.467	3.745
25	0.256	0.684	1.316	1.708	2.060	2.485	2.787	3.078	3.450	3.725
26	0.256	0.684	1.315	1.706	2.056	2.479	2.779	3.067	3.435	3.707
27	0.256	0.684	1.314	1.703	2.052	2.473	2.771	3.057	3.421	3.690
28	0.256	0.683	1.313	1.701	2.048	2.467	2.763	3.047	3.408	3.674
29	0.256	0.683	1.311	1.699	2.045	2.462	2.756	3.038	3.396	3.659
30	0.256	0.683	1.310	1.697	2.042	2.457	2.750	3.030	3.385	3.646
40	0.255	0.681	1.303	1.684	2.021	2.423	2.704	2.971	3.307	3.551
60	0.254	0.679	1.296	1.671	2.000	2.390	2.660	2.915	3.232	3.460
120	0.254	0.677	1.289	1.658	1.980	2.358	2.617	2.860	3.160	3.373
∞	0.253	0.674	1.282	1.645	1.960	2.326	2.576	2.807	3.090	3.291