FACTORS AFFECTING SISAL PRODUCTION BY SMALLHOLDER FARMERS IN KOROGWE DISTRICT, TANZANIA

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF AGRICULTURAL EDUCATION AND EXTENSION OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

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EXTENDED ABSTRACT

In Tanzania, smallholder sisal farmers contribute much to the total fibre produced countrywide and their contribution should not be underrated. This study which was conducted in Korogwe District aimed at investigating socio-demographic factors affecting sisal production. Specifically, the study sought to (i) determine the level of sisal production among smallholder farmers, (ii) examine smallholder farmer's knowledge and skills on sisal production, (iii) identify the farmer's sources of knowledge and skills in sisal production, and (iv) examine socio-demographic factors influencing sisal production in the study area.

The study involved three villages Mabogo, Chekeleni and Mswaha in Magoma, Makuyuni and Ngombezi wards in Korogwe District, Tanzania. In each village 30 small sisal farmers were selected randomly from the Tanzania Sisal Board database making a total of 90 respondents, in addition, six Key Informants (two from each village were included in the study. A cross sectional research design was applied where both quantitative and qualitative data were collected. Different data collection techniques were used including: Focus Group Discussions, Key Informant interview and questionnaire. It was also supplemented with direct observation for six weeks consecutively. It was found that only 35.6% of the respondents were knowledgeable on sisal production. To a large extent, respondents utilized only one source of information (extension delivery services). Socio-demographic characteristics of respondents, other factors, recent availability of market, advice and support received from Katani Limited, sharing of knowledge and experience among farmers themselves had influence on sisal production. However, shortage of capital, bush fires, pests, diseases and vermin were the major challenges facing smallholder sisal farmers in the study area. Therefore, the study concludes that

small scale farmers need to be supplied with adequate knowledge and support from responsible ministry (Ministry of Agriculture) and other stakeholders for increased sisal production as stipulated in the second goal of the National Development Vision 2025.

DECLARATION

I, VENUSTO HUBERT KASYAMAKULA, do hereby declare to the Senate of Sokoine University of Agriculture, that this dissertation is my original work within the period of time and that it has neither been submitted nor being concurrently submitted in any other institution.

_____ _____

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The above declaration is confirmed by:

_____ _____

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(Supervisor)

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DEDICATION

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LIST OF ABBREVIATIONS AND SYMBOLS

AMCOS	Agricultural Marketing Co-operative Society
ASPS	Agricultural Sector Programme Support
CSPD	Child Survival Protection and Development
DAECD	Department of Agricultural Extension and Community Development
DANIDA	Danish International Development Agency
DFID	Department for International Development
FAO	Food Agricultural Organisation
FHHs	Female Headed Households
GDP	Gross Domestic Product
GNP	Gross National Product
HHs	Household Heads
IFAD	International Fund for Agricultural Development
ILO	International Labour Organisation
IRDPs	Integrated Rural Development Projects
MCDGC	Ministry of Community Development, Gender and Children
MDG	Millennium Development Goal
MHHs	Male Headed Households
MoH	Ministry of Health
NGOs	Non- Governmental Organisations
OFSP	Off-Farm Seed Production
PPP	Public-Private Partnership
SISO	Sisal Smallholders and Outgrowers
SNAL	Sokoine National Agricultural Library
SPSS	Statistical Package for Social Sciences
SUA	Sokoine University of Agriculture

UNDP	United Nations Development Programme
UNICEF	United Nations Children Fund
UNIDO	United Nations Industrial Development Organization

CHAPTER ONE

1.0 GENERAL INTRODUCTION

1.1 Background Information

About 4.5 million tons of sisal fibers are produced annually on global scale from both small and large scale farmers for which the major producers are Tanzania, Brazil, China and South Africa (Pappu *et al.,* 2015). As production tends to fluctuate with changes in climate and political strategies in recent years, the biggest producers of sisal fibers by ranking from the highest to the least are Brazil, Kenya, Tanzania, Mexico, Madagascar, China (mainland), Haiti, Venezuela and Others (Morocco, South Africa, Mozambique Ethiopia, Angola and Jamaica) (Pappu *et al.,* 2019; FAO, 2019). Sisal fiber is an environmentally friendly product that is customarily used for making ropes, cards, fishing nets, padding mat, ropes for the marine industry as well as ornamental articles including table mats, purses, raw material in polymer composites, wall hangings and its wastes are used in energy production (Sarkar, 2015; Pappu *et al.,* 2019).

Sisal production is one of the key sources of income generating activities as it provides employment opportunities to a great number of people in sisal growing communities (Srinivasakumar *et al.,* 2013). For example, in India the sisal industry alone employs about 500 000 people per year (Sarkar, 2015). Sisal as a natural fibre, has an edge over other fibre crops as it can withstand many agro-ecological conditions and it is an environmentally friendly crop. It is a renewable resource that can form part of the overall solution to climate change (FAO, 2016). It is also a drought resistant crop that does not require the use of fertilizers, herbicides or insecticides and can be intercropped with other crops (Mande, 1998; Santos, 2018). During processing, sisal generates bioenergy, fertilizer and ecological housing materials that are not harmful to the environment (Henderson, 2012).

In East Africa the chief sisal producers and exporters are Kenya and Tanzania, Kenya is second and Tanzania is in third position at the global level (FAO, 2019). These countries earn vast amount of foreign currencies through the export of sisal fibers and the amount earned helps to boost the economy of the countries as reflected in the development and maintenance of infrastructures such as roads, railways, power supply, ports, buildings and water supply hence improved livelihood (Srinivasakumar *et al.*, 2013).

In Tanzania, the sisal industry employs over 100 000 people, with a total production of about 40 000 tons per year. Farmers participating in the sisal value chain include those working in estates and smallholders growing sisal as a cash crop in non-estate areas (Katani, 2016). In 2012, approximately 25% of sisal was produced by smallholder farmers (FAO, 2013). This contributed much to the positive economy of the country in various aspects such as creation of employment opportunities, construction of infrastructures and provision of social services throughout the country (Hartemink and Wienk, 1995; Katani, 2016). Tanzania Sisal Board (TSB) has planned to increase production of sisal fiber to 80 000 tons annually by 2022. This will be achieved by increasing production through reviving farms that have been abandoned and increasing the participation of smallholder farmers from the current 6 000 to 10 000 farmers (TSB, 2016). In Tanzania smallholder sisal farmer's involvement in production could potentially act as a startup gear towards increased sisal production if they are provided with conducive environment for them to explore their full potential, thus requiring targetful studies to better inform the stakeholders.

1.2 Problem Statement and Justification

Although several studies in the past decades have been done to assess factors affecting sisal production by smallholder farmers in Tanzania and elsewhere in the world, there

was a sharp decrease by 50% between 1970 and 1990 reflecting a global crisis (Common Fund for Commodities, 1990; Paola and Shakib, 2007; Santos *et al.*, 2018). In Tanzania, sisal production dropped significantly to less than 30 000 tons in 2001 as compared to peak production of 230 000 tons in 1964 (Katani 2016). Despite the recent increased demand on sisal fibre at the global scale, little is known about the factors affecting sisal production in Tanzania. Therefore, accurate knowledge on the factors affecting sisal production among smallholder farmers will better inform stakeholders to act accordingly in line with the second goal of the National Development Vision 2025, which advocates for the increased agricultural production, particularly sisal production. Thus, this study aimed to establish factors affecting sisal production by smallholder farmer's in Korogwe District, Tanzania.

1.3 Objectives of the Study

1.3.1 Overall objective

The overall objective of the study was to establish factors affecting sisal production by smallholder farmers in Korogwe District, Tanzania.

1.3.2 Specific objectives

The specific objectives of this study were to:

i. Determine the level of sisal production among smallholder farmers
ii. Assess smallholder farmers' knowledge and skills on sisal production
iii. Identify farmers' sources of knowledge and skills in sisal production
iv. Examine socio-demographic factors influencing sisal production in the study area.

1.4 Research Questions

i On average, how much sisal does a smallholder farmer produce per hectare?

ii What is the level of smallholder farmers' knowledge and skills on sisal production?

iii Where do farmers obtain knowledge and skills important for sisal production?

iv What socio-demographic factors affect sisal production?

1.5 Significance of the Study

The findings of this study will assist policymakers and other sisal industry agents in the study area and across the country to come up with suitable strategies and policies aiming at improving sisal production among smallholder farmers. The study also provides a platform for policymakers, such as local governments, NGOs, and other stakeholders interested in sisal production agricultural systems, to make appropriate decisions for increased sisal production and improved farmers livelihoods. Furthermore, this research adds to the background knowledge for future research on the sisal sector and related crops.

CHAPTER TWO

2.0 GENERAL LITERATURE REVIEW

2.1 Empirical Literature Review

2.1.1 Sisal production in the world

Sisal is a xerophytic, monocarp, semi-perennial leaf fiber producing plant that is produced globally as one of the major cash crops. Scientifically, sisal is called Agave and several species of it exist for example the Asparagaceae family that has the following species; *Agave fourcryodes, Agave vera-cruz, Agave cantala, Agave amaniensis, Agave angustifolia* and *Agave sisalana*. Of these species *A. sisalana* is widely produced and it contributes about 85% of the total world sisal fibre production (Sarkar, 2015). The biggest sisal fiber producers in the world are; Brazil, Kenya, Tanzania, Mexico, Madagascar, China (mainland), Haiti, Venezuela and Others (Morocco, South Africa, Mozambique Ethiopia, Angola and Jamaica) producing about 89 000, 28 000, 26 000, 20 000, 19 000, 16 000, 9 000, 7 000, 8 000 tons per year respectively (FAO, 2019). Brazil is the largest producer and exporter of sisal fiber and the sisal industry employs approximately 700 000 people in the state of Bahia, where about 95% of Brazilian sisal is produced (Cantalino *et al*., 2015).

Globally, the land allocated for sisal production is about 249 000, 58 000, 40 000, 27 000, 16 000, 15 000, 23 000 hectares for Brazil, Tanzania, Kenya, Mexico, Madagascar, Haiti, and others (China, Morocco, South Africa, Venezuela, Mozambique Ethiopia, Angola and Jamaica) respectively (IBAM, 2007; Sarkar, 2015). China is the leading country for sisal fiber importation followed by Spain and Mexico. Likewise, in East Africa, Kenya is the number one importer and exporter of sisal fiber (FAO, 2019).

2.1.2 Sisal production crises and recovery in the world

In the 1980s sisal experienced a severe crisis that was associated with the burning of the sisal plantations, a large reduction in production and a drop in the price of fiber in the international market (Santos *et al.,* 2017). Initially the crisis was attributed to the competition with synthetic fibers, later it was revealed that the wide-spread of diseases, inadequate upkeep of the fields, combined with sharp declines in international prices, placed the cultivation of sisal into a crisis that had the heaviest impact on sisal workers whose income became sharply reduced (Santos *et al.,* 2017).

The recovery of the sisal productive system and its restructuring in the early 1990s focused on the idea that it was not enough to simply decorticate and export, it was necessary to industrialize the fiber to add value, rescuing the worker for industrial employment and increasing the amount paid per kilo of fiber. It was also associated with the Worlds' emphasis on the use of biodegradable fiber to substitute synthetic fiber for environmental protection hence increased global market (Campanharo *et al.,* 2019). All these contribute to a path towards restructuring and integrating with the actions of smallholder producers who can join together to better compete in the sisal market.

2.1.3 Sisal production in Tanzania

In 1893 sisal was introduced in Tanzania by Dr. Hindorf (a German Agronomist). The first 62 sisal plants were planted in Pangani District, Tanga Region and these plants were the foundation of the sisal industry in East Africa (Lock, 1969). In 1904 some 2000 hectares of sisal were planted in Tanga and Lindi (FAO, 2013). Currently there are 48 sisal estates (Tanzania Sisal Board, 2017). The sisal producing regions in Tanzania are Tanga, Morogoro, Kilimanjaro, Arusha, Shinyanga, Mara, Lindi and Coast (Senkoro and

Mkorongwe, 2018). Meanwhile, the sisal sub-sector is the oldest commercially organized sector and one of the longest surviving agricultural industries in Tanzania (FAO, 2013).

In 1960, Tanzania was a leading sisal producer in the world and contributed 24% of the worlds' total fiber production but since 1970 onwards the production declined due to greater competition with the synthetic polymers that seemed to be cheaper than sisal fibers hence took over the market, as a result the sisal industry became half dead (Kimaro *et al.,* 1994). Nevertheless, of biodegradable fiber to substitute synthetic fiber with the major agenda on environmental protection hence increased global market (Campanharo *et al.,* 2019). From the year 2006 to 2018 sisal production in Tanzania started a slow recovery with an increase of about 6530.08 tons, that is to say it raised from 30 934 tons to 37 463.88 tons for which it is still very low as compared to the year 1964 that was 230 000 tons (Tanzania Sisal Board, 2018).

Smallholder sisal farming scheme came in since 1967 at Kabuku in Tanga and Kimamba sisal estate in Morogoro but it failed to flourish due to lack of knowledge and market among farmers, and the large farming schemes by then were under control of white farmers. In 1999 smallholder sisal farmers started again producing sisal under contract with Katani Company Limited under a scheme called Sisal Smallholder and Out growers (SISO) in Tanga region (Tanzania Sisal Board, 2016). This scheme thrived for only 19 years due frequent conflicts between the company (Katani Limited) and smallholder sisal farmers. The conflict was attributed by late payment to farmers and small turn over caused by low price. After the collapse of SISO it was then handed to Sisalana Company Limited which is still operating to date. There are other independent

farmers who are not under contract farming scheme rather they grow sisal independently (Tanzania Sisal Board, 2017).

Smallholder sisal farmers cultivate approximately 25% of total sisal cultivated in Tanzania (FAO, 2013). To date, the global demand of sisal fiber as a substitute to synthetic fibers is high resulting to high price on sisal fibers (Tanzania Sisal Board, 2018). Despite this assertion, sisal production in Tanzania is still low and little is known about the factors affecting sisal production in Tanzania. According to Hopkinson et *al.* (1964) and FAO (2018), sisal production requires a fertile soil, aerated soil with good rainfall distribution of about 1000 to 2000 mm throughout the year. The land has to be cultivated 45 centimeters deep in the main field for normal timely leaves sprouting and allow two times harvest in a year, maintaining strength of fiber, and well establishment of roots and stems. It is propagated by using bulbils produced from buds in the flower stalk' 'pole' or by suckers growing around the base of the plant 'rhizomes', bulbils are grown in nursery fields until large enough to be transplanted to their final positions in the main field. It is weeded four times a year when it is at immature stage and two times at mature stage. The crop takes three years to start harvesting which will then continue for 8-10 years. During harvesting the sisal knife "Okapi" is used to cut sisal leaves and get transported to processing machines. Sisal leaves are processed to fibers by a decortication machine (Corona) and the resulting pulp is scraped from the fiber and washed then dried by mechanical or natural means, and finally grading, packaging and storage ready for sale in the market.

2.1.4 Sisal value chain

Sisal value chain is a series of activities (nodes) that are involved in sisal production from the first stage to the final stage of marketing and it has four major nodes; Production

(land preparation, planting/replanting and field maintenance), Harvesting and haulage (field testing, cutting, loading and transporting), processing (feeding, decorticating, drying, brushing, grading and baling) and marketing (transporting, stocking and shipping). Smallholder sisal farmers are mainly involved at the nodes of production, harvesting and haulage, and at the marketing due to the fact that processing is done by experts (Jeckoniah, 2018).

2.2 Socio-Demographic Factors Affecting Crop Production

2.2.1 Gender

In Africa, women perform the majority of agricultural activities (Simperegui *et al.*, 2019). In agricultural production, nearly 70% of the workforce is females (Dekens and Vivek 2014). Women participate in sowing, weeding, harvesting, and storing crops (Diouf, 2013). Agriculture is the main activity of the population, especially in rural areas, with women accounting for 42.2% of the 65.5% of active population (Houinsa, 2013).

2.2.2 Age

Age is the most decisive factor that determines the productive potential of a certain household that can be seen differently. According to (Adebiyi and Okunlola, 2013; Shumet, 2011; Anyanwu, 2009) age can be related to farm experience and as age increases farm experience increases and then input adoption as well as production will increase up to a certain age limit. According to Shumet (2011) in Ethiopia and Amaza *et al.* (2006) agriculture in Nigeria, as in developing countries is more of labour intensive, after a certain age where farmers' physical strength decreases and their conservativeness increases, production will finally decrease.

2.2.3 Marital status

Marital status seems to be an important factor in crop production among and pastoral communities in the sense that majority of rural residents are still employed in the farming sector, where families with married couples and the household head is the male seem to be more stable hence higher crop production (Echebiri and Mbanasor, 2003; Hariohay *et al.,* 2017). Marital status is an important factor that should always be considered when speaking of crop production especially in African societies (Kilobe *et al*., 2013). Furthermore, married women can participate directly or indirectly on crop production due to their multiple roles and cultural practices in a particular community (Ayoola *et al*., 2014).

2.2.4 Education level

Education level of farmers is an important factor in crop production that is expected to have a positive correlation on crop production when other factors are under constant state. That is to say the educated farmers are more favoured to the changes and application of modern technology and easy to access knowledge from various media (Dolisca and Jolly, 2008); Odoemenem1 and Obinne 2010). Farmers with formal education are more likely to take advantage of rational decision-making regarding crop production and market without much difficulty (Mfunda *et al.,* 2010; Ngailo *et al.,* 2016).

2.2.5 Experience

The day-to-day management of the field operations over a long period of time has a positive impact on farmers' ability to master their fieldwork. Experience provides a person with some agronomic skills that helps for easy management of farm work and being in a position to solve some of the challenges (Johnson and Poulton, 2018). Thus it

is an important factor that is likely to have a positive correlation on crop production; meaning that the more the experience of a farmer the more crop production yield is expected (Ayoola1 *et al*., 2014; Borchelouie *et al*., 2015).

2.2.6 Occupation and main source of income

Farmers' occupation is an important parameter that defines the specialization of a particular person that can influence either positively or negatively upon production and exposure to environmental factors that in one way or another can define the health status of an individual hence positive or negative crop production (Kenneth *et al.,* 2014). Also it defines the place of crop farming activities as to whether practiced in urban or rural (Lekei *et al.*, 2014; Johnston, 2018). For most of agricultural communities in developing countries about 3/4 of the farming households earn their income from farming activities and the rest from both farming and non-farming activities (Ogato *et al.,* 2009). Nevertheless, income source especially in agricultural communities may be affected by climatic variations (Arndt *et al.*, 2012).

2.2.7 Land ownership and control of land

Land ownership is a crucial factor in agriculture and most of rural communities involved in crop production seem to own land, however, there is also contract farming and hiring of lands that is also practised and is more practical in case of sisal farming (Ngailo, 2016). Contract farming schemes has been recognized as one of the important components in agriculture sector with an intention to mobilize farmers' and distribute land for easy monitoring so as to boost their production hence improve their livelihood (Isager *et al.,* 2021). The amount of land owned and allocated for crop farming by an individual seem to have a direct relationship with crop production, meaning that the smaller the area allocated the smaller the yield is expected and vice versa (Guo, 2015). Furthermore,

households that are led by men seem to acquire more land compared to those led by female household heads (Khapayi *et al.*, 2016).

2.2.8 Household dependents

The number of dependents in a household has a direct effect on the availability of family labour in the household where defendants can be grouped into two main groups the productive group (children old enough to participate in crop production) and the non-productive group (young children, elderly and sick persons) (Chimai, 2011). As the number of children, elderly and ill members increase, availability of family labor declines and vice versa (Lebina, 2019). That is why in most of agricultural communities the number of household members is always high on average ranging from five to eight members (Ochieng, 2017).

2.3 Other factors affecting sisal production among farmers

Some studies have shown various factors affecting crop productivity particularly sisal production, among the revealed factors were; low application of irrigation, low use of fertilizers, supply of seeds that farmers do not like, and extension workers engaged in activities unrelated to their professions (Abrha, 2015). Not only that but also limited provision of extension education, non-agricultural policies, poor access to fertilizers, improved seed and other chemical inputs and dissemination services (Urassa, 2015). Likewise, Labour force, rainfall, government spending are factors that seem to affect sisal productivity (Muraya and Ruigu, 2017).

2.3.1 Land size allocated for crop production

According to Tsegaye (2008), growth in the number of child-rich households with higher consumption requirements and young labour force seeking land for employment creation

are the driving force behind area expansion. Similarly, it is believed that land size is an indispensable asset of agricultural production increment. Land holding size is directly related to crop production; and while quantifying a 1% expansion in land size will result in 0.32% increase in agricultural output (Mpawenimana, 2005).

2.3.2 Labour force availability

Farm labour is a major source of employment opportunity for the labour force in agriculture. Similarly, shortage of farm labour supply may lead to low farm productivity, a situation which has been considered a major problem especially in some developing countries (UNCTAD/LDC, 2015).

2.3.3 Technology use (tractors and other machines)

The use of technology in agriculture such as mechanized machines like tractors, planters and other related means has a greater impact in crop yields both in quality and quantity (Chimai, 2011). The use of technology helps to reduce time spent and number of labour in the field resulting into cultivation of a large area for more crop yields or a small area but more efficient (Mwaniki, 2018). In the majority of developing countries, agricultural production is low, mainly due to lack of mechanization and production processes powered with modern technology (Nerini *et al.,* 2016) Additional most of process machines for sisal production are most old and out-of-date.

2.3.4 Bush fires

Uncontrolled bush fires are one of the frequently reported challenges that appear to hinder crop production in most of agriculture communities. Fire has a direct effect on the plant life and the effect is even worse on the young plants (Puglisi, 2005; Neba, 2009; Dimitra

et al., 2019). Fires occur mainly on seasonal occasions during the process of land preparation for seasonal crops such as maize from the neighboring farms and as bush fires set by some cone people either intentionally or accidentally and as a result of conflicts between farmers' and pastoral communities (Benjaminsen *et al.,* 2009).

2.3.5 Vermin and diseases

Crops normally face some challenges from sowing to harvest, therefore are prone to some living creatures (vermin) that cause mechanical damage to plants such creatures are like monkey, warthogs etc. Apart from vermin, crops are affected by several diseases that need much attention before they completely destroy the crops (Savary *et al.,* 2012). For example sisal is affected by several diseases such as Korogwe leaf spot, dieback disease, zebra disease caused by Phytophthora nicotianae and the bole rot or red rot caused by Aspergillus niger. Once the sisal plant is infected by Aspergillus niger, the bole starts to rot, the internal tissues become brown and after some months, the plant meristem is completely affected, interrupting the communication between the bole and leaves, then the leaves becomes yellow and when bole is completely rotten the plant collapses to death (Gama *et al.,* 2015).

2.3.6 Market availability

In the1980s severe sisal crisis that was associated with the burning of the sisal plantations, a large reduction in production and a drop in the price of fiber on the international market. It was attributed by the competition with synthetic fibers and the widespread sisal diseases (Santos, 2018). Nevertheless, from the 1990s sisal regained its value due to the Worlds' emphasis on the use of biodegradable fiber to substitute synthetic fibers with the idea of environmental protection; this resulted into increased demand on sisal fibers hence raising the price as a result of increased market globally to date (Santos *et al.*, 2018).

2.3.7 Capital availability

Capital is an important factor in agriculture that enable farmers to increase yield through smooth runnig of their fields. More capital is needed for cash crop like sisal since the requres a big area Zakaria *et al.* (2019). Most of farmers in developing countries like Tanzainia use their own funds as it is not easy to access loans from formal financial institutions (Mdemu *et al.,* 2017). Also most farmers depend on incomes from friends and non-formal institutions (Salami *et al.,* 2010).

2.3.8 Strategies for enhancing knowledge and skills in farmers for crop production

Effective agricultural knowledge by farmers is important for increased access to agricultural knowledge (Khapayi and Celliers, 2016; Mtega and Ngoepe, 2018). There are different forms of flow of agricultural knowledge; one is the flow of agricultural knowledge from one person/organization to another through knowledge sharing, exchange, transfer or dissemination to the intended audience (Mtega and Ngoepe, 2018). Knowledge sharing involves acquisition and application of knowledge by the recipient; multi-directional movement of knowledge between different units, divisions or organizations rather than individuals (Wang, 2010). It also involves an exchange of knowledge between two individuals: one who communicates knowledge and one who assimilates it. The focus of knowledge sharing is on human capital and the interaction of individuals (Paulin, 2015). To enhance access to agricultural knowledge, it is important to determine how formal and informal knowledge-sharing settings are used to make agricultural knowledge sharing successful (Mtega and Ngoepe, 2018). Therefore, farmers receive knowledge and skills from various agencies such as extension delivery services through extension agricultural officers, various media like television, internet and radios, knowledge and skills sharing among farmers themselves, trainings from the ministry of

agriculture and other relevant stakeholders (Omari *et al.,* 2018). According to Rutatora and Mattee (2001), many districts in Tanzania are unable to fund extension services from their own sources without external assistance. The poor financial situation makes it difficult for the districts to allocate sufficient funds to extension services as a result the extension workers are not able to reach many farmers. To ensure the performance of the agricultural sector, it is important that agricultural extension services in Tanzania be provided regularly and timely (Rutatora and Matee, 2001).

2.4 Theoretical and conceptual framework of the study

2.4.1 Theoretical framework

The research is guided by the theory of production, which is based on Smith's paper: *The Wealth of Nation* (Smith, 1789). All production outputs, according to the theory, are determined by a selection of involved factors and their perceived and exhibited optimal combination (Njogu, 2019). The traditional approach to the idea focuses at the physical resources that are directly involved in production and may then be appropriated for value and cost. However, the modern approach, which is employed in this study, goes beyond physical resources to include technological progress, and intellectual and social capital (Daly and Ferley, 2011). According to Ojala *et al.* (2014), the theory drives the profit notion in terms of maximum output levels. To put it in another way; a farmer is a rational decisions maker striving to maximize profit, which, however, depends on his/her understanding of all factors involved in the production and their correct combination to yield a balanced costing system. According to Mourtzinis *et al.* (2017), factors affecting crop productivity include intellectual (farmer knowledge), demographic (age, sex), access to land, extension services, and technology. The theory is relevant to this study as it expounds on the necessary conditions for farmers to produce successfully.

2.4.2 Conceptual framework of the study

According to Adom *et al.* (2018), a conceptual framework is a construct model demonstrating the interaction between numerous attributes that fall mainly into two major groups namely independent variables and dependent variables for which they exhibit a causative relationship. Based on the objectives of this study, Figure 2.1 shows that any change in the independent variables is directly reflected to the outcome of the dependent variable as whether to influence the production positively or negatively. Physical resources, technological variables, intellectual and social capital all have an impact on production and a farmer makes rational decisions in order to maximize profit (Ojala *et al.*, 2014). Njogu (2019) divided these components into two categories: production and institutional factors.

This means that if small scale sisal farmers can optimize the use of technology like tractors, decortication machines, chemicals, access to credit, market access, extension services, access to sisal hybrid seedlings/plantlets, and access to reasonable sized land at a reasonable cost, it will result into high sisal production in terms of maximum number of tons that will be harvested annually. Furthermore, organization support, such as that provided by Katani Limited and the Tanzanian Sisal Board, as well as agricultural policy, have an impact on small sisal production among small farmers. Figure 2.1 depicts how sisal output increases when the independent variables are fully implemented and operationalized.

Independent variables

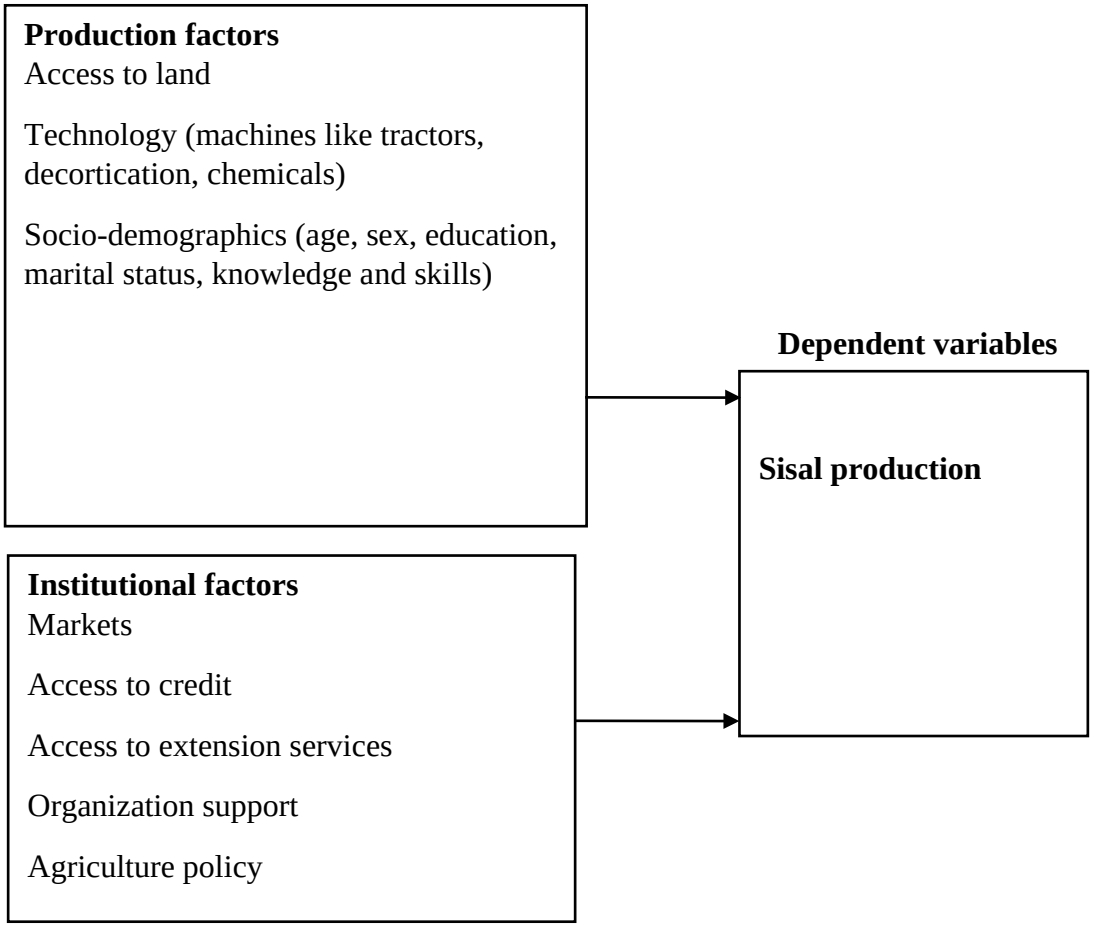

Figure 2.1: Conceptual framework adapted and modified from Njogu (2019).

CHAPTER THREE

Paper One

Level of Sisal Production among Smallholder Sisal Farmers in Korogwe District, Tanzania

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3.1 Abstract

Sisal industry at the global scale experienced a severe crisis in 1980s downfall and slowly resumed in the early 1990s. Tanzania was equally affected by the crisis and the sector nearly collapsed affecting both large scale and small producers, and upon recovery only a marginal change continued to be observed. Smallholder sisal farmers contribute nearly one third of total sisal cultivated in the country most of whom are in Tanga Region. Their production level is not well established, lagging behind the government efforts towards increased sisal production in the country. This study aimed at establishing production trend for appropriate decision making for increased production in the study area and country wide. A cross-sectional study that ran from early March to late April 2020 was conducted through the use of questionnaire. Focus group discussion and Key Informants were used as well. Also supplementary information was obtained through direct observation. Data were analysed both qualitatively and quantitatively using SPSS version 20 program and Microsoft Excel. The study findings revealed that about 28.9% of the respondents produce between 1 – 10 tons per harvest. This highlights that, production is still low despite the fact that more than half of the smallholder sisal producers in Tanzania are from Northern zone, Tanga Region in particular. Therefore, much is needed to be done by the government through the Ministry of Agriculture in supporting and timely solving challenges facing smallholder sisal farmers in the study area and the like.

Keywords: Sisal trend, Sisal crisis, Sisal production

3.2 Introduction

About 85% of the total world sisal fibers are produced by the following mega producers in terms of magnitude Brazil, Kenya, Tanzania, Mexico, Madagascar, China (mainland), Haiti, Venezuela and Others (Sarkar, 2015). Production is about 222 000 tons annually on the global scale whereby Brazil contributes a large share in production and exportation of sisal fiber (Cantalino *et al*., 2015; FAO, 2019). Similarly, Tanzania occupies the second position as the producer while Kenya is number one exporter and importer of sisal fiber in East Africa (IBAM, 2007; FAO, 2019). In the 1980s sisal industry had a severe downfall in production and it was resumed in the early 1990s due to global policy change on environmental protection aspects (Santos *et al.,* 2018; Campanharo *et al.*, 2019).

Sisal production in Tanzania had a slow increase of about 6 530.08 tons from 2006 to 2018 being low when compared to 1964 (230 000 tons) (Tanzania Sisal Board 2018). The contribution of smallholder sisal farmers is nearly one third of total sisal cultivated in Tanzania (FAO, 2013). Of these, smallholder sisal farmers in Tanga Region were reported to produce more as compared to other regions (Tanzania Sisal Board, 2018). To date, the global demand of sisal fiber is high while production is questionable with clear information of the subject matter (Tanzania Sisal Board, 2018). This prompted to search for an overview of the production trend among smallholder sisal farmers in Korogwe District, Tanzania. Therefore, clear understanding of the production trend will inform potential stakeholders better for timely and appropriate strategies formulation resulting to increased sisal production in the study area and the country at large.

3.3 Sisal Production Trend among Smallholder Farmers in Tanga Region (2010 - 2019)

The production of sisal among small holder farmers in the study area had shown a varied trend ranging from 4 tons to 6 tons per year. That is to say 4490, 4316, 4960, 4850, 5129, 5105, 6194, 5916, 5625 and 5778 tons in 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018 and 2019 respectively (Figure 3.1).

Figure 3.1: Small holder farmers' production trend for sisal in Tanga region from 2010 to 2019 (Source: TSB, 2019)

3.4 Methodology

3.4.1 Description of the study area

Korogwe district is located in Tanga Region, Tanzania. It has an area of 3,756 square kilometres and lies between the latitude 4º15’ and 5º15’ South, and between longitudes 38º0 and 38º45’ East. The District has loamy, sandy and clay soils with the natural vegetation being predominantly of the tropical type for which sisal grows well. It has an average annual rainfall ranging between 800-1000mm. Several rivers, like Pangani and Lwengera drain this area providing irrigation possibilities. The main food crops grown are maize, paddy, beans, cassava and potatoes while the cash crops cultivated includes cashew nuts, cotton, sisal and tropical fruits like mangoes, oranges and tangerines. Livestock is also reared for milk and meat production.

This study was carried out in Korogwe District where three wards were involved; Makuyuni, Ngombezi and Magoma as shown in Figure 3.2 below. The study areas were selected purposively based on the main reason that they are areas with large number of sisal farmers; also the large area of the land is occupied by sisal estates (Msuya *et al.*, 2018). In total, Korogwe District has about 1207 small scale sisal growers both in government owned large scale farms (estates) and private farming system (Tanzania Sisal Board, 2016).

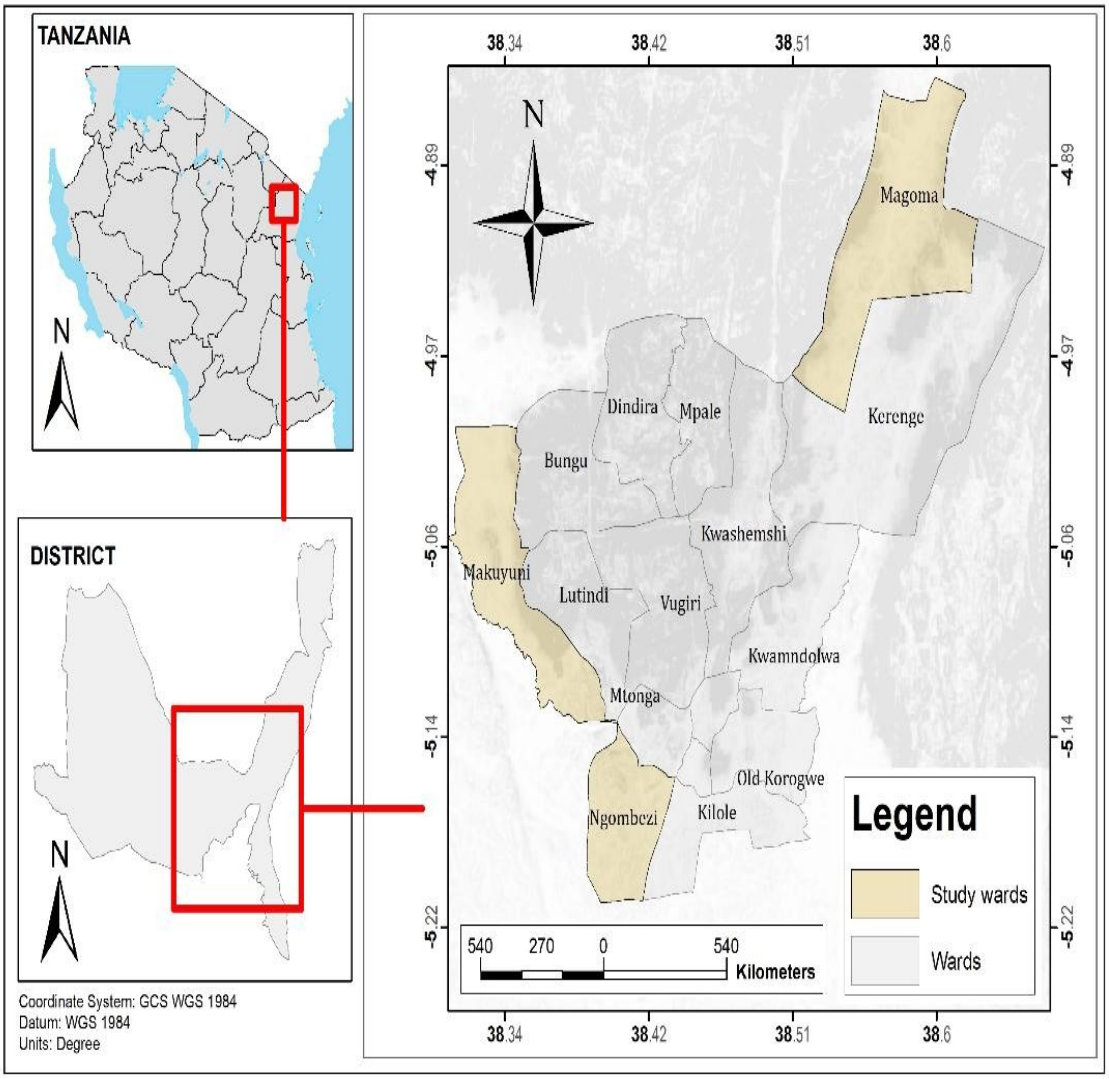

Figure 3.2: A map showing the study area in Korogwe District Tanzania where three wards were involved namely Makuyuni Ngombezi and Magoma

3.4.2 Study design

Pittenger (2003) defined research design as a technique used to collect data that intending to answer empirical questions. In this study, the researcher used cross-sectional research design for the study population (Omair, 2015). In cross-sectional study designs, data collection occurs at one point in time as opposed to longitudinal study designs, where subjects are followed over time (Johnson, 2010).

3.4.3 Sample size and sampling procedures

Sampling is an important part of research and the sample size ranging between 30 and 500 at 5% confidence level is regarded to be sufficient for many researchers (Altunışık *et al.*, 2004). The sampling frame for this study was all smallholder sisal farmers in Korogwe district. The sampling frame was obtained from the Tanzania Sisal Board database and it had a total of 1207 smallholder sisal farmers. Out of the 20 wards found in Korogwe district, three wards namely Magoma, Ngombezi and Makuyuni were selected purposively for the study as they are heavily involved in sisal cultivation. Only one village was selected from each ward by a simple random technique, and the selected villages were Mabogo, Chekeleni and Mswaha from Magoma, Makuyuni and Ngombezi wards respectively. Respondents were selected by simple random selection geared by generation of random numbers from the Tanzania Sisal Board database selecting 30 respondents from each village resulting into 90 respondents plus two Key Informants from each village. In addition six Key Informants were interviewed; three were ward executive officers one from each ward and the other three were leaders for smallholder farmers. The selected respondents were contacted and scheduled for interviews that was voluntary and involved only those who were ready and willing to participate.

3.4.4 Collection of data

Data collection was conducted from early March 2020 to late April 2020 in Korogwe District in Tanga Region. Data collection was done with the help of two trained enumerators. Semi structured questionnaire was used as a tool for interviewing participants. FGD and Key Informant interviews were conducted to obtain respondents views on the subject matter with the help on an interview guide. Three FGDs were conducted, one from each village comprising of 8 smallholder famers. The selection of

the famers considered gender, age, education and experience on sisal production. Primary data were collected from the sisal farmers using a questionnaire and interview schedules. Secondary data were collected from Tanzania Sisal Board on the farmers' activities such as land area, market trends, production and sales.

3.4.5 Data analysis

3.4.5.1 Quantitative data analysis

Data on level of sisal production were analysed both quantitatively. Quantitative data were analysed by the use of the Statistical Package for Social Sciences (SPSS) version 20 program and Microsoft Excel. Furthermore, descriptive statistics were computed to determine frequencies, percentages, means, minimum and maximum values of individual variables then presented in tables, figures and graphs.

3.4.5.2 Qualitative data analysis

Qualitative data were analysed as per qualitative analysis protocol; Transcription, Organisation, Coding into themes, Verification, Interpreting and Reporting. Data from Focus Group Discussions, Key Informant interviews and observations were analysed as follows; the audio responses were transformed into text format, it was then organised into computer files for easy retrieval, it was then followed by putting together the important ideas (themes) that had been said by about 75% of the respondents on key questions and the gathered information was then crosschecked in relation to other sources on the subject matter. Finally, themes were carefully analysed in order for the researcher to interpret the information beyond the data gathered so as to make conclusions which are valid and reliable.

3.5 Results and Discussion

3.5.1The trend of sisal production among smallholder farmers in the study area

From Table 3.1 the study results revealed that Chekeleni village was leading with 13.3% followed by Mabogo 10.0% and Mswaha 3.3% for farmers who produced between 1 – 5 tons. Between 6 – 10 tons production was 46.7%, 13.3% and 0.0% from Chekeleni, Mabogo and Mswaha respectively, between 11 – 15 tons was 10.0%, 6.7%, and 0 from Chekeleni, Mabogo and Mswaha respectively, and above 15 tons was 33.3%, 20.0% and 5.0% from Mswaha, Chekeleni and Mabogo respectively. However, during the study period farmers in the study area had immature sisal in about 65.0%, 63.3% and 10.0% of the respondents from Mabogo, Mswaha and Chekeleni respectively. This means over half of the smallholder sisal farmers in the study area had young sisal plantations not yet ready for harvest especially in Mswaha and Mabogo.

About 28.9% of the respondents produced between 1 – 10 tons followed by 24.5% who produced between 11 – 15 tons (Table 3.1). This infers that more than half of the smallholder sisal producers in Tanzania are from Northern zone. The findings concur with the report by TSB (2017) which indicated that about 69% of the total sisal grown in Tanzania was produced in Tanga Region where the current production in the country is approximately 40 000 tons of sisal fiber per year as recorded in 2015. In addition, Tanzania is in the top-five world producers of the product (GAFSP, 2016).

Table 3.1: Level of sisal production in tones among smallholders farmers for the past three years (2017 – 2019)

Village	Level of production (tons)				
	1-5	6-10	11-15	>15	Immature sisal
Mabogo	3(10.0)	4(13.3)	2(6.7)	1(5.0)	20(65)
Chekeleni	4(13.3)	14(46.7)	3(10.0)	6(20.0)	3(10.0)
Mswaha	1(3.3)	0(0.0)	0(0.0)	10(33.3)	19(63.3)
Total	8(8.9)	18(20.0)	5(5.6)	17(18.9)	42(46.6)

Source: Questionnaire data

3.6 Factors Contributing to Varying Trend of Sisal Production among Producers

3.6.1 Socio-demographic characteristics

From Table 3.2, the descriptive results from this study show that about 66.7% of men were engaged in sisal cultivation as compared to 33.3% of women. Majority of respondents had experience of 15 years and above (56.7%), crop farmers (74.4%), owned land (86.7%), men controlled the land (82.2%), 1-4 dependent children (83.3%) and 1-4 dependent adults (61.1%).

Characteristic	Category	Frequency	Percentage
Sex	Male	60	66.7
	Female	30	33.3
Age	18 - 25	2	2.2
	26 - 36	10	11.1
	37 - 50	41	45.6
	51 and above	37	41.1
Marital status	Single	6	6.7
	Married	65	72.2
	Widowed	17	18.9
	Divorced	2	2.2
Education level of respondents	Non-formal education	12	13.3
	Primary education	49	54.4
	Secondary education	12	13.3
	College (Certificate	11	12.2
	and Diploma)	6	6.7
	University		
Experience of respondent	Below 15 years	44	43.3
	15 years and above	51	56.7
Major occupation	Crop farmer	67	74.4
of respondent	Crop farming and livestock keeping	22	24.4
	Business and crop farming	1	1.1
Main source of income	Crop Farming	67	74.4
	Livestock keeping	1	1.1
	Crop farming and livestock keeping	22	24.4
Land ownership	Yes	78	86.7
	No	12	13.3
Controller of land	Husband	74	82.2
	Wife	16	17.8
Number of dependent children	0	11	12.2
	1 - 4	75	83.3
	5 - 8	4	4.5
Number of dependent adults	0	30	33.3
	1 - 4	55	61.1
	5 - 8	5	5.6

Table 3.2: Socio-demographic characteristics

Inferential results (Table 3.3) show the test results from binary logistic regression for socio-demographic characteristics revealed that there was no significant difference in sisal production with respect to gender, marital status, and number of dependent adults and main income source of the respondents. However, the test results revealed that there was a significant difference in sisal production with respect to age, land ownership, education level, experience, land controller whether male or female, number of dependent children and major occupation of the respondent as below;

Table 3.3: Socio-demographic characteristics in relation to the level of sisal production among smallholder farmers for the past three years

					95% C.I.for EXP(B)	
		B	df	Sig.	Exp(B)	Lower	Upper
Step 1[a]	Gender(1)	.314	1	.591	1.368	.436	4.295
	Age(1)	1.813	1	.026	1.944	1.107	8.835
	Marital status(1)	.046	1	.934	1.048	.347	3.165
	Land ownership(1)	1.339	1	.036	2.404	1.440	4.480
	Education level(1)	1.246	1	.024	3.475	1.180	10.238
	Experience(1)	-1.863	1	.002	2.031	1.921	11.580
	No. dependants adult(1)	-.379	1	.061	.685	.207	2.264
	Main income source(1)	-.252	1	.833	.777	.075	8.055
	Land controller (1)	.740	1	.031	2.096	.504	8.719
	No. dependants children(1)	.762	1	.035	2.142	.433	10.595
	Major occupation(1)	.844	1	.043	2.213	.343	12.264
	Constant	.386	1	.710	1.471		

3.6.2 Gender of respondents

The test result shows that there was no significant difference in sisal production in relation to gender of respondent implying that they almost produced the same. This is

contrary to the study done in Zambia as it revealed that in Africa, women perform the majority of agricultural activities (Simperegui *et al.,* 2019). Similarly, agricultural production, nearly 70% of the workforce is females (Dekens and Vivek, 2014). Agriculture is the mainocupation in rural areas, with women accounting for 42.2% of the 65.5% of active population (Houinsa, 2013). The above findings were on cultivation of crops other than sisal. Therefore, in this study the findings could be attributed by the nature of sisal cultivation itself as it requires participation of both sexes at various stages of production and a large number of participants were married hence worked together.

3.6.3 Age of respondents

Respondents aged from 37 years and above were likely to produce by 1.9 times more as compared to those below 37 years old. This implies that the majority of farmers involved in sisal production in the study area were energetic adults with some financial capacity enough to invest in sisal production. The findings are similar to those of Guo *et al.* (2015) and Kangile *et al.* (2020) which shown that majority of respondents engaged in crop production were aged between 40 to 50 years. Age is the most decisive factor that determines the productive potential of a certain household (Abrha, 2015). Age can be related to farm experience, as age increases farm experience increases and production is likely to increase up to a certain age limit (Anyanwu, 2009; Shumet, 2011; Adebiyi and Okunlola, 2013). Studies done in Nigeria and Ethiopia revealed that, agriculture in developing countries is labour intensive, after a certain age where the farmers' physical strength decreases, their conservatism increases and finally production decreases (Amaza *et al.,* 2006; Shumet, 2011).

3.6.4 Marital status

Marital status did not show any significant difference. This implies that there was no difference in sisal production in relation to whether the respondent was married or not married. This could be due to the fact that those who were not married used to hire other people as labour force. This is contrary to a study in South-Western Tanzania which showed that families with married couples to be more stable and likely to produce more (Hariohay *et al.,* 2017). In African societies marital status should not be ignored when talking of agricultural production (Kilobe *et al*., 2013). Furthermore, married women can participate actively on crop production but sometime they are occupied by their multiple roles and cultural practices (Ayoola1 *et al.,* 2014).

3.6.5 Education level

The study results revealed that farmers who had secondary education and above were likely to produce 3.5 more compared to those with primary or no formal education. This implies that farmers with secondary education and above are more likely to cope with the changes in various means of agriculture such as modern technology and access to information through various media (Dolisca *et al.,* 2008); Odoemenem1*et al.,* 2010). Educated farmers are more likely to make the right decisions and solve problems regarding crop production hence increased yields and profitability (Ngailo *et al.,* 2016).

3.6.6 Respondents' experience

The study results revealed that respondents with experience below 11 years of sisal cultivation were likely to produce by 2.4 times less compared to those with experience of 11 years and above. This concurs with the study done in Ghana highlighting that experience enables a person to acquire some agronomic skills for efficient management

(Johnson *et al.*, 2018). That is to say as long as the farmer stays in farming over years, he is likely to be competent for field work hence more production (Ayoola1 *et al*., 2014; Borchelouie *et al*., 2015).

3.6.7 Income earned from sisal production

From descriptive statistics (Table 3.4) indicated that, small-scale farmers in the study area had varied range of income earned from sisal production for the past three years whereby 73.3% of smallholder sisal farmers in Chekeleni village earned income less than 10 000 000 Tanzania shillings (Tsh) followed by 43.3% in Mswaha they earned income ranging between 10 000 001 – 15 000 000 Tshs, 36.7% in Mabogo earned income ranging between 15 000 001 – 20 000 000 Tshs and the rest 6.7 % and 3.3% earned income greater than 25 000 000 Tshs per year in Mswaha and Chekeleni respectively (Table 3.4). This means smallholder farmers in the study area on average each earned between 3.3 - 10 million Tshs per year. The findings are similar to the anticipated earnings to smallholders in Katani Company Limited from 2005 to 2015 that was US$ 31 million (UNIDO, 2006). This is a considerable higher amount earned as compared to other crops like cotton (BOT, 2016; Suleiman, 2018).

Table 3.4: Gross income per annum in the household (in million T shillings)

Village	No. of respondents	Level of income				
		<10	10.1-15	15.1-20	20.1 -25	>25
Mabogo	30	10(33.3)	7(23.3)	11(36.7)	2(6.7)	0(0)
Chekeleni	30	22(73.3)	1(3.3)	6(20)	0(0)	1(3.3)
Mswaha	30	6(20)	13(43.3)	7(23.3)	2(6.7)	2(6.7)

3.6.8 Land ownership and control of land

The result revealed that respondents who owned land were likely to produce sisal for about 2.4 times more compared to those who didn't own land. That is to say land ownership whether self or contract/hiring is very important in agriculture because you cannot undertake crop cultivation if there is no land and the land controlled by men as head of household seemed to be more stable and productive. The findings concur with the study in Indonesia which showed that land possession is an essential factor in agriculture where contract farming/ land hiring is most practiced in sisal farming (Greco, 2017). Likewise, a study in Tanzania showed that farmers under contract farming schemes are the important component in agriculture sector as they can easily be reached and monitored (Isager *et al.*, 2021). Also the study by Petro *et al.,* 2015) observed that the amount of land owned and allocated for crop farming by an individual is direct proportional with crop production, and the households led by men seem to acquire more land as opposed to those led by female (Manzanera *et al.,* 2016).

3.6.9 Household dependents/household size

The study findings show that households with dependent children are likely to have high production by 2 times more as compared with those having dependent adults and no dependents (Table 3.2). It means households with dependent adults are normally overwhelmed with the burden to take care of them and need to hire other people for field work hence low production and vice versa. The findings are similar to the studies in Zambia and Ethiopia shows that as the number of non-productive persons increase, labourforce is affected negatively (Chimai, 2011; Lebina, 2019). That is why in most agricultural communities the number of household members is always high ranging from five to eight in order to secure labourforce (Ochieng, 2017). According to Khoza *et al.,*

2019 and Rai *et al.*, 2019 in their studies done in South Africa, southern and northern Tanzania revealed that family size is direct proportional to crop production.

3.7 A Binary Logistic Regression for the Factors Affecting Sisal Production

Inferential results (Table 3.5); among the above-mentioned factors three factors were statistically significant in relation to sisal production in the study area namely agricultural machines (e.g. tractors) ownership, bush fires and total land size allocated to sisal production, and others didn't show statistical significant difference (Table 3.5). This relates to the study by Abrha (2015) as it revealed that crop production is prone to a number of factors that may influence positively or negatively. Similarly, the factors may be rooted at personal level, climatic, institutional, sector wise or at the higher authority like the government (Urassa, 2015; Muraya and Ruigu, 2017). Further explanations are as shown in the Table 3.5.

Table 3.5: Binary logistic regression for the factors affecting sisal production among smallholder farmers in the study area

						95% C.I.for EXP(B)	
		B	df	Sig.	Exp(B)	Lower	Upper
Step 1[a]	Factor1(1)	1.995	1	.154	7.354	.472	114.616
	Factor2(1)	-3.399	1	.041	.033	.001	1.127
	Factor4(1)	-3.971	1	.001	.019	.002	.191
	Factor5(1)	1.572	1	.078	4.818	.837	27.722
	Factor7(1)	1.139	1	.369	3.123	.261	37.370
	Factor8(1)	-.654	1	.647	.520	.032	8.519
	Factor9(1)	-25.799	1	.999	.000	.000	.
	Factor10(1)	-1.022	1	.021	.360	.151	.858
	Constant	1.295	1	.603	3.652		

NB: Predicted probability is of membership for high sisal production

Key:

Factor 1 = Labor force availability

Factor 2 = Tractors ownership

Factor 3 = Control of vermin

Factor 4 = Fire from neighbor farms

Factor 5 = Control of vermin and diseases

Factor 6 = Decorticating machines ownership

Factor 7 = Land scarcity

Factor 8 = Market availability

Factor 9 = Shortage of capital

Factor 10 = Total land size allocated for sisal production

3.7.1 Total land size allocated for crop production

Inferential results (Table 3.5): Shown that for every unit reduction in the land size, the farmer is likely to produce by 64% less and vice versa. This implies that as the farmer allocates more land for sisal production he is more likely to produce by more than half at every unit increase in land size. The findings are similar to that of Tsegaye (2008) revealed that agricultural communities tend to acquire more land for more crop production. Similarly, land holding size is directly related with crop production; and while quantifying a 1% expansion in land size will result in 0.32% increase in agricultural output (Mpawenimana, 2005).

Descriptive results (Table 3.6): The study findings shows that farmers cultivated sisal with a varied land size ranging from 0.5 hectares as the smallest farm size to 6.5 hectares as the largest farm size. About 34.4% of the farmers in Mabogo and Chekeleni cultivated land size less than 0.5 hectares, 23.4% cultivated land size between 0.5 – 4 hectares, 20%

cultivated land size between 4.1 – 6.5 hectares and 22.2% cultivated land size greater than 6.5 hectares for all the villages. The study findings imply that the majority of the farmers (77.8%) in the study area cultivated sisal with a varied land size ranging from 0.5 hectares to 6.5 hectares. Similarly, a study in four East African economies (Uganda, Ethiopia, Kenya and Tanzania) indicated that over 75 percent of smallholder farmers had farm sizes of about 2.5ha (Salami *et al.*, 2010; FAO, 2018). Likewise, the findings support that sisal production requires a large land size for maximize production in quality and quantity of products (Etwire *et al.*, 2013; GAFSP, 2016). This is contrary to the land size required for growing seasonal crops like maize and cassava as revealed in the Savannah Zone of Northern Ghana that on average 2.4 acres was used for cassava cultivation and it is similar to the study in maize production from southern and northern zones of Tanzania (Hariohay *et al.*, 2017; Rai *et al*., 2019).

Table 3.6: Land size allocated for sisal production in the study area

Village	**Land size allocated for sisal cultivation (hectares)**			
	0.5-2	2.1-4	4.1- 6.5	>6.5
Mabogo	14(46.7)	8(26.7)	5(16.6)	3(10.0)
Chekeleni	17(56.7)	7(23.3)	2(6.7)	4(13.3)
Mswaha	(0)	6(20.0)	11(36.7)	13(43.3)
Total	31(34.4)	21(23.4)	18(20.0)	20(22.2)

3.7.2 Technology use (tractors and other machines)

The study findings have shown that the use of technology that is associated with ownership of mechanized machines such as tractors, planters etc. is likely to produce about 97% higher (Table 3.4). That is to say farmers who use agricultural technology are more likely to have more sisal yields and the opposite is true. The findings concur with those by Chimai (2011) who highlighted that the use of technology in agriculture has a greater impact in crop yields both in quality and quantity. Likewise, the use of technology

helps to reduce the amount of time spent and number of labour in the field hence more efficiency with more output (Nerini *et al.,* 2016; Mwaniki, 2018).

3.7.3 Bush fires

The study results show that the occurrence of fire in sisal fields is likely to negatively affect sisal production by 98% (Table 3.4). This implies that occurrence of bush fires by hunters or neighboring farmers during their land preparation for seasonal crops like maize do affect much sisal plants deterring growth and finally resulting to poor harvest or even no harvest at all when the magnitude of fire is big. This correlates with several studies that disclosed that uncontrolled bush fires are one of the frequent reported challenges (Puglisi, 2005). It appears to hinder crop production in most of agricultural societies as it has direct effect to plant life normally causing death hence lowering the amount of harvest (Neba, 2009; Dimitra *et al*., 2019). Furthermore, fires tend to occur as a result of land preparation by neighboring farmers, careless people and misunderstanding between farmers and pastoral societies (Benjaminsen *et al.,* 2018).This is similar to what was reported by a Key Informant as follows; "Sisal farms are burned through fire coming from other farmers very close to ours especially those cultivating cereal crops such as maize who prepare their farms by using fires to chase dangerous organisms such as a snake" (Key informant interview from Mswaha16/3/2020).

During FGDs in Chekeleni, Mabogo and Mswaha, it was revealed that sisal destruction by fires is a common phenomenon. They said that neighbouring farmers who cultivate seasonal crops such as maize, millet and other crops prepared their farms with the aid of fire. They do so in order to deter rodents and snakes but they fail to control the fire resulting into negatively affecting the growth of sisal in the nearby farms.

The above quotes imply that farmers in the study area lose their harvests due to fire. Meanwhile, this is an indication of lack of proper knowledge on the negative effects of fire on plants. The findings concur with the study in Kilimanjaro that showed fires reduced beauty of the heathlands that attract tourists and destroyed flowers, crops and other vegetation (Agrawala *et al.*, 2003). It is also similar to a study done near Pangani, Tanzania (Puglisi, 2005). Likewise, it correlates with the study in south western Amazonia which revealed that fire destroyed forest crops and it affected the economy (Campanharo *et al.*, 2019).

3.7.4 Labour force availability

Inferential results shown that there was no statistical significance for the labour force availability in the study area (Table 3.4). This could reflect the fact that majority of the respondents said there was no scarcity of labourforce in the area. The findings agree with the fact that labour force is an important component in agriculture sector as it is directly related to crop production (UNCTAD/LDC, 2015).

3.7.5 Vermin and disease control

Inferential results did not show statistical significance for the vermin and disease control in the study area (Table 3.4). This could imply that majority of respondents did not bother about the control of vermin and diseases that is to say farmers leave their sisal to grow under nature and this is directly related to the shortage of capital for buying the required materials. Similarly, the study by Savary *et al.* (2012) revealed that vermin cause mechanical damage to plants and apart from vermin crops are affected by several diseases like zebra disease, Korogwe leaf spot, dieback disease, and the bole rot causing plant death hence lowering production (Gama *et al.*, 2015).

Similar issues were reported and discussed by Key informants and also during FGDs. Sisal weevils and disease known as Korogwe leaf spot were named as major problems sisal farms responsible for reduced production. The destruction of sisal plants by goats, monkey and wild pigs (warthogs) were also mentioned as a serious problem to young sisal plants. One Key informant from Mabogo on 18/03/2020 mentioned that "Wild pigs and monkey used to come at night and eat sisal plant where they preferred the young sisal plants. It seems young sisal plant has a flavor that attracts monkey and wild pig".

This implies that smallholder sisal farmers in the study area were affected by such problem. The findings are similar to a study by Savary *et al.* (2012) which indicated that pests, vermin and diseases had a negative impact on crop production hence reduced production both at local and global scale.

3.7.6 Market availability

Inferential results did not show statistical significance for market availability (Table 3.4). This implies that sisal production in the study area was still low despite the majority knew that the market was highly available (95.6%). The findings are similar to those of Santos *et al.* (2018) who disclosed that from 1990s sisal recovered its value due to the worlds' emphasis on the use of biodegradable fiber to substitute synthetic fibers to protect the environment.

Discussion during FGDs also acknowledged that market is available for their products all the time. Key informants from all villages reported that there was no problem on

availability of market but they do not have the ability to produce much (Table 3.4). For instance, one of the key informants from Chekeleni on 17/03/2020 said, “Surely the market is so inspiring that we wish we could produce much but as you can see that sisal require a big area that need some mechanized machines like tractors which need much capital”.

3.7.7 Capital availability

Inferential results did not show statistical significance for capital availability (Table 3.4). This is due to the fact that all respondents in the study area reported to experience shortage of capital and they cannot access loans from financial institution. The findings are similar to those of Zakaria *et al.* (2019) who revealed that capital is a necessary factor in agriculture that has a direct effect on crop production especially for cash crops like sisal that requre considerable big areas Zakaria *et al.* (2019). Similarly, many farmers in third World countries like Tanzainia have no access to loans from formal financial institutions; therefore they depend to get funds from friends (Salami *et al.*, 2010; BOT, 2016).

3.8 Results from FGDs and Key Informants

Participants reported to have no enough capital for sisal production since sisal production is costly in terms of labour and other running costs that begin from farm preparation up to harvesting. The issue of lack of capital was equally raised during Focus Group Discussion in all villages and people involved in FGDs agreed that lack of capital was a problem that hindered them to cultivate large farms. They even claimed that sometimes they fail to harvest mature sisal due to lack of mechanized tools such as tractors to carry sisal leaves to the factory. This situation sometimes destroys sisal leaves especially at the harvesting time if farmers do not have mechanism to harvest hence leaves dry and become wasted.

For example, a participant from Mabogo reported that "Sisal cultivation is labour-intensive and it demands care especially during cultivation state including farm preparation planting, weed control and during harvesting. Small scale farmers lack mechanized tools such as tractors thus it becomes difficult during tillage of their farms and transportation of sisal leaves after harvesting" (Key informant interview 14/3/2020). The issue of lack of mechanism was noted to be a serious problem facing small scale farmers resulting to poor produce. They even claimed that sometimes they fail to harvest mature sisal in time hence experience pre harvest loss.

These findings are similar to those of Zakaria *et al*. (2019) who revealed that capital enabled farmers to increase yield in Soutn Africa. Also, a report by BOT (2016) revealed that most farmers in Tanzania use own funds because it is difficult to access loans from formal financial institutions due to high interest rates and bureaucratic procedures. Similarly, a study done in the four East African economies namely Uganda, Ethiopia, Kenya and Tanzania indicated that farmers rely on financial support from friends and relatives, gift, and informal money lenders (Salami *et al.*, 2010).

3.9 Other Factors Influencing Sisal Production in the Study Area

The study findings show that good income from sisal farming (81.3%) was a leading factor that influenced farmers to grow sisal (Figure 3.3). This implies that smallholder farmers planted sisal with the expectation of earning money from sisal produce. This is an indicator of good market for sisal both local and international resulting from the increase in global demand for environmentally friendly commodities made from sisal fibres. That is to say, from 2006 to date global fibres consumers have shifted from the use of synthetic fibres to sisal fibres because sisal products can decompose easily hence ecologically friendly as compared to synthetic fibres.

Another factor was the recent availability of market (74.4%) (Figure 3.3) due to high demand of sisal fibres in the global market that caused the price of one ton of raw sisal after processing to rise from two million and a half to three million Tanzania shillings (2 500 000 – 3 000 000 Tshs) compared to the previous price in early 2000 which was 1 200 000/= TZS. The issue of market availability was raised by participants from all wards in the study area during Focus Group Discussion and Key informants interview, for example one of the Key informants from Mswaha on 3/3/2020 said; “Precise marketing information within and outside the county encouraged smallholder farmers to cultivate sisal. Also, small-scale farmers had an opportunity to learn from their fellow farmers on the benefit they received from current sisal markets".

Another factor was advice and support received from Katani Company Limited influenced sisal production by small scale farmers 58.9% (Figure 3.3). The support offered to farmers by Katani limited included assisting farmers in land preparation for sisal seedling growing, sisal estate weed and pest control. Not only that but also, Katani Company Limited assisted farmers in harvesting, transporting sisal produce to the decortication machine, processing sisal leaves for final products, packaging and stocking ready for sale to the local and global markets.

Furthermore, the findings reported 34.4% of the small-scale sisal farmers got advice from Katani Company Limited that motivated other farmers to adopt cultivation of sisal, this served as an influential factor for the production (Figure 3.3). This reflects the spread of knowledge and technology on sisal cultivation among farmers themselves. This implies that small-scale farmers planted sisal for money gains in an attempt to utilize the current opportunity for a good market on sisal at local and international settings. This is due to

the fact that the world is now shifting to the use of environmentally friendly commodities made from sisal fibres as opposed to synthetic fibres.

Support offered by Katani Company Limited to small-scale sisal farmers is appreciated in the sisal production at all stages to the final stage of marketing the product. Also knowledge and experience sharing among farmers were found to be important factors influencing sisal production in the study area. In addition, shared knowledge and experience among farmers should not be ignored but should be backed with professional knowledge.

Similarly, a study by Urassa (2015) found that income generation, availability of market, farmers experience and support from responsible institutions were among the factors affecting crops production. Also, Valentine (2014) found that factors affecting agriculture production in Tanzania were directly related to farmer's level of knowledge, market availability and access to financial institutions. The same is true from a study in South Africa that insisted on the importance of assisting farmers in all possible ways that would result in high crop production (Khoza *et al.*, 2019).

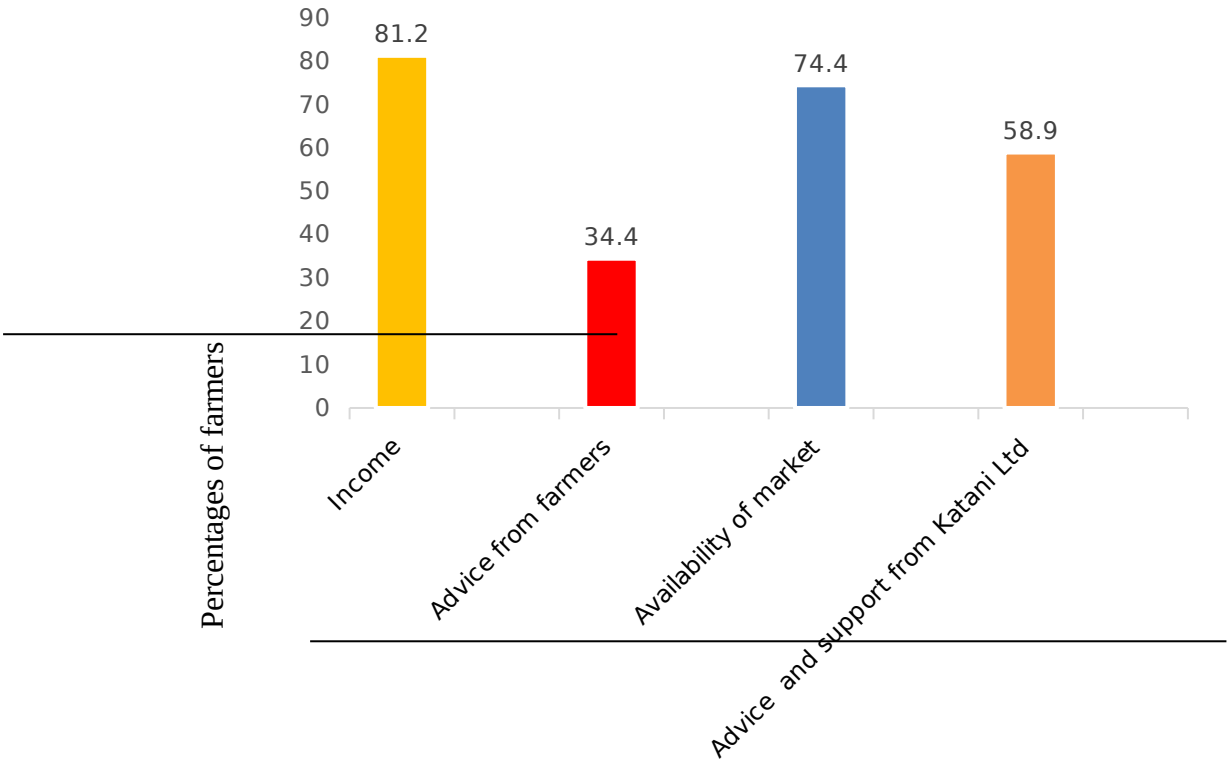

Figure 3.3: Factors influencing sisal production in the study area

3.10 Conclusions and Recommendations

3.10.1 Conclusions

The study findings revealed that socio-demographic characteristics of respondents such as age, land ownership, education level and experience, number of dependent children and major occupation of the respondents were likely to affect sisal production either positively or negatively. Also, the ownership of agricultural machines (e.g. tractors), bush fires and the total land size allocated to sisal production were other factors affecting sisal production in the study area that need urgent attention when speaking of smallholder sisal farmers.

It was also observed that the main factors influencing small scale sisal farmers to engage in sisal production to a great extent was good income from sisal fibre and availability of market. In addition, advice and support from agencies like Katani Company Limited attracted small scale sisal farmers. On the other hand, shortage of capital for investment in sisal production, uncontrolled bush fires from neighboring farmers and the presence of pests, diseases and vermin were factors that seriously affected young sisal plants resulting to low sisal output.

3.10.2 Recommendations

Based on the findings of this study, it is recommended that;

1. The government through its responsible ministries, (e.g. particularly the Ministry of Agriculture), should pay attention and timely solves smallholder sisal farmer's challenges.
2. There should be linkage between financial service providers and sisal farmers in an attempt to resolve the challenge of capital by providing soft loans that are friendly (eg low interest rates) to smallholder sisal farmers under supervision of the Sisal Board of Tanzania.
3. The Ministry of Agriculture should formulate suitable policies that will encourage more stakeholders to invest in sisal processing and manufacturing industries for significant impact on sisal production in the study area and the country at large.

3.11 Suggestions for Further Research

Further studies can focus on the cost benefit analysis for smallholder sisal farmers.

3.12 Ethical Approval and Consent to Participate

Research ethics must be observed every time when a Researcher is about to conduct a research to protect himself and the respondents (Kvale, 1994; Hyder and Wali, 2006). Ethical consideration minimizes negative perceptions and assures confidentiality to respondents (Meena, 2009; Silverman, 2011). This study was approved by the Research and Publication Committee of The Sokoine University of Agriculture (SUA). Also, the permit for data collection in the study area was obtained from the office of Administrative Secretary of Korogwe District, and then communication was done with leaders of the wards, divisions and local leaders so as to get permission to meet respondents. In addition, a verbal informed consent was given prior to the interview process.

3.13 Acknowledgements

I thank and praise the diviner the Almighty God, for his grace. Many thanks are to my supervisor Dr. Siwel Y. Nyamba, for his generous guidance to the accomplishment of this work. Also, special thanks to the Head of Department of DAECD, Dr. Innocent M. Busindeli and to all staff members in the Department. Thanks to my fellow MSc and PhD students and my Employer, the Director General of the Tanzania Sisal Board, my wife Vera F. Mosha and our children for their tolerance during my absence. Likewise, special acknowledgement be to Mr. Mbogo Kija, Mr. Kenneth Mapunda, Dr. Emelda Gelvas, Prof. Zebedayo Mvena, Mr. Fedric Mfinanga, The District Administrative Secretary and Divisional Officers of Korogwe District Council, Ward Executive Officers of Makuyuni, Magoma and Ngombezi, and village executive officers of Chekeleni, Mabogo and Mswaha, all sisal farmers and extension workers, and all individuals who assisted me in one way or another to accomplish this work.

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CHAPTER FOUR

Paper two

Knowledge, Skills and Sources of Information on Sisal Production among Smallholder Sisal Farmers in Korogwe District, Tanzania

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4.1 Abstract

Sisal like other crops needs intensive care backed with appropriate knowledge and skills among smallholder sisal farmers for higher and quality production. Smallholder farmers' knowledge and skills is still questionable particularly on sisal production in Korogwe District and Tanzania in general. In fact we are missing some salient information on farmers' level of knowledge for a better approach to impart them with appropriate knowledge and skills. Therefore, this study aimed at assessing the level of knowledge and skills on sisal production among smallholder sisal farmers in Korogwe District for better informed decision making towards increased sisal production.

A cross-sectional study that ran from early March to late April 2020 was conducted through the use of questionnaire, Focus group discussion and Key Informants. Also supplementary information was obtained through direct observation done three times at an interval of two weeks. Data were analysed both quantitatively using SPSS version 20 program and Ms Excel, and qualitatively as per protocol. A one way ANOVA and descriptive statistics was done at a 95% confidence level whereby a significance level of < 0.05 was considered to be statistically significant otherwise not. The study findings revealed a considerable low level of knowledge and skills among smallholder sisal farmers in the study area (64.4%) and to greater extent utilized only one source of information namely the extension service delivery from agricultural extension officers at occasional frequencies. Therefore, smallholder sisal farmers in the study area need to be supplied with adequate knowledge and skills that will accelerate higher sisal production.

Keywords: Sisal production, Smallholder sisal farmers, Knowledge, Agricultural extension officers

4.2 Introduction

Sisal is widely produced as one of the major cash crops where Brazil is the leading producer and exporter of sisal fiber with the industry employing about 700 000 people in Bahia state alone (Cantalino *et al*., 2015; FAO, 2019). Tanzania is among the biggest world's sisal producers being second after Brazil while Kenya is the number one importer and exporter of sisal fiber in East Africa (IBAM, 2007; FAO, 2019).

Though sisal industry experienced a severe crisis in the 1980s due to several factors including the competition with synthetic fibers that led to the drastic fall in production and price worldwide. Its market recovered in the early 1990s due to the global agenda on environmental protection through use of biodegradable fibers as opposed to synthetic fibers (Santos *et al.,* 2018; Campanharo *et al.,* 2019).

From the year 2006 to 2018 Tanzania sisal production experienced slow recovery with an increase of about 6 530.08 tons which is still very small compared to the year 1964 (230 000 tons) while the recent demand in sisal fibers is high in the global market prompting for high price (Tanzania Sisal Board, 2018). The contribution of sisal production by smallholder sisal farmers has significant impact as they produce about 25% of the total sisal produced in Tanzania (FAO, 2013).

Sisal like other crops needs intensive care using appropriate knowledge and skills by smallholder sisal farmers for higher and quality production (Khapayi and Celliers, 2016). Effective knowledge of farmers in agriculture plays a key role for increased crop production (Mtega and Ngoepe, 2018). Lack of appropriate agricultural knowledge and skills on crop production results to poor farm management hence low yield with poor

quality (Omari *et al.*, 2018). It is therefore very important that farmers possess sufficient knowledge and skills for better production (Marc Corbeels, 2000). In order to achieve this, governments through their agriculture sector and relevant stakeholders need functional strategies aiming at imparting knowledge and skills to smallholder farmers (UNIDO, 2006; TARI, 2017). In Tanzania, the government through the agriculture sector has set some initiatives to supply farmers with adequate knowledge through various ways of information flow like agricultural extension officers, NGOs, sisal companies and various boards for respective crops (Lwoga *et al*., 2011; Paulin, 2015; Mtega and Ngoepe, 2018). Likewise, the sources of agriculture information are passed through different media like radios and televisions, religious leaders, village leaders and seminars (Mubofu and Malekani, 2020). Despite the afore mentioned initiatives, they are still not functioning properly to reach the majority of smallholder farmers (Rutatora and Matee, 2001).

Despite several studies conducted to assess farmers' knowledge and skills on agriculture sector, little is known about smallholder sisal farmers' knowledge and skills on sisal production in Korogwe District. Therefore, by knowing the level of knowledge and skills among smallholder sisal farmers it will help stakeholders to come up with appropriate strategies for imparting knowledge and skills to farmers hence increased sisal production in the study area and nationwide.

4.3 Methodology

4.3.1 Description of the study area

Korogwe District is one of the eight districts of Tanga Region (other districts are Tanga, Muheza, Lushoto, Handeni, Pangani, Kilindi, Mkinga and Korogwe), Korogwe District

has an area of 3756 square kilometres which is 13% of the total land area of Tanga Region, and lies between latitude 4º15’ and 5º15’ South, and between longitudes 38º0 and 38º45’ East. The District has three major agro-ecological zones namely the mountainous, low wetlands and semi-arid zone. The variations in the topography and climate provide different cropping possibilities. The District has loamy, sandy and clay soils while the natural vegetation is predominantly of the tropical type where sisal grows well in these environmental conditions. The Low wetland zone occupies about 35% of the District, it lies between 600-800 meters above sea level, is hot humid, and has an average rainfall between 800-1000mm per year. Several rivers, including the Pangani and Lwengera drain this area providing irrigation potentials. The main food crops grown are maize, paddy, beans, cassava and potatoes while the cash crops cultivated include cashew nuts, cotton, sisal and tropical fruits like mangoes, oranges and tangerines. Livestock (exotic and indigenous) are reared for milk and meat. The zone covers Korogwe (Ngombezi ward) and some part of Magoma division and Mombo division (Makuyuni ward).

This study was carried out in Korogwe District where three wards were involved: Makuyuni, Ngombezi and Magoma as shown in Figure 4.1. The study areas were selected purposively based on the main reason that they are areas with large number of sisal farmers; also a large area of the land is occupied by sisal estates (Msuya *et al.*, 2018). In total, Korogwe District has about 1207 small scale sisal growers both in government owned large scale farms (estates) and private farming system (Tanzania Sisal Board, 2016).

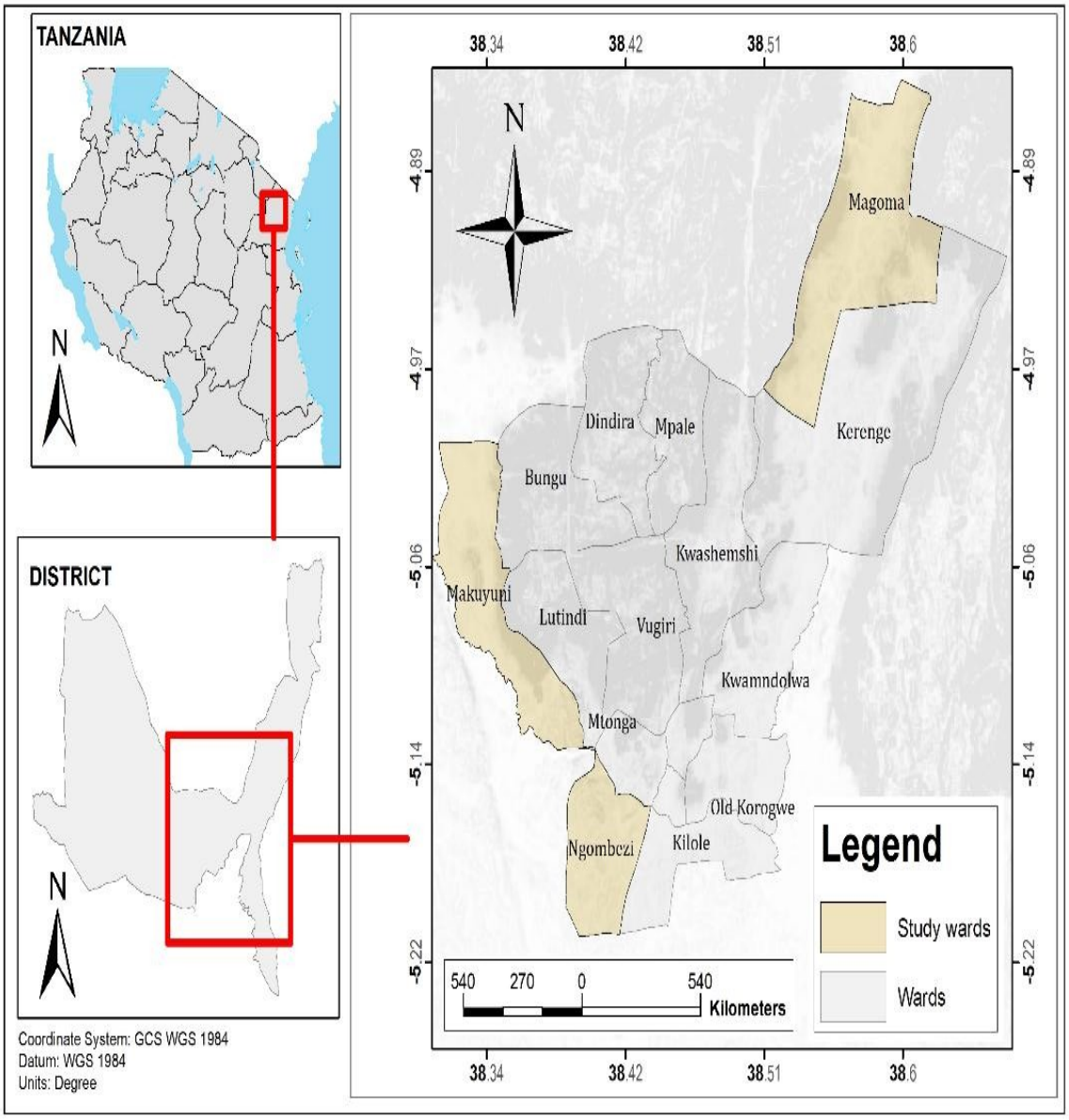

Figure 4.1: A map showing the study area in Korogwe District Tanzania where three wards were involved namely Makuyuni Ngombezi and Magoma

4.3.2 Study design

Pittenger (2003) defined research design as a technique used to collect data that decisively answers empirical questions. In this study, the researcher used cross-sectional research design because it takes a representative sample from the population to generalize the findings to the study population (Omair, 2015). Additionally, in cross-sectional study design, data collection occurs at one point in time as opposed to longitudinal study design, where subjects are followed over time (Johnson, 2010).

4.3.3 Sample size and sampling procedures

Sampling is an important part for research and the sample size ranging between 30 and 500 at 5% confidence level is regarded to be sufficient for many researchers (Altunışık *et al.*, 2004). The sampling frame for this study was all smallholder sisal farmers in Korogwe district. The sampling frame was obtained from the Tanzania Sisal Board database and it had a total of 1207 smallholder sisal farmers. Out of the 20 wards in Korogwe District, three wards namely Magoma, Ngombezi and Makuyuni were selected purposively for the study as they are heavily involved in sisal cultivation. Only one village was selected from each ward by a simple random technique, and the selected villages were Mabogo, Chekeleni and Mswaha from Magoma, Makuyuni and Ngombezi wards respectively. Respondents were selected by simple random selection geared by generation of random numbers from the Tanzania Sisal Board database selecting 30 respondents from each village resulting into 90 respondents plus two Key Informants from each village. In addition, six Key Informants were interviewed; three were ward executive officers one from each ward and other three were leaders for smallholder farmers. The selected respondents were contacted and scheduled for the

interview which was voluntary and involved only those who were ready and willing to participate.

4.3.4 Data collection

Data collection was conducted from March 2020 to April 2020 in Korogwe District in Tanga Region. Data collection was done with the help of two trained enumerators guided by the researcher. Semi structured questionnaire was used for interviewing participants. FGD and Key Informant interviews were conducted to obtain respondents views on the subject matter using an interview guide. Three FGDs were conducted, one from each village comprising of eight smallholder famers. The selection of the famers considered gender, age, education and experience on sisal production. Primary data were collected from the sisal farmers using a questionnaire and interview schedules. Secondary data were collected from Tanzania Sisal Board on the farmers' activities such as land area, market trends, production and sales. Also supplementary information was obtained through direct observation three visits to each village at an interval of two weeks. The focus was to assess factors affecting sisal production by smallholder sisal farmers in Korogwe District, Tanzania.

4.3.5 Data analysis

4.3.5.1 Quantitative data analysis

Data for level of sisal production, farmers' knowledge and skills, and farmers' sources of knowledge and skills on sisal production were analysed both quantitatively and qualitatively. Quantitative data was analysed by using Statistical Package for Social Sciences (SPSS) version 20 program and Microsoft Excel whereas qualitative data were analysed as per qualitative analysis protocol namely transcription, organisation, coding into themes, verification, interpreting and reporting. Statistical test named one way

ANOVA and descriptive statistics were done. The tests were done at a 95% confidence level whereby a significance level of < 0.05 was considered to be statistically significant. A one way ANOVA was performed to determine knowledge level and skills of respondents; this was done by taking into account the total scores of every respondent as per questionnaire interview. The scores were then grouped into two groups in where a cut-off point of 51% score was set and respondents who scored below 51% were regarded as having low knowledge and skills, and those who scored 51% and above were regarded as having high knowledge. The three villages under study namely Chekeleni, Mabogo and Mswaha where the different groups for which respondent's knowledge and skills on sisal production were tested. Furthermore, descriptive statistics were computed to determine frequencies, percentages, and means, minimum and maximum values of individual variables which were then presented in tables, figures and graphs.

4.3.5.2 Qualitative data analysis

Qualitative data from Focus Group Discussions and Key Informant interviews were analysed using content analysis; the audio responses were transformed into text format, it was then organised into computer files for easy retrieval. This was followed by putting together the important ideas (themes) that had been said by about 75% of the respondents on key questions and the gathered information was crosschecked in relation to other sources on the subject matter. Finally, themes were carefully analysed in order for the researcher to interpret the information beyond the data gathered so as to make valid and reliable conclusions. Furthermore, data from observations and documentary sources were carefully summarized manually to ensure that they accurately reflect the original meanings of the statements made by participants.

4.4 Results and Discussion

From Table 4.1. the descriptive results from this study show that about 66.7% of men were engaged in sisal cultivation as compared to 33.3% of women. Majority of respondents had experience of 15 years and above (56.7%), crop farmers (74.4%), owned land (86.7%), men controlled the land (82.2%), 1-4 dependent children (83.3%) and 1-4 dependent adults (61.1%).

Table 4.1: Socio-demographic characteristics of study respondents

Characteristic	Category	Frequency	Percentage
Sex	Male	60	66.7
	Female	30	33.3
Age	18 - 25	2	2.2
	26 - 36	10	11.1
	37 - 50	41	45.6
	51 and above	37	41.1
Marital status	Single	6	6.7
	Married	65	72.2
	Widowed	17	18.9
	Divorced	2	2.2
Education level of respondents	Non-formal education	12	13.3
	Primary education	49	54.4
	Secondary education	12	13.3
	College (Certificate and Diploma)	11	12.2
	University	6	6.7
Experience of respondent	Below 15 years	39	43.3
	15 years and above	51	56.7
Major occupation of respondent	Crop farmer	67	74.4
	Crop farming and livestock keeping	22	24.4
	Business and crop farming	1	1.1
Main source of income	Crop Farming	67	74.4
	Livestock keeping	1	1.1
	Crop farming and livestock keeping	22	24.4
Land ownership	Yes	78	86.7
	No	12	13.3
Controller of land	Husband	74	82.2
	Wife	16	17.8
Number of dependent children	0	11	12.2
	1 - 4	75	83.3
	5 - 8	4	4.5
Number of dependent adults	0	30	33.3

1 - 4	55	61.1
5 - 8	5	5.6

4.4.2 Knowledge and skills on sisal production

The study shows that small scale farmers have varied level of knowledge on sisal production and they were aware that sisal cultivation demands adherence to good principles of cultivation similar to other crops, knowledge acquired from extension agents. However, the acquired knowledge seemed not to be fully put into practice by the farmers in the study area. The results revealed that only 35.6 % of the respondents had considerable good knowledge and skills on sisal production. Respondents with considerable good knowledge were those who scored more than 51% during interview and those who scored below 51% were regarded to have low knowledge on sisal production (Table 4.2).

Table 4.2: Knowledge on sisal production with respect to villages in the study area

Village	**Knowledge level of respondent**		**Total**
	Low knowledge	**High knowledge**	
Mabogo	23(76.7)	7(23.3)	30(100)
Chekeleni	19(63.3)	11(36.7)	30(100)
Mswaha	16(53.3)	14(46.7)	30(100)
Total	58(64.4)	32(35.6)	90(100)

Also, upon further statistical analysis for the comparison of mean scores of respondents with respect to place of residence (village) revealed that there was no statistical significant difference in knowledge and skill among respondents with respect to place of residence (Table 4.3). This implies that smallholder sisal farmers in the study areas had almost an equal level of knowledge and skills hence they all needed to be given appropriate knowledge and skills on regular bases with close observation.

A report by UNIDO (2006) and TARI (2017) about Kenya and Tanzania recommended that there should be major strategies aiming at imparting knowledge and skills to smallholder farmers in order to raise sisal production. The findings concur with the study in Ethiopia by Marc Corbeels, 2000) who insisted on the importance of farmers given with sufficient knowledge and skills for better production Also, though farmers can participate in some harvesting activities sisal processing requires involvement of professionals and money for hiring or acquiring the required technology (Dlamini *et al.,* 2014).

Table 4.3: One way ANOVA output indicating variation in knowledge level on sisal production across the three study villages

		95% Confidence Interval	
Village of respondent	**Sig.**	**Lower Bound**	**Upper Bound**
Magoma	1.000	-6.96	7.41
	1.000	-9.77	4.61
Makuyuni	1.000	-7.41	6.96
	1.000	-9.99	4.38
Ngombezi	1.000	-4.61	9.77
	1.000	-4.38	9.99

4.4.3 Involvement of smallholder sisal farmers' in various stages of handling sisal

The findings show that sisal farmers were engaged in series of activities from harvesting, processing up to the last stage of stocking of sisal bales. 64.4% of farmers were highly engaged in cutting of sisal leaves during harvesting followed by bales of fibre 37.8% and stocking sisal fibre bales 34.4% and few farmers engaged in sorting of fibre 2.2% and 12.2% brushing and grading of fibre (Table 4.4). Sisal farmers were engaged more in harvesting, transportation, packaging and stocking as compared to processing activities. This was due to the fact that, farmers were responsible for cutting and transportation of raw sisal from the farm to the factory; then after handling the sisal to the factory processing was done by few responsible persons as experts. Finally, farmers were highly

engaged in packaging, transporting and stocking to counter check their products ready for selling via various agents like AMCOS. This implies that smallholder sisal farmers were engaged in various activities from harvesting up to the final stage though the participation rate was low in some stages especially the production process (Table 4.4).

Table 4.4: Smallholder sisal farmers' involvement at various stages of sisal processing

Stages	Number of respondent	Percent
Cutting of sisal leaves	58	64.4
Transportation of sisal leaves	15	16.7
Sisal processing into fibers	18	20.0
Drying sisal fibers	12	13.3
Sorting of fibers	2	2.2
Brushing and grading of fibers	11	12.2
Bailing of fibers	34	37.8
Stocking of sisal fiber bales	31	34.4

*The results in column of number of respondents and percentages are multiple responses.

After the observation, the researcher had an opportunity to assess how farmers used to carry out sisal production processes right from farm to the final destination in the market. Observation was done three times at an interval of two weeks in every village and the approximate rating on every stage of sisal production was recorded, lastly the average rating was computed and the following was observed (Table 4.4): about 46.7% of the farmers in the study area used to cut sisal leaves properly, 61.1% did proper transportation of sisal leaves to the processing machines, proper processing of sisal leaves into fibers was done by 88.7%, proper sisal fibers grading by 91.1%, proper fibers packaging 92.2%, Proper stocking of fiber bales 83.3% and proper transport to the market by 87.8%. The findings revealed that there was a big challenge on cutting sisal leaves as farmers tend to cut more leaves per plant in favor for quantity hence affecting quality of sisal fibers.

Table 4.4: Sisal farmer's practices across the value chain

Stage	Status	Frequency (average)	Percentage
Proper cutting of sisal leaves	Done	42	46.7
	Not done	48	53.3
Proper transportation of leaves	Done	55	61.1
	Not done	35	38.9
Proper processing into fibers	Done	80	88.7
	Not done	10	11.3
Proper fibers grading	Done	82	91.1
	Not done	8	8.9
Proper packaging of fibers	Done	83	92.2
	Not done	7	7.8
Proper stocking of bales	Done	75	83.3
	Not done	15	16.7
Proper transport to the market	Done	79	87.8
	Not done	11	12.2
Intercropping	Done	82	91.1
	Not done	8	8.9

*The results of frequency and percentages are multiple responses

4.4.4 Strategies for enhancing knowledge and skills to farmers on sisal production in Tanzania

Results from the study area revealed that farmers received knowledge and skills from various agricultural agents though a large percentage of the farmers were not reached by these agents due to shortage of funds to facilitate the process. Similar finding were reported by Rutatora and Mattee (2001) who claimed that many districts in Tanzania are unable to finance extension services from own sources without external support. Likewise other scholars (Khapayi and Celliers, 2016: Omari *et al.,* 2018) pointed out that, lack of appropriate agricultural knowledge and skills on crop production results to poor farm management hence low yield with poor quality.

4.5 Farmers' sources of knowledge and skills in sisal production

The results showed that farmers received knowledge and skills mainly from five sources including agriculture extension officers, smallholder sisal farmers, Tanzania Sisal Board staff, Agriculture Marketing Cooperative Society and Katani Company Limited (Figure 4.2). The results show various sources of knowledge and skills for small scale sisal farmers; agriculture extension officers by (53.3%) followed by fellow sisal farmers (42.2%), 24.4% by Katani Company Limited, AMCOS by 20% and Tanzania Sisal Board Staffs (18.9%) (Figure 4.2). This implies that smallholder sisal farmers shared knowledge and information through the networks within themselves and to a great extent with extension agents.

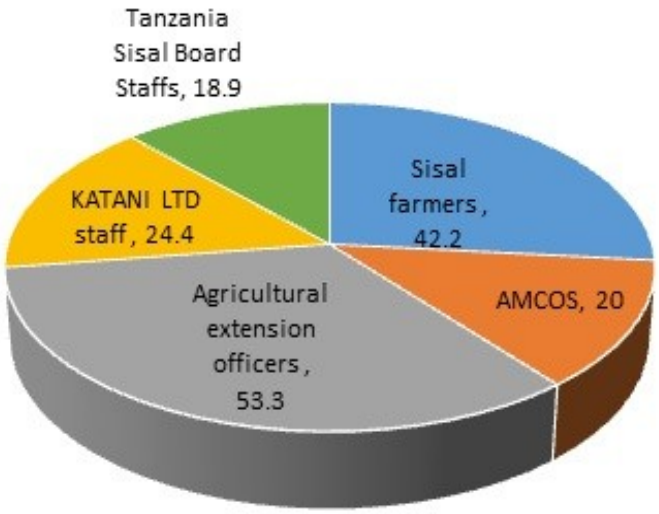

Figure 4.1: Percentages of farmers' source of knowledge and skills on sisal production

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4.5.1 Results from FGDs and key informants

Participants from all the villages reported that most of the time they shared information among themselves and to lesser extent from agricultural extension services through extension officers who provided knowledge and skills to the farmers but infrequently and reached only a small proportion of the smallholder sisal farmers. They said they had

a problem in accessing the right information and sometimes they have to hire some people to provide them with the right information they needed.

For example, one of the Key informant in Mabogo said "Getting the right information at the right time here in our area is a big challenge since responsible people who are knowledgeable from the government make few visits per year, therefore we are used to teach and share information among ourselves" (Key informant interview 18/3/2020).

The findings are contrary to those of Lwoga *et al*. (2011) who pointed four main sources of information and knowledge for where 72.9% were friends, followed by extension officers (71.8%) and the rest were family members (56.9%) and input suppliers (43.6%). Likewise, the study by Mubofu and Malekani (2020) conducted in Iringa Tanzania noted the sources of agriculture information were radios, religious leaders, village leaders and seminars as the main channels used by extension officers to disseminate agricultural information to farmers.

4.5 Further Description of Sources of Knowledge and Skills

4.5.1 Katani Company Limited staff

Katani Company Limited staff claimed to engage on educating farmers on sisal production and worked closely with farmers who were interested to learn on good sisal production practices. The company also agreed contract farming with farmers to cultivate sisal in estates owned by the government under Tanzania Sisal Board (Key informant interview 19/3/2020).

4.5.2 Extension agents

Extension agents claimed to play their part in educating sisal farmers from within estates and outside the estates. They acknowledged not meet the majority of the farmers timely due to several challenges in trip logistics that need payment to staff on outreach, transport and teaching materials, which all need money while the budget allocated is normally limited (Key informant interview 20/3/2020).

4.5.3 Sisal farmers

Sisal farmers said that they received information from the agents but very rarely and most of the time they organised themselves and paid some staff who are off job on local arrangements when they are in real need. Furthermore, they said they are the teachers and students among themselves. For example one of the participant from Mswaha said “at the time we have urgent need for the professional advice we normally organize ourselves to bring a staff by payment during off hours (FGD 17/3/2020).

4.5.4 Tanzania sisal board staff

Tanzania sisal board staff claimed to visit farmers and see the progress of sisal growing. During the visit, they teach farmers and other stakeholder on good sisal husbandry from land preparation, nursery preparation, and nursery planting and management, planting sisal in the main field and maintenance to harvesting. Generally they inspect of sisal production from the beginning to end product (Key informant interview 20/3/2020).

4.5.5 AMCOS

AMCOS is a cooperative union which educates sisal farmers on good husbandry of the crop for quality and quantity harvest. However, they acknowledge a challenge of not

meeting majority of the farmers timely as said by the Key informant on 16/3/2020 that “we really acknowledge that it is not easy for us to reach farmers timely and frequently as we are running short of staffs”.

4.6 Conclusions and Recommendations

4.6.1 Conclusions

The study findings show that the level of knowledge and skills among smallholder sisal farmers is considerably low (64.4%). It was also observed that to a great extent smallholder sisal farmer’s utilized only one source of information namely the extension delivery service from agricultural extension officers which was, however, infrequently. Most of the time sisal farmers shared information through their own networks. This means that smallholder sisal farmers in the study area need adequate knowledge and skills through appropriate means that is easily accessible by the majority of the farmers.

4.5.2 Recommendations

Based on the study findings, it is recommended that:

1. There should be special programs aiming at boosting the level of knowledge and skills to small scale sisal farmers on sisal production with close supervision by the responsible authorities.

2. The government should train and retrain more extension workers specifically on sisal value chain. This will help in resolving the challenge of shortage of qualified extension workers. TARI Mlingano should be utilized to educate farmers on sisal diseases and soil fertility.

3. Ministry of Agriculture and other agricultural stakeholders should organize special programs aimed at providing knowledge and skills to farmers on sisal production through media that are easily accessible.

4.6 Ethical Approval and Consent to Participate

In research, ethics is an important part to be taken into consideration by the researcher in order to protect himself and the respondents (Kvale, 1994; Hyder and Wali, 2006). Ethical consideration minimizes negative perceptions and assures confidentiality to respondents (Meena, 2009; Silverman, 2011). This study was approved by the Research and Publication Committee of the Sokoine University of Agriculture (SUA). Also, the permit for data collection in the study area was obtained from the office of Administrative Secretary of Korogwe district, and then communication was done with leaders of the wards, divisions and local leaders so as to get permission to meet respondents. In addition, a verbal informed consent was given prior to the interview process.

4.7 Limitation of the Study

To some extent, the occurrence of Covid 19 limited the data collection process due to fear of social gatherings by participants.

Consent for publication

All the authors assented for the publication of this manuscript.

Availability of data and materials

The data sets used for this study are available from the corresponding author upon reasonable request.

Competing interests

The authors do affirm that there is no competing interest in this study.

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Authors' contribution

This work was prepared in close cooperation with my supervisors from proposal, fieldwork, data analysis and preparation of the manuscript for publication.

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CHAPTER FIVE

5.0 GENERAL DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 General Discussion

The aim of the present study was to establish factors affecting sisal production by smallholder farmers in Korogwe District, Tanzania. Thus is specifically aimed to assess the level of sisal production, knowledge, skills and sources of information on sisal production among smallholder sisal farmers in the study area.

The study revealed that about 28.9% of the respondents in the study area produced between 1 – 10 tons and 24.5% produced between 11 – 15 tons (Table 3.1). This refers to the fact that more than half of the smallholder sisal producers in Tanzania are from Northern zone. The findings correspond with the report by TSB (2017) which indicated 69% of the total sisal grown in Tanzania was produced in Tanga Region. In addition, Tanzania is in the top-five world producers of sisal (GAFSP, 2016).

The result shows that there was no significant difference in sisal production in relation to gender of respondent implying that they almost produced the same. This is contrary to the study done in Zambia as it revealed that in Africa, women perform the majority of agricultural activities (Simperegui *et al.,* 2019). Similarly, agricultural production, nearly 70% of the workforce is females (Dekens and Vivek, 2014). Agriculture is the main occupation in rural areas, with women accounting for 42.2% of the 65.5% of active population (Houinsa, 2013). These findings were on cultivation of crops other than sisal. Therefore, in this study the findings could be attributed by the nature of sisal cultivation

itself as it requires participation of both sexes at various stages of production and a large number of participants were married hence worked together.

Respondents aged from 37 years and above were likely to produce by 1.9 times more compared to those below 37 years old. This implies that the majority of farmers involved in sisal production in the study area were energetic adults with some financial capacity enough to invest in sisal production. The findings are similar to those of Guo *et al.* (2015) and Kangile *et al.* (2020) which shown that majority of respondents engaged in crop production were aged between 40 to 50 years. Age is the most decisive factor that determines the productive potential of a certain household (Abrha, 2015). Age can be related to farm experience, as age increases farm experience increases and production is likely to increase up to a certain age limit (Anyanwu, 2009; Shumet, 2011; Adebiyi and Okunlola, 2013). Studies done in Nigeria and Ethiopia revealed that, agriculture in developing countries is labour intensive, after a certain age where the farmers' physical strength decreases, their conservatism increases and finally production decreases (Amaza *et al.*, 2006; Shumet, 2011).

Marital status did not show any significant difference. This could be due to the fact that those who were not married used to hire other people as labour force. This is contrary to a study in South-Western Tanzania which showed that families with married couples to be more stable and likely to produce more (Hariohay *et al.*, 2017). In African societies marital status should not be ignored when talking of agricultural production (Kilobe *et al.*, 2013). Furthermore, married women can participate actively on crop production but sometime they are occupied by their multiple roles and cultural practices (Ayoola1 *et al.*, 2014).

Farmers who had secondary education and above were likely to produce 3.5 times more compared to those with primary or no formal education. This implies that farmers with secondary education and above are more likely to cope with the changes in various means of agriculture such as modern technology and access to information through various media (Dolisca *et al.,* 2008); Odoemenem1*et al.,* 2010). Educated farmers are more likely to make the right decisions and solve problems regarding crop production hence increased yields and profitability (Ngailo *et al.,* 2016).

Up on experience, respondents with experience below 11 years of sisal cultivation were likely to produce by 2.4 times less compared to those with experience of 11 years and above. This concurs with the study done in Ghana highlighting that experience enables a person to acquire some agronomic skills for efficient management (Johnson *et al.,* 2018). That is to say as long as the farmer stays in farming over years, he is likely to be competent for field work hence more production (Ayoola1 *et al*., 2014; Borchelouie *et al*., 2015).

On average earnings, smallholder farmers in the study area each earned between 3.3 - 10 million Tshs per year. The findings are similar to the anticipated earnings to smallholders in Katani Company Limited from 2005 to 2015 that was US$ 31 million (UNIDO, 2006). This is a considerable higher amount earned as compared to other crops like cotton (BOT, 2016; Suleiman, 2018).

Upon land ownership, respondents who owned land were likely to produce sisal for about 2.4 times more compared to those who didn’t own land. That is to say land ownership whether self or contract/hiring is very important in agriculture because you cannot

undertake crop cultivation if there is no land and the land controlled by men as head of household seemed to be more stable and productive. The findings concur with the study in Indonesia which showed that land possession is an essential factor in agriculture where contract farming/ land hiring is most practiced in sisal farming (Greco, 2017). Likewise, a study in Tanzania showed that farmers under contract farming schemes are the important component in agriculture sector as they can easily be reached and monitored (Isager *et al.*, 2021). Also the study by Petro *et al.,* 2015) observed that the amount of land owned and allocated for crop farming by an individual is direct proportional with crop production, and the households led by men seem to acquire more land as opposed to those led by female (Manzanera *et al.,* 2016).

Households with dependent children are likely to have high production by 2 times more as compared with those having dependent adults and no dependents. It means households with dependent adults are normally overwhelmed with the burden to take care of them and need to hire other people for field work hence low production and vice versa. The findings are similar to the studies in Zambia and Ethiopia shows that as the number of non-productive persons increase, labourforce is affected negatively (Chimai, 2011; Lebina, 2019). That is why in most agricultural communities the number of household members is always high ranging from five to eight in order to secure labourforce (Ochieng, 2017). According to Khoza *et al.,* 2019 and Rai *et al.,* 2019 in their studies done in South Africa, southern and northern Tanzania revealed that family size is direct proportional to crop production.

Among many factors, only three factors were statistically significant in relation to sisal production in the study area namely agricultural machines (e.g. tractors) ownership, bush

fires and total land size allocated to sisal production, and others didn't show statistical significant difference (Table 3.5). This relates to the study by Abrha (2015) as it revealed that crop production is prone to a number of factors that may influence positively or negatively. Similarly, the factors may be rooted at personal level, climatic, institutional, sector wise or at the higher authority like the government (Urassa, 2015; Muraya and Ruigu, 2017).

Land size was statistically significant in a sense that, for every unit reduction in the land size, the farmer is likely to produce by 64% less and vice versa. This implies that as the farmer allocates more land for sisal production he is more likely to produce by more than half at every unit increase in land size. The findings are similar to that of Tsegaye (2008) revealed that agricultural communities tend to acquire more land for more crop production. Similarly, land holding size is directly related with crop production; and while quantifying a 1% expansion in land size will result in 0.32% increase in agricultural output (Mpawenimana, 2005).

The study findings show that farmers cultivated sisal with a varied land size ranging from 0.5 hectares as the smallest farm size to 6.5 hectares as the largest farm size. Majority of farmers (77.8%) in the study area cultivated sisal with a varied land size ranging from 0.5 hectares to 6.5 hectares. Similarly, a study in four East African economies (Uganda, Ethiopia, Kenya and Tanzania) indicated that over 75% of smallholder farmers had farm sizes of about 2.5ha (Salami *et al.*, 2010; FAO, 2018). Likewise, the findings support that sisal production requires a large land size for maximize production in quality and quantity of products (Etwire *et al.*, 2013; GAFSP, 2016). This is contrary to the land size required for growing seasonal crops like maize and cassava as revealed in the Savannah Zone of

Northern Ghana that on average 2.4 acres was used for cassava cultivation and it is similar to the study in maize production from southern and northern zones of Tanzania (Hariohay *et al.*, 2017; Rai *et al*., 2019).

The use of technology that is associated with ownership of mechanized machines such as tractors, planters etc. was likely to produce about 97% higher. That is to say farmers who use agricultural technology are more likely to have more sisal yields and the opposite is true. The findings concur with those by Chimai (2011) who highlighted that the use of technology in agriculture has a greater impact in crop yields both in quality and quantity. Likewise, the use of technology helps to reduce the amount of time spent and number of labour in the field hence more efficiency with more output (Nerini *et al.,* 2016; Mwaniki, 2018).

The occurrence of fire in sisal fields is likely to negatively affect sisal production by 98%. This implies that occurrence of bush fires by hunters or neighboring farmers during their land preparation for seasonal crops like maize do affect much sisal plants deterring growth and finally resulting to poor harvest or even no harvest at all when the magnitude of fire is big. This correlates with several studies that disclosed that uncontrolled bush fires are one of the frequent reported challenges (Puglisi, 2005). It appears to hinder crop production in most of agricultural societies as it has direct effect to plant life normally causing death hence lowering the amount of harvest (Neba, 2009; Dimitra *et al*., 2019). Furthermore, fires tend to occur as a result of land preparation by neighboring farmers, careless people and misunderstanding between farmers and pastoral societies (Benjaminsen *et al.*, 2018). This is similar to what was reported by a Key Informant from Mswaha as follows; "Sisal farms are burned through fire coming from

other farmers very close to ours especially those cultivating cereal crops such as maize who prepare their farms by using fires to chase dangerous organisms such as a snake" (Key informant interview from 16/3/2020).

During FGDs in Chekeleni, Mabogo and Mswaha, it was revealed that sisal destruction by fires is a common phenomenon. They said that neighbouring farmers who cultivate seasonal crops such as maize, millet and other crops prepared their farms with the aid of fire. They do so in order to deter rodents and snakes but they fail to control the fire resulting into negatively affecting the growth of sisal in the nearby farms. This is an indication of lack of proper knowledge on the negative effects of fire on plants. The findings concur with the study in Kilimanjaro that showed fires reduced beauty of the heathlands that attract tourists and destroyed flowers, crops and other vegetation (Agrawala *et al.*, 2003). It is also similar to a study done near Pangani, Tanzania (Puglisi, 2005). Likewise, it correlates with the study in south western Amazonia which revealed that fire destroyed forest crops and it affected the economy (Campanharo *et al.,* 2019).

Labour force availability in the study area was not statistically significant due to the fact that majority of respondents said there was no scarcity of labourforce in the area. The findings agree with the fact that labour force is an important component in agriculture sector as it is directly related to crop production (UNCTAD/LDC, 2015).

Also results did not show statistical significance for the vermin and disease control in the study area. This implies that majority of respondents did not bother about the control of vermin and diseases that is to say farmers leave their sisal to grow under nature and this is directly related to the shortage of capital for buying the required materials. Similarly, the

study by Savary *et al.* (2012) revealed that vermin cause mechanical damage to plants and apart from vermin crops are affected by several diseases like zebra disease, Korogwe leaf spot, dieback disease, and the bole rot causing plant death hence lowering production (Gama *et al.,* 2015).

Sisal weevils and disease known as Korogwe leaf spot were named as major problems affecting sisal farms hence reduced production. The destruction of sisal plants by goats, monkey and wild pigs (warthogs) were also mentioned as a serious problem to young sisal plants. One Key informant from Mabogo on 18/03/2020 mentioned that "Wild pigs and monkey used to come at night and eat sisal plant where they preferred the young sisal plants. It seems young sisal plant has a flavor that attracts monkey and wild pig". This implies that smallholder sisal farmers in the study area were affected by such problem. The findings are similar to a study by Savary *et al.* (2012) which indicated that pests, vermin and diseases had a negative impact on crop production hence reduced production both at local and global scale.

Market availability was not statistically significant implying that sisal production in the study area was still low despite the majority knew that the market was highly available (95.6%). The findings are similar to those of Santos *et al.* (2018) who disclosed that from 1990s sisal recovered its value due to the worlds' emphasis on the use of biodegradable fiber to substitute synthetic fibers to protect the environment.

Focus Group Discussions acknowledged that market is available all the time. Also Key informants from all villages reported that there was no problem on availability of market but they do not have the ability to produce much. For instance, one of the key informants

from Chekeleni on 17/03/2020 said, “Surely the market is so inspiring that we wish we could produce much but as you can see that sisal require a big area that need some mechanized machines like tractors which need much capital”.

Study results did not show statistical significance for capital availability. This is due to the fact that all respondents in the study area reported to experience shortage of capital and they cannot access loans from financial institution. The findings are similar to those of Zakaria *et al.* (2019) who revealed that capital is a necessary factor in agriculture that has a direct effect on crop production especially for cash crops like sisal that requre considerable big areas Zakaria *et al.* (2019). Similarly, many farmers in third World countries like Tanzainia have no access to loans from formal financial institutions; therefore they depend to get funds from friends (Salami *et al.,* 2010; BOT, 2016).

Participants reported to have no enough capital for sisal production since sisal production is costly in terms of labour and other running costs that begin from farm preparation up to harvesting. The issue of lack of capital was equally raised during Focus Group Discussion in all villages and people involved in FGDs agreed that lack of capital was a problem that hindered them to cultivate large farms. They even claimed that sometimes they fail to harvest mature sisal due to lack of mechanized tools such as tractors to carry sisal leaves to the factory. This situation sometimes destroys sisal leaves especially at the harvesting time if farmers do not have mechanism to harvest hence leaves dry and become wasted.

For example, a participant from Mabogo reported that "Sisal cultivation is labour-intensive and it demands care especially during cultivation state including farm preparation planting, weed control and during harvesting.

Small scale farmers lack mechanized tools such as tractors thus it becomes difficult during tillage of their farms and transportation of sisal leaves after harvesting" (Key informant interview 14/3/2020). The issue of lack of mechanism was noted to be a serious problem facing small scale farmers resulting to poor produce. They even claimed that sometimes they fail to harvest mature sisal in time hence experience pre harvest loss.

These findings are similar to those of Zakaria *et al*. (2019) who revealed that capital enabled farmers to increase yield in Soutn Africa. Also, a report by BOT (2016) revealed that most farmers in Tanzania use own funds because it is difficult to access loans from formal financial institutions due to high interest rates and bureaucratic procedures. Similarly, a study done in the four East African economies namely Uganda, Ethiopia, Kenya and Tanzania indicated that farmers rely on financial support from friends and relatives, gift, and informal money lenders (Salami *et al.,* 2010).

The study findings show that good income from sisal farming (81.3%) was a leading factor that influenced farmers to grow sisal. This implies that smallholder farmers planted sisal with the expectation of earning money from sisal produce. This is an indicator of good market for sisal both local and international resulting from the increase in global demand for environmentally friendly commodities made from sisal fibres. That is to say, from 2006 to date global fibres consumers have shifted from the use of synthetic fibres to sisal fibres because sisal products can decompose easily hence ecologically friendly as compared to synthetic fibres.

Another factor was the recent availability of market (74.4%) due to high demand of sisal fibres in the global market that caused the price of one ton of raw sisal after processing to

rise from two million and a half to three million Tanzania shillings (2 500 000 – 3 000 000 Tshs) compared to the previous price in early 2000 which was 1 200 000 Tshs. The issue of market availability was equally raised by participants from all wards in the study area during Focus Group Discussion and Key informants interview, for example one of the Key informants from Mswaha on 3/3/2020 said; “Precise marketing information within and outside the county encouraged smallholder farmers to cultivate sisal. Also, small-scale farmers had an opportunity to learn from their fellow farmers on the benefit they received from current sisal markets".

Another factor was advice and support received from Katani Company Limited influenced sisal production by small scale farmers 58.9% (Figure 3.3). The support offered to farmers by Katani limited included assisting farmers in land preparation for sisal seedling growing, sisal estate weed and pest control. Not only that but also, Katani Company Limited assisted farmers in harvesting, transporting sisal produce to the decortication machine, processing sisal leaves for final products, packaging and stocking ready for sale to the local and global markets.

Furthermore, the findings reported 34.4% of the small-scale sisal farmers got advice from Katani Company Limited that motivated other farmers to adopt cultivation of sisal, this served as an influential factor for the production (Figure 3.3). This reflects the spread of knowledge and technology on sisal cultivation among farmers themselves. This implies that small-scale farmers planted sisal for money gains in an attempt to utilize the current opportunity for a good market on sisal at local and international settings. This is due to the fact that the world is now shifting to the use of environmentally friendly commodities made from sisal fibres as opposed to synthetic fibres.

Support offered by Katani Company Limited to small-scale sisal farmers is appreciated in the sisal production at all stages to the final stage of marketing the product. Also knowledge and experience sharing among farmers were found to be important factors influencing sisal production in the study area. In addition, shared knowledge and experience among farmers should not be ignored but should be backed with professional knowledge.

Similarly, a study by Urassa (2015) found that income generation, availability of market, farmers experience and support from responsible institutions were among the factors affecting crops production. Also, Valentine (2014) found that factors affecting agriculture production in Tanzania were directly related to farmer's level of knowledge, market availability and access to financial institutions. The same is true from a study in South Africa that insisted on the importance of assisting farmers in all possible ways that would result in high crop production (Khoza *et al.*, 2019).

Upon knowledge and skills on sisal production, the findings revealed that only 35.6 % of the respondents had considerable good knowledge and skills on sisal production. Respondents with considerable good knowledge were those who scored more than 51% during interview and those who scored below 51% were regarded to have low knowledge on sisal production (Table 4.2).

Also, upon further statistical analysis for the comparison of mean scores of respondents with respect to place of residence (village) revealed that there was no statistical significant difference in knowledge and skill among respondents with respect to place of residence (Table 4.3). This implies that smallholder sisal farmers in the study areas had

almost an equal level of knowledge and skills hence they all needed to be given appropriate knowledge and skills on regular bases with close observation.

A report by UNIDO (2006) and TARI (2017) about Kenya and Tanzania recommended that there should be major strategies aiming at imparting knowledge and skills to smallholder farmers in order to raise sisal production. The findings concur with the study in Ethiopia by Marc Corbeels, 2000) who insisted on the importance of farmers given with sufficient knowledge and skills for better production Also, though farmers can participate in some harvesting activities sisal processing requires involvement of professionals and money for hiring or acquiring the required technology (Dlamini *et al.,* 2014).

Sisal farmers were also engaged in series of activities from harvesting, processing up to the last stage of stocking of sisal bales. 64.4% of farmers were highly engaged in cutting of sisal leaves during harvesting followed by bales of fibre 37.8% and stocking sisal fibre bales 34.4% and few farmers engaged in sorting of fibre 2.2% and 12.2% brushing and grading of fibre (Table 4.4). Sisal farmers were engaged more in harvesting, transportation, packaging and stocking as compared to processing activities. This was due to the fact that, farmers were responsible for cutting and transportation of raw sisal from the farm to the factory; then after handling the sisal to the factory processing was done by few responsible persons as experts. Finally, farmers were highly engaged in packaging, transporting and stocking to counter check their products ready for selling via various agents like AMCOS. This implies that smallholder sisal farmers were engaged in various activities from harvesting up to the final stage though the participation rate was low in some stages especially the production process (Table 4.4).

Upon direct observation, the researcher had an opportunity to assess how farmers used to carry out sisal production processes right from farm to the final destination in the market. Observation was done three times at an interval of two weeks in every village and the approximate rating on every stage of sisal production was recorded, lastly the average rating was computed and the following was observed (Table 4.4): about 46.7% of the farmers in the study area used to cut sisal leaves properly, 61.1% did proper transportation of sisal leaves to the processing machines, proper processing of sisal leaves into fibers was done by 88.7%, proper sisal fibers grading by 91.1%, proper fibers packaging 92.2%, Proper stocking of fiber bales 83.3% and proper transport to the market by 87.8%. The findings revealed that there was a big challenge on cutting sisal leaves as farmers tend to cut more leaves per plant in favor for quantity hence affecting quality of sisal fibers.

Farmers received knowledge and skills from various agricultural agents though a large percentage of the farmers were not reached by these agents due to shortage of funds to facilitate the process. Similar findings were reported by Rutatora and Mattee (2001) who claimed that many districts in Tanzania are unable to finance extension services from own sources without external support. Likewise other scholars (Khapayi and Celliers, 2016: Omari *et al.*, 2018) pointed out that, lack of appropriate agricultural knowledge and skills on crop production results to poor farm management hence low yield with poor quality.

Farmers received knowledge and skills mainly from five sources including agriculture extension officers, smallholder sisal farmers, Tanzania Sisal Board staff, Agriculture Marketing Cooperative Society and Katani Company Limited (Figure 4.2). The results show various sources of knowledge and skills for small scale sisal farmers; agriculture extension officers (53.3%) followed by fellow sisal farmers (42.2%), 24.4% by Katani

Company Limited, AMCOS by 20% and Tanzania Sisal Board Staffs (18.9%) (Figure 4.2). This implies that smallholder sisal farmers shared knowledge and information through the networks within themselves and to a great extent with extension agents.

Results from FGDs and Key informants revealed that participants from all the villages reported that most of the time they shared information among themselves and to lesser extent from agricultural extension services through extension officers who provided knowledge and skills to the farmers but infrequently and reached only a small proportion of the smallholder sisal farmers. They said they had a problem in accessing the right information and sometimes they have to hire some people to provide them with the right information they needed. For example, one of the Key informant in Mabogo said "getting the right information at the right time here in our area is a big challenge since responsible people who are knowledgeable from the government make few visits per year, therefore we are used to teach and share information among ourselves" (Key informant interview 18/3/2020).

The findings are contrary to those of Lwoga *et al*. (2011) who pointed four main sources of information and knowledge for where 72.9% were friends, followed by extension officers (71.8%) and the rest were family members (56.9%) and input suppliers (43.6%). Likewise, the study by Mubofu and Malekani (2020) conducted in Iringa Tanzania noted the sources of agriculture information were radios, religious leaders, village leaders and seminars as the main channels used by extension officers to disseminate agricultural information to farmers.

Further description of sources of knowledge and skills

Katani Company Limited staff; claimed to engage on educating farmers on sisal production and worked closely with farmers who were interested to learn on good sisal production practices. The company also agreed contract farming with farmers to cultivate sisal in estates owned by the government under Tanzania Sisal Board (Key informant interview 19/3/2020).

Extension agents; claimed to play their part in educating sisal farmers from within estates and outside the estates. They acknowledged not meet the majority of the farmers timely due to several challenges in trip logistics that need payment to staff on outreach, transport and teaching materials, which all need money while the budget allocated is normally limited (Key informant interview 20/3/2020).

Sisal farmers; said that they received information from the agents but very rarely and most of the time they organised themselves and paid some staff who are off job on local arrangements when they are in real need. Furthermore, they said they are the teachers and students among themselves. For example one of the participant from Mswaha said “at the time we have urgent need for the professional advice we normally organize ourselves to bring a staff by payment during off hours (FGD 17/3/2020).

Tanzania sisal board staff; claimed to visit farmers and see the progress of sisal growing. During the visit, they teach farmers and other stakeholder on good sisal husbandry from land preparation, nursery preparation, and nursery planting and management, planting sisal in the main field and maintenance to harvesting. Generally they inspect of sisal production from the beginning to end product (Key informant interview 20/3/2020).

AMCOS; is a cooperative union which educates sisal farmers on good husbandry of the crop for quality and quantity harvest. However, they acknowledge a challenge of not meeting majority of the farmers timely as said by the Key informant on 16/3/2020 that "we really acknowledge that it is not easy for us to reach farmers timely and frequently as we are running short of staffs".

5.2 Conclusions

Based on the study findings, the following are the main conclusions:

Results from this study revealed that farmers had some knowledge and skills on sisal production but is not sufficient for the higher production of sisal among smallholder farmers.

In terms of source of knowledge, farmers depended on agricultural extension officers to get information and skills on sisal production. Farmers also shared knowledge among themselves.

Factors influencing sisal production were: income generation, availability of market due to increased global demand on sisal fibers, advice and support offered by Katani Company Limited, and farmer to farmer advice.

Furthermore, shortage of capital for investment in sisal production, presence of uncontrolled bush fires from neighboring farmers and the presence of pests and vermin were among factors that seriously affected young sisal plants resulting to low production.

5.3 Recommendations

Based on the study findings, it is recommended that:

i. There should be special programs aiming at boosting the level of knowledge and skills of farmers on sisal production by responsible authorities.

ii. There should be linkage between financial service providers and sisal farmers as an attempt of resolving the challenge of capital through provision of loans that have friendly conditions (e.g. low interest rate) to smallholder farmers under supervision of the Sisal Board of Tanzania.

iii. The government should train and retrain more extension workers specifically on sisal value chain. This will help in resolving the challenge of shortage of qualified extension workers.

iv. TARI Mlingano should be used to train and retrain extension workers

v. Ministry of Agriculture should formulate suitable policies that will encourage more stakeholders to invest in sisal processing industries for significant impact on sisal production in the study area and the country at large.

5.4 Suggestions for further research

Further studies can focus on the cost benefit analysis for small holder sisal farmers. Establishment of the cost of production among small-scale farmers and computation of income per unit area will be helpful in determining areas that need intervention for small holder farmers to improve sisal production.

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APPENDICES

Appendix 1: Questionnaire for sisal production

Introduction

My name is Venusto H. Kasyamakula. I am an MSc. student from Sokoine University of Agriculture (SUA). I am conducting a study on the smallholder sisal farmers in your area. Based on your experience, you are requested to provide your views and information based on the questionnaire. All the information will be treated confidentially and will be used for the purpose of this research

Identification

Name of Enumerator …… Date of interview ……..

Name of Village ……

Name of Ward ……

Respondent's No ……

Instructions: Tick (√) or **fill in the space provided where appropriate.**

Q1: Socio-economic Characteristics

Q1A. Sex of respondent:

1. Male [ ]
2. Female [ ]

QIB. Age of respondents in years

1. 18- 25 [ ]
2. 26-36 [ ]
3. 37-50 [ ]
4. 51 and above [ ]

Q1C. Marital status of respondent

1. = Single [ ]
2. = Married [ ]
3. = Widow [ ]
4. = Divorced [ ]

Q1D. Educational level

1. = No-formal education [ ]
2. = Primary education [ ]
3. = Secondary education [ ]
4. = College (Certificate and Diploma) [ ]
5. = University [ ]
6. = Other (Specify) ……

Q1E. How long have you been living in this village? …….years

Q1F. Indicate the number of dependents in your household

1. Adult (Men) ……..…
2. Adult (Women) …….……
3. Children/Child …….…..

Q1G. Major occupation of the respondent:

1. = Crop farmer [ ]
2. = Livestock keeper [ ]
3. = Crop and livestock keeper [ ]
4. = others (specify)……

Q1H. What is your household gross income per annum (in TShs)?

1. Below 10,000,000 [ ]
2. 11,000,000-15,000, 000 [ ]
3. 15,100, 000- 20,000, 000 [ ]
4. 20, 100, 000 -25,100,000 [ ]
5. Above 25, 000,000 [ ]

Q1I. What are your main sources of income? (Tick only One)

1. Crop Farming [ ]
2. Livestock farming [ ]
3. Crop and livestock farming [ ]
4. Off-Farm employment [ ]
5. Others (Please specify)…….

Q1J. Do you own land?

1. = Yes [ ]
2. = No [ ]

Do you grow sisal within an Estate? If yes name the Estate

1. Yes[ ]
2. No[ ]

Q1K. If the answer is yes in question Q1J above, what is the size of your land in 2015-2019 season?

1. 0.5-1.0 hectares [ ]
2. 1.1.0 – 6.0 hectares [ ]
3. 6.5 – 10. Hectares [ ]
4. >15 hectares [ ]

Q1M. Who controls the household land?

1. Husband [ ]
2. Wife [ ]

Q2: **Extent of utilization of improved sisal technologies and practices**

Q2A.**Technologies1**

Improve Agriculture technology /practice	**Full use**	**Half use**	**Not used**
Technology available e.g. Caterpillars and wheel tractors, disc ploughs & harrows			
Proper land preparation			
Proper planting			
Use of hybrid varieties			
Use of fertilizers and pesticides			
Availability of water pumps			
Availability of water storage tanks			

Q2B practices

- Proper plant materials
- Proper planting
    - Planting time
    - What is the depth
    - When is the proper time for gapping

- Proper supervision
  - Who is the supervisor?
  - Yourself or someone else?

- Proper spacing (between plants and rows) in nursery and field
- Proper field and nursery maintenance
- Proper harvesting sisal leaves, handling leaves.
- Proper transport of leaves
- Proper decortication
- Proper drying line for fiber
- Proper sorting
- Proper brushing of fibers
- Proper grading of fibers
- Proper baling of fibers
- Proper stocking
- Proper transport for sisal fiber bales to the market

Factors Affecting Smallholder Sisal Production

1. What are challenges you face when you prepare the land for nursery and main field for Sisal crop?
   i. Are laborers available?
   ii. Are Tractors for cultivation available?
   iii. How do you manage to cultivate Sisal field and maintain it?
   iv. Do you have your own tractor to cultivate and transport sisal leaves from the field to the decorticating machine? If no how do you transport sisal leaves?
   v. Is the capital a problem to you? If Yes what are the difficulties?
   vi. What method do you use to control weed?
   vii. How does “FIRE” affect sisal?
      - How do you control Fire?
   viii. How do you control vermin in your farm?
   ix. Do you have your own mobile decorticating machine? If no what is the cost of decorticating one ton? And what are the difficulties? If yes what is the cost effectiveness of decorticating one ton?

x. What other difficulties do you face in sisal production in general?

a) On keeping sisal fiber safe from moisture, dusts, and thieves
b) On selling sisal fiber?
c) Any other challenges on sisal production
d) Is land scarce?
e) Is land profitable for sisal cultivation?
f) After how many years do you start harvesting?
g) What are the serious challenges on harvest sisal?

2. What is the cost for establishing sisal farm?
3. How do you process sisal leaves to fiber and what is the cost?
4. Where do you selling your sisal fiber?
5. Are you comfortable in cultivating sisal? If yes how? If no why?

"THANK YOU FOR YOUR COOPERATION"

Appendix 2: Interview schedule for sisal farmers

i) **To determine the level of sisal production among smallholder farmers**

1. How many acres do you have?
2. Who is the owner of the farm?
3. What is the average harvest you have had in the past 3 years?
4. When and what was the highest produce in the sisal production?
5. What have you done with the highest amount of money you got from your sisal produce
6. How many times do you harvest your sisal in a year?
7. What are the differences of the harvest in time and they're average per hectare?

ii) **To assess smallholder farmers' knowledge and skills on sisal production**

1. Shortly can you explain to me how do you prepare the land for sisal planting?
2. How are you plant sisal plant and where do you get planting materials?
3. How do you know on pesticides or insecticides to be used in sisal production?
4. What are the important procedures in sisal harvesting that you normally practise?
5. How are you processing sisal leaves to fiber and what is the cost effective
6. How many times do you harvest your sisal in a year? What are the differences of the harvest and they're average per hectare?
7. What are the cost effective on collectiveness for sisal development (i.e. from preparing the land for nursery, main field, planting and maintenance per hectare/ three years?
8. Whom giving you an important information on cultivation

iii) **To identify the farmers' sources of knowledge and skills in sisal production**

4 Who gives you important information on sisal production?

5 Did you get any training on sisal development and production anywhere within or out of our country?

6 How many years you are cultivating sisal crop?

iv) **To examine factors influencing sisal production in the study area**

1. How do your family members perceive and support you in your involvement in sisal production?
2. What are the factors convincing you to cultivate sisal?
3. Can you tell me how you benefit from cultivate sisal rather than other crops?
4. What are the challenges you face as you cultivate sisal.
5. Are you comfortable on cultivating sisal? If yes how? If no why?
6. What are the factors influences sisal to grow at this area?

"THANK YOU FOR YOUR COOPERATION"

Practice		Frequency	Percentage
Technology use	Used	83	92.2
	Not used	7	7.8
Proper land preparation	Done	81	90
	Not done	9	10.0
Proper planting	Done	82	91.1
	Not done	8	8.9
Use of hybrid varieties	Used	90	100
	Not used	0	0.0
Intercropping	Yes	86	95.6
	No	4	4.4
Use of fertilizers and pesticides	Used	8	8.9
	Not used	82	91.1
Water pump use	Used	1	1.1
	Not used	89	98.9
Water storage tank use	Used	0	0.0
	Not used	90	100
Proper supervision	Self	87	96.7
	Someone else	3	3.3
Proper field maintenance	Done	8	8.9
	Not done	82	91.1
Proper harvesting	Done	31	34.4
	Not done	59	55.6

Appendix 3: Agricultural practices by study participants

Appendix 4: Socio-demographic characteristics of study respondents

Characteristic	Category	Frequency	Percentage
Sex	Male	60	66.7
	Female	30	33.3
Age	18 - 25	2	2.2
	26 - 36	10	11.1
	37 - 50	41	45.6
	51 and above	37	41.1
Marital status	Single	6	6.7
	Married	65	72.2
	Widowed	17	18.9
	Divorced	2	2.2
Education level of respondents	Non-formal education	12	13.3
	Primary education	49	54.4
	Secondary education	12	13.3
	College (Certificate and Diploma)	11	12.2
	University	6	6.7
Experience of respondent	Below 15 years	44	48.9
	15 years and above	56	51.1
Major occupation	Crop farmer	67	74.4
Of respondent	Crop farmer and livestock keeper	22	24.4
	Business and crop farming	1	1.1
Main source of income	Crop Farming	67	74.4
	Livestock keeping	3	3.3
	Crop farming and livestock keeping	20	22.2
Land ownership	Yes	78	86.7
	No	12	13.3
Controller of land	Husband	74	82.2
	Wife	16	17.8
Number of dependent children	0	11	12.2
	1 - 4	75	83.3
	5 - 8	4	4.5
Number of dependent adults	0	30	33.3
	1 - 4	55	61.1
	5 - 8	5	5.6