SOCIO-ECONOMIC IMPLICATIONS OF BROWN STREAK DISEASE ON CASSAVA PRODUCTION AMONG SMALLHOLDER FARMERS IN KISARAWE DISTRICT, COAST REGION, TANZANIA

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A DISSERTATION SUBMITED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTERS OF SCIENCE IN AGRICULTURAL ECONOMICSOFSOKOINE UNIVERSITY OF AGRICULTURE.MOROGORO, TANZANIA.

2018

ABSTRACT

Cassava Brown Streak Disease (CBSD) has been among major challenge to sustainable smallholder cassava production in Kisarawe District. A smallholder cassava farmer's survey was conducted using personal interviews to determine the implication of CBSD on cassava production and income at smallholder farmer's level in Kisarawe District. Data were collected using structured questionnaires in a cross-sectional survey involving 107 respondents in two selected wards and villages in Kisarawe District. Descriptive statistics were used to determine farmers' opinions on the extent of infestation on farms. Cobb Douglas production model was used to determine the implication of CBSD and other variables on the cassava yield. Disease risk perception was measured using the likert scale on three point scale. In the study, experience and extension services, had negatively influenced cassava yield. Conversely, farm size, education, marital status, family size and sex positively influence the yield. Also marital status, extension services, farm size and sex had a positive influence on income. However, the study concluded that CBSD had significant negative implication on cassava yield as well as gross margins (GM). Thus, this study provides useful information about the implication of the CBSD on smallholder cassava production and on specific socioeconomic parameters that farmers, extensionists, researchers and policy makers can use in designing appropriate interventions towards mitigating the negative implication of CBSD on overall cassava productivity.

DECLARATION

I, Derick Samwel do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work done within the period of registration and has neither been submitted nor being concurrently submitted for a degree award in any other institution.

______________________________ ______________________________

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The above declaration is confirmed by;

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Dr. Jeremia Makindara **Date**

(Supervisor)

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ACKNOWLEDGEMENTS

I would like to thank the Almighty God for providing me with all the necessary needs, protection and ability throughout my study until successful accomplishment of this work. I would first and foremost thank Dr. Kiddo Mtunda the Coordinator of Community Action in Cassava Diseases Control through Clean Seed Project under the Sugarcane Research Institute (SRI), Kibaha for sponsoring my studies together with DED and DAICO of Mkuranga District for granting me permission to pursue further studies at Sokoine University of Agriculture. Special thanks and appreciation is also due to Dr. Jeremia Makindara my supervisor for his guidance, suggestions throughout this study. Also my thanks to Dr. Damas Philip of School of Agricultural Economics and Business Studies for accepting to allocate his private time for consultation and finally, I would like to acknowledge the entire staff of the Department of Agricultural Economic and Agribusiness of Sokoine University of Agriculture, and my fellow postgraduate students to the success of my Master Degree Studies.

Special thanks should go to my brothers and sisters of Timothy Samwel family and my wife Monica Gershon for their continuous encouragement and inspiration during the entire study period. Acknowledgement is also extended to all staffs and farmers in Kisarawe District for their willingness to participate in this study. Most of all I wish to extend my gratitude to all individuals who assisted me to accomplish this work. However, I am entirely responsible for any shortcomings in this study.

DEDICATION

This work is dedicated to ALMIGHTY GOD, the creator and giver of life to living creatures. To my Late Father Timothy Samwel who laid the foundation of my educational trajectory. This is a result of his support and devotion. May his Soul Rest in eternal Peace, Amen.

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LIST OF ABBREVIATIONS AND SYMBOLS

CBSD	Cassava Brown Streak Disease
CD	Cobb Douglas production function form
CMD	Cassava Mosaic Disease
DAICO	District Agriculture, Irrigation and Cooperative Officer
DED	District Executive Director
DRC	Democratic Republic of Congo
FAO	Food and Agriculture Organization
GL	Generalized Leontif form of production function
GM	Gross Margin
Ha or ha	Hectare
IITA	International Institute for Tropical Africa
KDP	Kisarawe District Profile
MARI	Ministry of Agriculture Research Institute
OLS	Ordinary Least Squares
SARRNET	Southern Africa Root Crop Research Network
SPSS	Statistical Package for Social Sciences
SRI	Sugar Research Institute
SSA	Sub-Sahara Africa
SUA	Sokoine University of Agriculture
TR	Total Revenue
TVC	Total Variable Costs
URT	United Republic of Tanzania

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Roots and tubers produced in Africa account for 30% of world's production and have emerged as critical in feeding the continent's increasing population (FAO, 2011). Worldwide potato has the largest share (43.1%) among the root and tuber crops. However, in Africa cassava total production is leading and contributes about (55%) of the global 233 million metric tons (Mwebaze, 2016). The crop is essential in the poor Central, Eastern and Southern Africa regions for the role that it plays compared with other food crops such as rice and maize. In this case, the crop referred to as a food security crop (FAOSTART, 2010). Cassava was introduced in Sub-Sahara Africa (SSA) by Portuguese traders in the 18th century and is the third largest carbohydrate food source in the Tropical regions, after rice and maize (Alabi, *et al*., 2011; IITA, 2013).

Tanzania is currently the World's eighth largest producer of cassava, and Africa's fifth largest after Nigeria, Democratic Republic of Congo (DRC), Ghana and Angola (Lyimo, 2006). Its annual root production is estimated at 5.5 million tons from 761 100 ha with the main producing areas in Tanzania being: the Coastal strip along the Indian Ocean (23.7%), around Lake Victoria (13.7%), Lake Tanganyika (7.9%) and along the shores of Lake Nyasa (3.5%) which produce more about (48.8%) of total production (Mkamilo and Jeremiah, 2005). Cassava is also regarded as the first or second staple food in Tanzania (Mtunda, *et al.*, 2002). While cassava is claimed to be the second most important food crop after maize in terms of production volume, per capita consumption and its supports to the livelihood of smallholder farmers, its production in terms of both weight and area under cultivation has been roughly static for the last two decades at the yield of 7-9 tons/ha (Myaka, 2011; IITA, 2011).

However, cassava production trend in Tanzania from 2000/2001 to 2010/2011seasons depicted promising hope with the average cassava fresh root yield of about 16 tons/ha (FAO, 2001; FAOSTART, 2010), though this was well below the continent's average of 30 tons/ha of the world's largest producers such as Nigeria and India (FAO, 2015; IITA, 2011). Yield gap is caused by low productivity of local and commonly grown varieties due to susceptibility of such varieties to major diseases such as Cassava Mosaic Diseases (CMD) and Cassava Brown Streak Disease (CBSD) among others (Mulualem and Bekeko, 2015; Mtunda *et al.*, 2002).

These two viral diseases are currently the greatest challenges of the cassava crop in Tanzania as they destroy tubers and leaves as well. Until now, tolerant cultivars are not widely available and farmers are advised to combat them by growing improved cultivars (IITA, 2011; Coulson and Diyamett, 2012). For instance, many researchers reported as high as 55% to 70% of losses in the local cultivars are caused byCBSD (Thresh, 1994; Mtunda *et al*., 2002; Ndyetabula, 2005 and Legg, 2005; Thresh, 1987: Selvarajah and Geretharan, 2013). Hence, in order to succeed at effectively reducing the devastating outcomes of CBSD, the adoption of control measures such as using healthy planting cultivars, improved varieties and roguing is of paramount importance in the short run (Thresh, 1987; Fargette, 1990; Legg, 1999; Mallowa *et al.,* 2011).

Table 1: Cassava production in Kisarawe

Area (ha)	KISAROWE CASSAVA PRODUCTION - YEARS						
CROP	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
TONS	6 310	6 126	5 870	5 340	4 858	4 279.60	4 284

Source: KDC (2015)

Kisarawe District is one of the potential areas for cassava production. However, it has experienced declining cassava yields in the recent years due to among others the presence of CBSD, Figure 1. This has had negative implications on farmers' income, household food availability and the livelihood status of smallholder farmers (FAO, 2012),

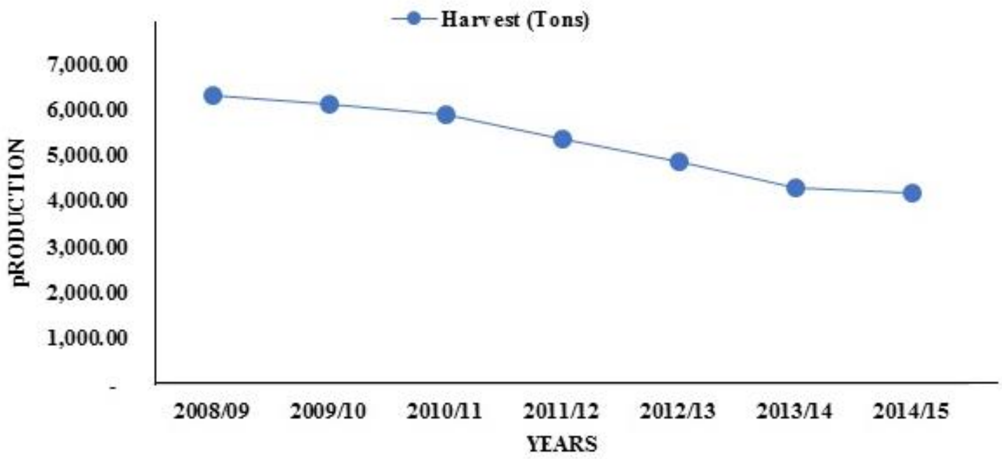

Figure 1: Production trend of cassava in Kisarawe District
Source: KDP (2015).

1.2 Problem Statement and Justification

Despite the fact that cassava is very important in Tanzania, both as a subsistence and cash income crop, its average yield is low (IITA, 2013). In Tanzania, cassava yield is 10 tons/ha, which is lower than the world largest producers such as Nigeria whose cassava yields range from 11-30 tons/ha, (IITA, 2013) followed by India whose yields are 26 tons/ha (Mwebaze, 2016). Tanzania's cassava yields are even lower than those recorded in Western Kenya and Uganda of about 11tons/ha (IITA, 2013; FAOSTAT, 2010; FAO, 2001).

In the Kisarawe district of Tanzania, cassava is one of the most important food crops due to its capacity to adapt to marginal farming conditions (FAO, 2012). However, between 2008 and 2014 cassava production declined from 6 300 tons to 4 200 tons, respectively (KDP, 2015), due to, among others, the occurrence of CBSD in the district leading to low productivity. In Kisarawe, cassava yield is about 2.5 tons to 4 tons/ha, which is lower the country average yield of about 16 tons/ha (IITA, 2013).

The Government and development partners have been struggling to find measures of controlling CBSD disease using different strategies. These include the development of high yielding cassava varieties, which are less susceptible to diseases, as a substitute to the existing varieties. However, despite these efforts, little is known about the implications of CBSD on yield, and income as well as how it influences the socio-economic characteristics (such as farm size, education, and income) of smallholder cassava farmers in Kisarawe District.

The implications of CBSD on cassava production as well as how it influences the socio-economic characteristics of smallholder cassava farmers forms the basis for this study that will provide insights in order to generate recommendations on what can be put in place towards mitigating the negative effects of the disease on smallholder cassava farmers in Kisarawe District.

1.3 Objectives of the Study

1.3.1 Overall objective

The overall objective of this study was to analyze the implication of CBSD on cassava production in Kisarawe district in order to determine the consequence of the disease on socio-economic wellbeing.

1.3.2 Specific objectives

i. To determine smallholder farmers' opinions on the extent of the CBSD on cassava production in Kisarawe District.
ii. To determine the influence of CBSD on cassava yield in Kisarawe District; and
iii. To examine the influence of CBSD on the income of smallholder cassava farmer in Kisarawe District.

1.4 Research Question/Hypothesis

1.4.1 Research question

i. What are the farmer's opinions on the extent of CBSD on cassava production?

1.4.2 Hypothesis

ii. **H_0:** The CBSD has no significant influence on yield of smallholder cassava farmers in Kisarawe District.
iii. **H_0:** The CBSD has no significant influence on income of smallholder farmers in Kisarawe District.

1.5 Organization of the Dissertation

General introduction has been presented in Chapter one. Chapter two presents literature review, the theoretical and conceptual frame works. Whereas; chapter three presents the methodology used in conducting the study. Chapter four presents the results and discussion. The final chapter gives the conclusions and recommendations.

1.6 Limitations of the Study

The study was limited to one district due to inadequate budget and time to conduct the study. The university requirement is that student researchers have to collect data by themselves to gain experience in field research and hence generalizations of the results have been carefully made. The study was also limited to cross sectional data.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Theoretical Framework

2.1.1 Production theory

The production theory which outlines the conversion of inputs to outputs (Davis, 2004) forms the basis for the current study. In the Encyclopaedia Britannica (2004) the theory of production has been defined as an effort to explain the principles by which a business firm decide how much output or products aimed to sell will be produced and how much its inputs or factor of production will be used. The assertions are that a producer wants to maximize output or minimize input for a given output level in a production process (Henderson *et al.,* 1995). Therefore, in a broader definition, the production theory entails a combination of different inputs to maximize output/s (Mansfield, 1998). The primary objective of this study is to explore socio-economic implications of brown streak disease on cassava production among smallholder farmers. Although CBSD is one of the risks to majority of cassava producers, farmers still choose to plant cassava crop, simply because this is their traditional cash as well as subsistence crop (IITA, 2013).

For instance, Nahayo and Irene (2012) found that cassava production contribute significantly to the household income in Rwanda. Mahungu *et al.* (2011) argues that cassava production is important on food security crop in Africa. Hillocks *et al.,* (2001) examined the effect of CBSD on yield and quality in Tanzania and found that the disease has an effect on yields. Apart from the disease, smallholder cassava farmers face several other risks on production, price and marketing. The risks on production are natural causes such as variation in rainfall, weather, pests, and diseases (Valdes and Konandres, 1981).

Therefore, under the production function which theory is expressed, the study accepts

$Y_i = f(x_i)$ …………………………….……………………….…………………………….……. (1)

Whereby;

X_i is a vector of inputs (Capital, Labour and Land) and

Y_i is the output.

The general production function has a set of assumptions. The common assumptions are that resources are scarce relative to their demand inputs, production function is assumed to yield maximum output for arbitrary input vector, and that for a unit increase in input output increases by the same ratio (Mansfield, 1995).

2.1.2 Definition underpinning the study

This study adopted the following definitions in the whole documents as it has been defined in literature.

Assessment: Is the process of collecting data and information that would enable unbiased evaluation and suggestion of an occurrence of a certain economic phenomena (Atherton, 2010), in this case CBSD and its implications on cassava production.

Household: This is defined as a self-governing male or female producer and his or her dependants who must have lived together for a period of not less than six months (Ellis, 1988).

Smallholder farmers: Farm holdings of less than ten hectares and fewer than ten dairy animals (Musalia *et al.,* 2007). In this study, a smallholder farmer is defined as the one who has less than two hectares of land under farming.

Socio economic implications: Results that occur in the social and economic wellbeing of an individual or household after a certain activity or event that has happened (Peezey *et al.*,1998). In this study, the results of the incidence of the disease on the economic status of the farmers is explained and illustrated from the analyzed data.

Risk: According to a Global report on reducing disaster risk 2004, risk is the likelihood of something (usually unwanted) happening, multiplied by the consequence if it does.

Table 2: Description of variables for the Cobb-Douglass function

Variable Name	**Description**	**Expected Sign**
If decision maker is male/female	Dummy (male =1,female = 0)	-
Access to extension services	1 if yes, 0 otherwise	+
Sex	Numbers	-
Log farm size	Acres	+
log for farming experience	Years	-
log for cassava price	Tshs	+
log for yield of cassava	Tons	+

The study sought to determine the influence of CBSD on cassava production and the cob Douglas production function was used to get results. Table 2 illustrates the variables that were used to determine cassava production. Key variables were: Sex, Access to extension services, farm size, farming experience, cassava price and cassava yield.

Table 3: Description of variables used in the gross margin model

Variable Name	**Description**	**Expected Sign**
Family size	Numbers	-
Amount of cassava produced	bags	+
Price of cassava	Tshs	+
Age of the respondent	Years	+
Sex of the respondent	1= male 0 = female	- +
Access to extension services	1 if yes, 0 otherwise	-
Area of land under production	Acres	+

The study sought to determine the influence of CBSD on the income and multiple linear regression model was used to get results. Table 3 illustrates the variables that were used to determine gross margin. Key variables were: family size, amount of cassava produced, price of cassava, age of respondents, sex of respondents, access to extension services and area under cassava production.

The description of variables used in the gross margin model as shown in Table 2 can be elaborated mathematically as follows:-

$$Y= \alpha+\beta_1X_1 +\beta_2X_2 +\beta_3X_3 +\beta_4X_4+\beta_5X_5+\beta_rD_r+\beta_eD_e+\mathcal{E} \qquad (2).$$

Y=is a gross margin,

α and β *are* coefficients to be estimated,

α= is a constant term,

D_r= is the dummy variable for sex of respondents (1-male, 0-female)

D_e= is the dummy variable for access to extension services (1-yes, 0-otherwise)

$\mathcal{E}$= is the error term

Therefore, we have the situation in which X_1, X_2, X_3, X_4 and X_5 are exogenous and are instruments used to predict Y which is treated as an endogenous variable.

2.1.3 Production functional forms

The objective of any producer is to maximizing output (Y_i) or to minimize inputs (X_i). The production function can be expressed using specific function form and assumptions depending on the nature of the problem. To estimate the parameters, different production functional forms such as transcendental logarithmic function (Translog), the Cobb-Douglas production function (CD) and the generalized Leontif production function (GL) can be used. However, Cobb-Douglas functions have been the most popularly used in analysing agricultural production. This model provides a compromise between (a) adequate fit of the data, (b) computational feasibility and (c) sufficient degrees of freedom. The logarithmic Cobb-Douglas type model has therefore been widely employed in production studies including studies on the effect of credit on production (Debertin, 2012).

The Cobb-Douglas production function was developed and used by Charles W. Cobb and Paul H. Douglas in 1928 and since then, it has remained the most widely used theoretical function in production economics (Debertin, 2012). It conforms to the basic properties of production theories, such as non-decreasing in x and concavity, although on the other hand, it has disadvantages where it imposes fixed and global returns to scale, and assumes that one input can be freely replaceable with other inputs without changing their marginal product (Castiglione, 2012).Although widely used, the Cobb-Douglas production function is also argued to be too restrictive due to its properties of global returns to scale and constant elasticity of substitution (Hussain *et al*., 2012).

Cobb-Douglas production function was used to estimate the implications of CBSD on cassava production to get the results. Table 1 illustrates the variables that were used to determine cassava production.

A linear multivariate regression model was used to determine the socio-economic implications of CBSD on income of smallholder cassava farmers. Linear regression refers to any approach to modeling the relationship between one or more dependent variables denoted by Y_i and one or more independent variables denoted by x_i, such that the dependent variable depends linearly on the unknown parameters to be estimated from the data. The general form of the relationship is presented in equation 7 (Debertin, 2012).

$Y_i = a + bx_i$……………………………………………... (3)

Whereby;

X_i is the set of explanatory variables and Y_i is the dependent variable. The slope of the curve is b, and a is the intercept (the value of Y when X = 0).

A study by Khuda *et al.* (2005) on “Impact assessment of zero-tillage technology in rice wheat system: a case study from Pakistani Punjab”, the gross margin was calculated and used as a dependent variable to run a regression. Regression analysis was used to test for the level of relationship or significance between the gross margin (dependent variable) and marketing costs (independent variables). $Y_i = f(x_1, x_2, x_3, x_4, e)$ where Y_i = gross margin (dependent variables) x_1 *to* x_4 = (independent variables).

Similar and related studies that have adopted the gross margin and linear regression models have been done by (Huong, 2009) on emerging supply chains of indigenous pork and their impacts on small scale farmers in upland areas of Vietnam, and also a study by (Pham, 2007) on production and marketing of indigenous pig breeds in the uplands of Vietnam adopted the same model for analysis.

2.2 Empirical Review

2.2.1 Cassava brown streak disease

Cassava Brown Streak Disease (CBSD) represents the greatest threat for millions of cassava farmers in East and Central Africa (Mbanzibwa*et al.,* 2011). CBSD is caused by cassava brown streak virus which is transmitted by whiteflies *Bemisiatabaci* (Maruthi *et al.,* 2005) and propagated through infected cuttings. The disease began to spread in the Great Lakes region of East Africa in 2003 (Alacai *et al.,* 2007). CBSD has a limited effect on the growth and appearance of plants, but can be disastrous for production as the dry rot that it produces in tuberous roots can render entire crops unusable (Hillocks*et al*, 2001).

2.2.2 Symptoms of Cassava Brown Streak Disease (CBSD)

Nichols (1950) provided the first detailed description of the symptoms of CBSD from his work at Amani in Northeastern Tanzania. Some key symptoms highlighted by (Nichols,

(1950) were their extreme variability, both from one variety to another, and from season to season. Symptoms were noted on the leaves, stems, fruits, and storage roots. In sensitive varieties, symptoms may be present on all plant parts, while for more tolerant types, there may be only one symptom, commonly on the leaves (Alacai*et al.,* 2007). There are two types of symptoms that are recognized on the leaves; the first is a yellow chlorosis associated with the secondary and tertiary veins. The second is a more common type, with a general blotchy chlorotic mottle. In both cases, these were more prominent on lower leaves. The most important symptom produced by CBSD is the development of dry, sepia to brown, corky, and necrotic lesions in the root tissue (Alabi *et al.,* 2011).

2.2.3 The implications of CBSD on smallholder farmers' yield

CBSD is a serious threat to food availability because it reduces total yields and renders the roots unpalatable for human consumption due to the necrosis on the starch storage tissues (Patil *et al.,* 2015). Symptoms in roots become more intense as the crop matures, particularly away from physiological maturity at about 12 months after planting (Hillocks, *et al*, 2001). The losses are particularly acute for local varieties in which root necrosis begins to increase from six months after planting, encouraging farmers to harvest prematurely. The losses caused by root necrosis only become apparent after the crop is harvested (Alacai *et al.,* 2007).

CBSD is the disease in Sub-Sahara Africa, resulting in production losses of over US$1 billion every year (Legg, *et al.,* 2011). The disease affects farmer in two major ways: low yield and poor root quality due to mainly necrosis. The disease causes low yield because it leads to production of fewer roots, roots of smaller size, and distorted roots due to pitting and constriction. (SARRNET, 1996) Claimed that on average, there was about 34% loss of yield due to CBSD in Tanzania. In addition field experiments which determined the effect of the disease on yield and quality of the roots showed that CBSD can decrease root weight in the most sensitive cultivars by up to 70% in Tanzania (Hillocks *et al*., 2001). Furthermore, rot of cassava roots has an effect on root quality caused by patches of root necrosis that make the roots unsuitable for home consumption and the market (Alabi *et al*., 2011).

2.2.4 The implication of CBSD on smallholder farmers' income

Cassava production tends to generate more household income due to its advantage over subsistence production (Mtunda *et al.,* 2002). However, unless rural markets are well-integrated and risks are low due to disease that influences household decision behavior, the shift from subsistence to commercial crop production may have an importance by exposing households to stable market prices (Jeremiah *et al.,* 2014). In Philippine, the role of high food prices is seen largely in terms of its effect on welfare, growth and efficiency concerns which are of crucial significance in less developed countries (Cabanilla, 2006). Thus, food prices do not only affect producers and consumers' welfare but also economic growth and efficiency in resource allocation (Cabanilla, 2006). Furthermore, high food prices not only increase the income for producers, but also increase the cost of purchasing food for consumers. At present, the effects of CBSD leads to estimated low cassava production in Tanzania which is likely to put an upward pressure on food prices in the country (Hertel, 1997).

In Tanzania, Kisarawe District has experienced high food crops' price due to the seasonal nature of agriculture, effects of pests and diseases and commercialization process, which leads to a lagged supply response (KDP, 2015). As demand has outpaced supply, prices have increased significantly, particularly for maize (corn), and rice. Cassava planting material prices has also increased dramatically over the last two years as increased supply to match rising demand which has been held back by limited production capacity (KDP, 2015).

2.2.5 Management Control of CBSD

It has been defined that pest and disease management is the science and technology of crop protection (FAOSTAT, 2013). A disease management system that is in the context of the associated environment and the population dynamics of the pest and pathogen species utilises all suitable techniques and methods in a manner as compatible as possible and maintains the population at levels below those causing losses. While minimizing hazards to humans, animals, plants and the environment (Ciancio and Murkerji, 2007),a broad range of approaches and several options have been suggested, but with varying levels of success (IITA, 2013). Use of disease free planting materials, uprooting of infected plants, control of insect vectors, use of tolerant varieties and quarantine are some options that have been tried (Alacai *et al.*, 2007).

In Tanzania, an alternative method addressed by (Legg *et al.,* 2011) on controlling CBSD includes growing and roguing cassava plants which is done by training practitioners of plants in isolated field and area of low disease pressure. Plant breeder and researchers are required to develop potential tolerant or resistance seed and establish clean seed system for improvement of the viability and sustainability of the sites managed by cassava seeds entrepreneurs, tertiary multiplication sites and managing CBSD using phytosanitary measures (Sisterson and Stranger, 2013).

The first case of CBSD in Uganda 1940s was managed by destruction of all cassava with symptoms together with strict quarantine measures (Jameson, 1964). This demonstrated the ability of managing CBSD through phytosanitary measures. However, for such programs to be effective, three factors must come into play. These include: commitment by all stakeholders to combat the disease, major educational and training input to all stakeholders and the capacity for farmers or even the researchers to correctly identify CBSD-free materials (Donald, 2010). For the case of Uganda, the use of planting materials from non tolerant varieties have accelerated the spread of the disease from one area to another (Mulimbi *et al*., 2012). It is therefore authoritatively that strict quarantine procedures are implemented so that movement of germplasm in vegetative form from one area to another should be strictly controlled.

In Africa, according to (Bigirimana *et al*., 2011) specific disease management strategies need to be considered for viral diseases of cassava. Thus, highlighting the importance of the distribution healthy planting material to restrict the spread of CBSD. It is also very important to establish and perform strict quarantine on the exchange of cassava germplasm between countries, regions and continents (Legg*et al.*, 2011). Generally, successful management of CBSD must be emphasized and engaged phytosanitary measures.

2.3 Conceptual Framework

The conceptual framework provides a base for understanding and finding measures on the low cassava yields by interaction between socio-economic factors, production factors, institutional factors and government support. This interaction plays a major role in creating awareness among farmers which would lead to improved cassava yield and hence income. In agriculture the aim of a rational farmer is to maximize output or minimizing inputs. The production often used to provide guidance for decisions related to optimal use of inputs. However, this must be well influenced by government towards socio-economic factors such as farm size, education, sex of the head of the household, marital status as well as institutional factors such as access to extension services, may contribute to farmers' awareness about new cassava varieties which are resistant to CBSD and therefore increase productivity and income of smallholder farmers (Figure.2).

The district was highly producing cassava in 2008 to 2011. The decline in cassava production since 2011 largely reflects the impact of cassava disease (CBSD). Based on that community face challenges on low assets holding which made them prone to food scarcity and income earned.

However, there're key governance and district rule, law and issues that were not well organized on cassava production control and improvement, based on social-economic factors, production factors and institution factors which may be due to: poor government function and weak corporate governance.

As a basis of establishing structure changes on cassava production due to the presence of CBSD there is a need to create farmers awareness about the disease by identifying the causes, management, means for mitigation and phytosanitation measures so as to improve cassava yields and income (IITA, 2013).

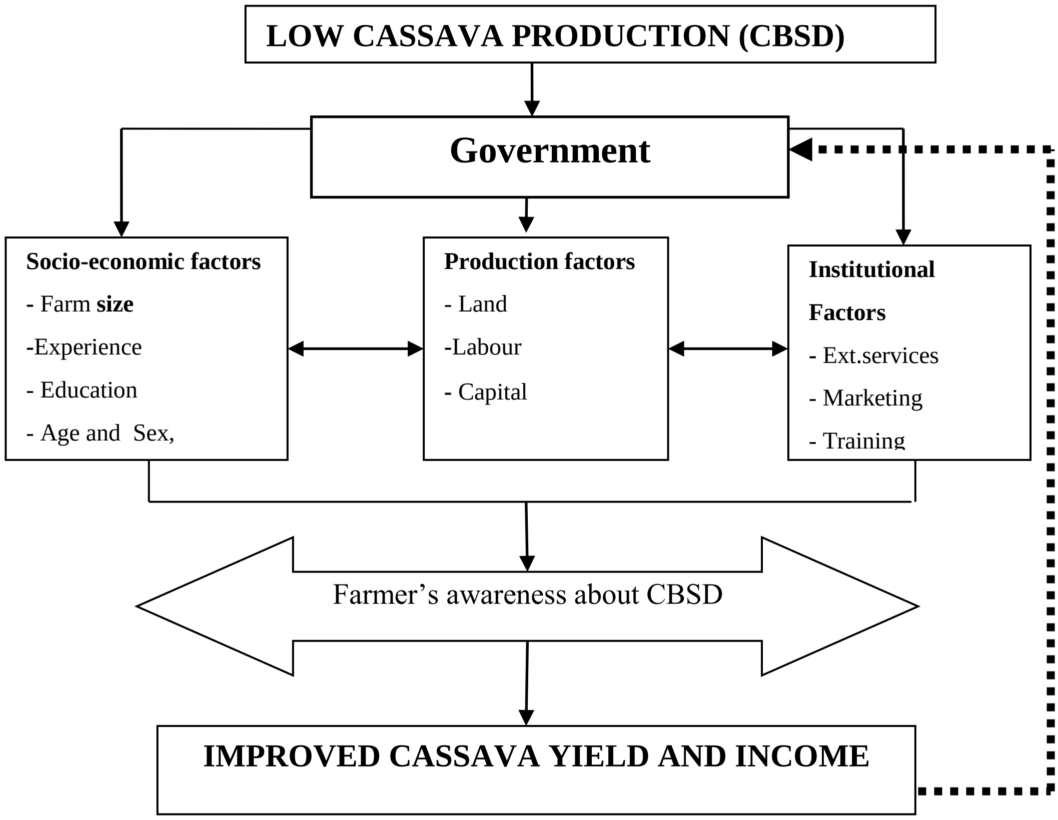

Figure 2: Conceptual framework

CHAPTER THREE

3.0 METHODOLOGY

Research methodology is a systematic way of solving the research problem (Kothari, 2004). This chapter discusses the research methods and procedures used in the whole process of data collection, the techniques used and practical purposes. It includes brief description of the study areas, sampling procedures and data collection methods. It also discusses the instruments used in the data collection, the procedure for data collection and the method for data analysis as well as other technical issues.

3.1 Description of the Study Area

The study was carried out in Kisarawe District; Coast Region where the occurrence of the disease is high. Kisarawe is one of the 6 administrative districts of the Coast Region of Tanzania. It is bordered to the North by Kibaha district, to the East by the Mkuranga district, to the South by Rufiji district and to the West by Morogoro region. The district lies between Latitude $6^{0}50^{'}$ and 35^{0} 00 South of the Equator and Longitude $38^{0}15^{'}$ and $39^{0}30^{'}$ East of Greenwich. The rain ranges between 1400mm and 1600mm and an average rainfall of 1000 mm annually (URT, 2013). The district experienced dual rainfall, short rains which start in October to December, and long rains which cover the months of March to June.

The main economic activity in the district is crop production and livestock keeping. Over 90% of people in Kisarawe District are fully depending on agricultural activities (URT, 2013). Major crops cultivated include maize, paddy, sorghum, cassava, and legumes. Major cash crops are cashew, fruits and coconuts (KDP, 2015). According to The National Population and Housing Census of 2012, the district had a total population of 101 598 whereby 50 631 are males and 50 967 are female (URT, 2013). The district was purposively selected on the basis of the fact that it is experiencing declining cassava yields due to cassava diseases, more use of local cassava varieties and cassava being the major food crop and source of income (Mtunda *et al.,* 2002).

3.2 Research Design

Cross-sectional research design was used to conduct this study. The design allows data to be collected at a single point in time (Olsen, 2004). And due to study time horizon and fund availability a cross-sectional design was suitable for the study.

3.3 Sampling Procedure

Multistage sampling technique was used whereby four division with high occurrence of the CBSD were randomly sampled from the district. The wards in four divisions were listed and two wards which are Kibuta and Marumbo were randomly selected. From the two wards the researcher randomly selected one village to be involved in the study; the selected villages were the Mhaga and Marumbo. The list of farmers from the selected villages was available from extension officers in Kisarawe District Council Agricultural Department. The systematic random sampling was employed to obtain respondents.

3.3.1 Sample frame

The sampling frame or target population of this study consisted of all cassava producer in the study area.

3.3.2 Sample unit

The sample unit of this study was the head of the household involved in cassava farming in the study area.

3.3.3 Sample size

The samples of 107 farmers' from Mhaga and Marumbo were systematically selected. A sample size determination formula proposed by Kothari, (2004) was used to generate a sample size used in this study.

$$n = \frac{z^2 pq}{e^2} \quad \text{...} \quad (4)$$

Where;

n =sample size in the study area when population > 10 000, z = Standard normal deviation, set at 1.96 corresponding to the 95% confidence interval level = Proportion of the target population (50% if population is not known).q = 1.0 – p (1-50) (1-0.5) = 0.5. e = degree of accuracy desired, (set at the 95% equivalent to 0.05)

Therefore:

$$n = \frac{(1.96)^2(0.5)(0.5)}{(0.095)^2} = 106.4 \approx 107 \quad \text{..} \quad (5)$$

Therefore, 107 were selected to represent the population in the study area which is enough as supported by (Kumar, 2005), who argues that a sample size of between 80 and 120 respondents is suitable for rigorous statistical analysis.

3.4 Data Collection Procedure

Primary data of 2014/15 cassava farming were collected through a cross sectional survey using structured questionnaires in Kisarawe District. A total of 107 farmers were sampled from the two villages of Mhaga and Marumbo in the Western part of the district. The two villages were selected because of the high occurrence of the CBSD and having high proportions of cassava small-holder farmers. According to Kothari (2004), primary data are first-hand information that are directly collected by the researcher from original sources and assembled specifically for the research project at hand.

The questionnaire was designed to collect information on general household and socio-economic characteristics. The major information collected was on socio-economic characteristics such as age, education, gender, farm size, household size, access to extension services and experience.

3.5 Data Processing and Analysis

3.5.1 Data processing

The data collected were processed using Statistical Package for Social Scientists (SPSS), and Microsoft Excel. This included aspects like editing, coding, classification and tabulations. Processing of data yielded to descriptive analysis includes; means percentages, frequencies and crosstabs that were computed to generate social economic profiles of sampled producers. The data collected were used in further analysis by use of models. In addition, inferential analysis is t-test statistics was done to find out the significant difference to an expected two or more sample means under comparison (Kothari, 2004). The t-test establishes the relationships that exist between socio-economic characteristics of cassava farmers and multiple linear regression models was used to investigate the influence of the hypothesized factors on cassava yield.

3.5.2 Data analysis

i The first objective: to determine farmers Opinions on the extent of CBSD on cassava farms

This objective was analyzed using descriptive statistics. The statistical analyses include determination of mean, percentages and frequencies from Likert scale techniques in order to determine farmers' opinions on the extent of CBSD on farms. The study focused on farmers' views and opinions on the extent of CBSD and also on its effects on cassava farming. The data collected included disease risk perception, identification of disease by the farmers, affected cassava farms and also the effect of the disease on cassava yield. Disease risk perception was measured using the Likert scale on a three point scale with 1= Low, 2= Moderate, 3=High. There was also data on whether the farmers obtain extension services with regards to CBSD. The frequencies, percentages, mean and cross tabulations were generated during analysis.

ii The second objective: To determine the influence of CBSD on cassava yield in Kisarawe District

For the second objective the hypothesis testing was used that:

Ho: CBSD has no significant influence on yield of smallholder cassava farmer.

This hypotheses aims to test for object number two whereby cassava output were regressed against the independent variables, including cassava price, total variable cost of production, and access to extension service other variables include sex of the respondents, farm size, education and farming experience. The log-log production function of cassava was presented by the equation 6. The equation estimated the responsiveness of cassava output to the socio-economic and production factors. According to micro economic theory, a production function is a model that is used to formalize the relationship between inputs and outputs as specified in general form as follows;

$Y_i = f(X_i)$.. (6)

Whereby;

Y_i= represents the output

X_i= represents the variable inputs

Then the equation 5 can be represented as follows;

$$Y = A_1^{\beta 1} x_2^{\beta 2} x_3^{\beta 3} \varepsilon \quad (7)$$

Analytical model

$$lnY = \beta_0 + \beta_1 lnx_1 + \beta_2 lnx_2 + \beta_3 lnx_3 + \ldots + \beta_6 lnx_6 + \varepsilon \quad (8)$$

Whereby:

lnY= Natural logarithm of yield

β_0= is the constant term of the regression

β's = Unknown parameters to be estimated,

X's= Socio-economic and farm specific characteristics.

iii. For the third objective whereby the hypothesis was, Ho: the CBSD has no significant influence on income of smallholder farmers in the study area.

A partial budget using Gross Margin analysis per hectare and independent samples t-tests statistic were used to assess the income of cassava farming. This also aimed at estimating the costs of production and returns to various output used in cassava farming. Gross Margin analyses provide an economic benefit on cassava farming. The following empirical model was used;

$$GM = TR - TVC \quad (9)$$

Where;

GM =Gross margin for cassava (Tshs/ha)

TR= Total Revenue for sale of cassava (Tshs/bag) this is given by multiplying the quantity produced by the unit price.

TVC = Total variable cost on production of each crop (this include labour and inputs) multiplying the quantity of resources by their corresponding price.

Gross margin as response function was estimated by using ordinary least squares (OLS). Functional forms considered were; quadratic, Cobb Douglas type, semi-log and linear. The linear form showed a good fit.

This study adopted the model used by (Ezuil, 2011) on analysing the socio-economic factors and profitability of rice production among small-scale farmers in Ebony State, Nigeria as follows:-

$$GM = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \varepsilon \text{ ....………… (10)}$$

Whereby;

GM = Gross Margin, X1 = Age (yrs), X_2 = Sex(dummy variables where male=1,female=0), X_3 = Marital status, X_4 = Household size,X_5= Educational level(yrs), X_6 = Farming experience (yrs), X_7 = Farm size (acre),α= Constant and $\mathcal{E}$= Stochastic Error term.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

This chapter presents the descriptive and econometric analyses of the sampled population. Descriptive analysis focuses on the influence of the socio-economic characteristics, various economic activities engaged by farmers, farm characteristics and access to agriculture extension service. This chapter also presents the empirical results from the determinants of cassava yields and income.

4.1 Socio-economic Characteristics of Sampled Households

This section discuses farm and farmer characteristics inherent among farmers, this included number of results-oriented issues for the descriptive analysis of the sample households presented in this section. Descriptive statistics results describe the socio-economic characteristics of cassava farmers; demographic characteristics in the farm area and economic activities the farmers were engaged.

4.1.1 Marital status of the respondents

The findings presented in Table 4 shows that the majority (76%) of the farmers were married, (10%) were single while the rest i.e (13%) were widows and divorced. According to Pekk *et al*. (2005) marriage provides additional farm labour.

Table 4: Marital status of the respondents (n = 107)

	Variables	Mhaga	%	Marumbo	%
Marital status					
	Married	37	35	44	41
	Single	9	8	4	1
	Divorce	6	6	1	1

Widow	2	2	4	4

4.1.2 Age of the respondents

In the study area the mean age of respondent was (38.16) years ranging from 18 to 61 years. The findings as presented in Table 5 indicate that the majorities (82.2%) of the sampled respondents' were aged between 18 and 55 years and the remaining i.e. (21.8%) of the respondents were older than 55 years. This implies that most active human resource was engaging in farming activities (Nahayo and Irene, 2012). Young people of below 18 years were not sampled in this study because they were at school during sampling activities thus were not active in carrying out all farm operations.

The active age in crop production guarantee absorption of improved production technologies as accentuate in a study by Onu and Madukwe (2002), that active people are likely to accept improved farming and become agents of innovation transfer; this serves as an advantage for the adoption and spreading of innovative practices. Again, farmers who are actively involved in production before old age would catch up with production methods and improve yield and income in general (Kemper *et al.,* 2004). Furthermore, these age patterns are similar to that reported in National Population Census that majority of Tanzanians are aged 18 and 50 years (URT, 2013). This implies that the sample for this study was correct as it reflects the actual patterns of the population structure.

Table 5: Age of the respondents (n = 107)

	Male		**Female**			
Age	**Mhaga**	**Marumbo**	**Mhaga**	**Marumbo**	**Total**	**Percent**
< 26	0	3	2	3	8	7.5
26 -35	4	8	8	3	23	21.5
36 -45	6	13	12	2	33	30.8
46 -55	3	14	6	1	24	22.4
56 &>	8	4	5	2	19	17.8
Total	**21(19.6%)**	**42(39.3%)**	**33(30.8%)**	**11(10.3%)**	**107**	**100.0**

4.1.3 Sex of the respondents

From Fig.3 it can be observed that in the study area, 59% of the sampled respondents was male and 41% were female. The reasonable proportionality between male and female respondents in this study implies that both males and women are involved on cassava production but men were actively participating in production for commercial purpose. However, women's access to productive resources and decision making tends to take place through the negotiation of men/their spouses despite their immense contribution in cassava production (Jahnke, 1982).

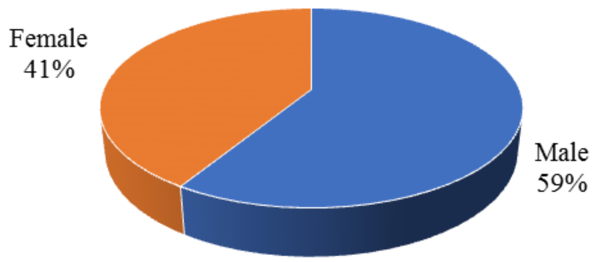

Figure 3: Sex of respondents

4.1.4 Access to extension services

Approximately 61.7% of the total respondents do not received extension services regarding CBCD while about 15% of the respondent received the extension service only once per season as presented in Table 6 due to the lack of enough extension staffs.

Table 6: Access to extension services with regards to CBSD (n =107)

Number of visit	n	Percent
Null	66	61.7
Once	16	15.0
Twice	10	9.3
Several times	15	14.0
Total	**107**	**100.0**

This indicates that very few farmers received extension services. This would negatively affect the performance of their farm activities since these services greatly promote agriculture in terms of purchasing inputs and managing disease as well.

4.1.5 Education level

Education is an important variable in every aspect of human life; its lack may lead to suffering in many social and environmental related challenges (Amao and Awoyemi, 2008). In reference to this study education predetermines how well people will adapt to the recommended farming practices. The findings as presented in Table 7 indicate that the majority (75.5%) of the respondents' attained primary education, compared to very few 9.1% who had no formal education. Whilst, 10% had completed secondary education, about 1.8% post-secondary and lastly about 3.6% completed adult education. From these findings, it can be concluded that majority of the sampled respondents were literate.

Table 7: Education level of the respondents (n = 107)

Education level	**n**	**Percent**
Adult education	14	12.7
Collage	2	1.8
Primary	83	75.5
Secondary	11	10.0
Total	**110**	**100.0**

4.1.6 Farm size distribution across the villages

The land holdings (in acres) owned by the farmers across the two villages is presented in Table 8. The overall relationship between farm sizes was statistically significant at 1%. The variation of farm size across the villages did not highly differ. Mhaga village had the highest mean while Marumbo village had the lowest. Most of the farmers in Mhaga had large pieces of land compared to Marumbo village. The farmers in Marumbo are able to plough more land and have higher yields if all other factors of production are held constant.

Table 8: Average farm size distribution across the villages studied (n = 107)

Variables	**Mhaga**	**Marumbo**	**Total**
Average farm size	3.98	3.65	7.63
% of ownership	100	100	**100**

4.2 Assessment of the extent of CBSD

4.2.1 Proportion of farmers' farms affected by CBSD

The majority (87.9%) of farmers were having the disease on their cassava farms as shown in Table 9. This indicates that most of the farms in the study area are experiencing the adverse negative effects of the disease and it is negatively affecting their yield and subsequently their cassava production. Therefore, urgent measures are needed to curb the disease so that the farmers are able to enjoy the benefits of cassava farming.

Table 9: Proportion of farmers being aware of the disease on their farms (n=107)

Variables	**n**	**Percent**
Yes	94	87.9
No	13	12.1

4.2.2 Farmers affected by the disease, identification and perception

Table 10 indicates that all (100%) respondents interviewed indicated CBSD occurrence on their farms based on the symptoms of the disease as deterioration of cassava roots and low yield and thin stems. Disease risk on affected cassava plants perception and occurrence of roots rotting was viewed as high, medium and low by 55.1%, 35.5%, and 9.3% of the farmers, respectively. There was moderate risk perception because the farmers were trying to cope with the disease by using alternative improved cassava varieties. The results indicate that the farmers can identify the unhealthy cassava roots and their perception on the disease shows that the disease is risky and is negatively influencing their livelihoods. This finding concurs with that of the study conducted in Coast and Mtwara Regions which reported that the effects of CBSD is very severe in those regions (IITA, 2013). Similar observation was also reported in the study conducted in Tanzania’s cassava producing regions by (Bennett *et al.,* 2012).

Table 10: Extent of the diseases (n = 107)

Variable	n	Percentage
Farmers affected by the disease	107	100
Disease perception		
High	59	55.1
Medium	38	35.5
low	10	9.3

4.3 Factors Influencing Cassava Production

The Cobb Douglas function in Table 11 was used to assess factors influencing cassava yield. The table also presents the coefficient estimates of the regressions. The model was significant at 5%, with 7 degrees of freedom. The R^2 indicates that the explanatory variables explained 44 % of the variance in the dependent variable. The coefficient shows that 1% change in the independent variable result in percentage increase in the dependent variable when all factors remains constant while the sign on the coefficient (positive or negative) gives the direction of the effect. The adjusted R^2 value of 0.401 implies 40% of the variations in cassava production in Kisarawe District were explained by the independent variables in the model equation. However, it also implies that some variables (56%) which might have significant influence on cassava yield were missed during the model equation estimation. Such variables are open for investigation in further researches. The Cobb-Douglas linear regression model was used to investigate the influence of the hypothesized factors on cassava production in Kisarawe District. Therefore, seven independent variables (farm size, marital status, extension services, education, family size, farm experience and sex of respondents) were regressed against the dependent variable “cassava production in bags”. Results as presented in Table 10 indicate that some of the predictor variables inserted in the model equation were statistically influencing cassava production.

The results in Table 11 therefore indicate varied levels of significance both in magnitude and direction for some explanatory variables found. Based on the instruments shown in Table 2 Several variables were found to influence the cassava yield. Among the socio-economic characteristics, farm size, education, sex, marital status and family size were found to have a positive influence on cassava yield. Others which had negative influence included extension services and farming experience.

Furthermore, Sex is a socio-economic variable, which is being used to analyze assigned roles, responsibilities, constraints, opportunities and incentives of people involved in agriculture. Sex and responsibilities in agricultural production systems vary from region to region according to culture, religion and socio-economic conditions (Jahnke, 1982) As compared to crop production, the participation of rural women in farming related activities is much higher. A majority of the females are engaged in agricultural activities.

However, cassava farm size has a positive influence as expected at 0.593 with significant ratio 1%. This implies that higher quantity of product obtained from cassava area plays an important role in wealth and income of smallholder farmers, which is positively correlated to earning of the smallholder cassava farmers or it implying that if farm size increased by

1% we estimate cassava bags to increase by 0.593% when all other factors remains constant. Farm area under cassava cultivation is associated with output.

Similar observation was made in the study conducted among coconut smallholder farmers in Zanzibar which weights the influence of farm size in boosting coconut production (Khalfan, 2015). It is argued in literature that achieving agricultural productivity growth and production are not possible without developing and disseminating yield-increasing technologies because it is no longer possible to meet the needs of increasing numbers of people by expanding the area under cultivation (URT, 2013)

From this finding null hypothesis which states that “There is no statistically significant influence of the CBSD on cassava yield” was rejected since the socio economic characteristics variables were statistically significant at 99% and 95% confidence interval (p = 0.000 and p=0.05) therefore, alternative hypothesis, in this case “there is statistically significant influence of CBSD on cassava yield” was accepted by the study.

Table 11: Regression results of factors influencing cassava yield

Independent variable	Coefficients	Std error	t	Sig.
(Constant)	-	0.497	1.726	0.088
Experience in years	-0.036	0.012	-0.459	0.647
Marital status	0.065	0.103	0.716	0.476
Education level	0.154	0.03	1.9	0.060**
Sex dummy	0.179	0.152	2.28	0.025**
Extension dummy	-0.041	0.162	-0.494	0.622
Family size	0.152	0.034	1.769	0.080**
Lnfarmsi	0.593	0.121	0.717	0.000***
Number of observation	107			
F(6, 99)	11.141			
Prob> F	0.000			
R-squared	0.441			
Adj R-squared	0.401			

*Note: *** & ** (Significant at99% &95% confidence interval)*

Furthermore, access to extension services has an effect on production of cassava depends on controlling diseases and impart skills on proper agronomic practices, absence of which may negatively impact cassava production. Also, education level had a positively influence on cassava production. According to Khalfan (2015) farmers who seek knowledge have the greater chance of optimizing their production compared to their counterpart, similar assertion was made by (Mwachiro and Gakure, 2011) who observed that differences in production between farmers who were literate compared to those who were illiterate. Lastly, family size was found to have an influence on cassava production and was positively correlated to cassava production.

4.4 Gross Margin Analysis of Cassava

The result in Table 12 shows a gross margin analysis per acre of cassava.

Table 12: Gross Margin analysis of cassava

Parameters	Mean	Minimum	Maximum
Age of respondents	42.07	2100	63.00
Education level	6.74	1.00	13.00
Family size	5	1.00	11.00
Farm size	2.9	1.00	20.00
Sex of respondents	0.52	-	1.00
Total output in bags (Tshs)	14.42	1.40	64.00
Total revenue (TR)	240,580.37	16,000.00	1,920,000.00
Total variable costs (TVC)	122,385.47	6,050.00	180,000.03
Gross Margin (GM)	118,194.90	9,950.00	1,739,999.97

However, the low gross margin for cassava production can be attributed to the usage of local cassava planting materials which are low yielding and more prone to pests and diseases. The results also show that cassava returns was unreliable due to the fact that farmers sold their produce at low prices which did not reflect the production cost.

4.5 Gross Margin Model Results

Factors influencing cassava gross margin per season as response function were estimated by using ordinary least squares (OLS) in Table 13. A linear regression model was Employed to estimate variables influencing the gross margin levels at the farm level. The coefficient is the change in the dependent variable resulting from a unit change in the independent variable while the sign on the coefficient (positive or negative) gives the direction of the effect. Four variables were found to significantly influence the gross margin. Among the socio-economic characteristics farm size and other variables such as marital status and access to extension services were found to have a positive influence on gross margin. Farm size positively influenced gross margin implying that one unit increase in farm size leads to a unit increase in gross margin.

Table 13: Factors influencing gross margin for smallholder farmers per season

Gross Margin	Coefficients	Std. Error	t	Sig.
(Constant)	-	141.914	1.376	0.172
Age of respondents	-0.461	44.122	0.200	0.839
Experience in years	-0.460	79.126	-0.204	0.839
Marital status	0.080	29.125	0.716	0.476
Education level	-0.013	8.826	-0.119	0.905
Family size	-0.107	9.783	-0.977	0.331
Extension dummy	0.025	34.004	0.256	0.799
Farm size	0.272	6.987	2.836	0.010**
Sex dummy	0.016	44.470	0.156	0.873
Number of obs	107			
F(8, 98)	1.060			
Prob> F	0.000			
R-squared	0.173			
Adj R-squared	0.148			

Notes: Coef means Coefficient; Std. Err. is Standard Error *** significant at 1%, ** significant at 5% and * significant at 10%.

This study sought to establish the implication of CBSD on cassava income per season. The results indicate a negative influence of the proportion of experience, education, family size and sex on gross margin of cassava. The coefficient indicates that a unit increase in the experience may lead to a unit decrease in the gross margin. This implies that farmers who are more experienced on cassava production can decide to do other petty business. Furthermore, the unit increase in education may also lead to a unit decrease in gross margin. It implies that more literate people are not interesting in growing cassava instead they immigrate in towns to find other jobs. The unit increase in family size may lead to a unit decrease in gross income. It implies that most of the respondents who are labour working force they are immigrating in towns and live small children who are less involved on cassava production in the study area.

On average the mean cassava gross margin per acre in the study area is Tshs 118 194.90. Moreover, (Zilihona *et al.*, 2013) indicates that an average income farmers earned on cassava per year in Tanzania is about Tshs 226 666.70, with an average of 20 bags per acre which is more than the mean income and bags obtained in the study area, this could be due to the high prices of cassava fetched by farmers during deficit supply. Table 12 shows gross margin per acre at farm level.

The implication of this study is for the farmers, through the extension officers, to seek for control measures of the CBSD(Jeremiah, 2014) which have demonstrated that uprooting infected plants and replacing them with healthy cassava cuttings have been applied with some success (Legg *et al.*, 2011). Therefore, Farmers are encouraged to identify clean planting material, either by selecting cassava cuttings from other farmers who their farms are not affected by disease. Or by buying planting material from other areas where disease incidence is low.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

The overall objective of this study was to analyze the implication of CBSD on cassava production in Kisarawe district in order to determine the consequence of the disease on socio-economic wellbeing.

5.1 Conclusion

From this study, it can be observed that majority (82.2%) of the respondents were in the active labour age (18 to 55 years) and almost equal proportionality in sex of the sampled respondents was observed. The majority (75.5%) of the sampled respondents were literate; however, this literacy was not translated into deeper understanding of the CBSD related symptoms on Cassava farms that were highly affected by the CBSD.

In addition, the study also aimed at determining the contribution of cassava production to the smallholder cassava farmers yield and income as well as the consequence of the disease on yield and then after to socioeconomic wellbeing of smallholder farmers in the study area.

The analysis of quantitative and qualitative data collected from the survey was done using descriptive and analytical statistics. Based on the results from this study, the null hypothesis that CBSD has no significant influence on the income of smallholder farmers was rejected in favour of the alternative hypothesis and accepted that CBSD has a significant influence on the income of smallholder cassava farmers. In other words, the implications of CBSD on cassava production have greater effects on farmer’s income.

Furthermore, following the influence of CBSD on cassava production, there was enough evidence to reject the null hypothesis in favour of the alternative hypothesis which stated that CBSD has an influence on cassava yield with the P-value < 0.000. This implies that there was an effect of CBSD on socio economic characteristics such as farm level, education and health status of smallholder farmers in the study area which have an impact on cassava production.

5.2 Recommendations

5.2.1 Recommendations to farmers

In order to succeed effectively in managing CBSD and guarantee households' food availability it is recommended that cassava farmers should be receptive to knowledge on cassava production, management, disease control and marketing disseminated by players along cassava value chain.

5.2.2 Recommendations to policy makers

Policy makers should take into consideration the issue of improving efficiency of the existing agriculture extension services by formulating strategies that can be used by the government in provision of public private partnerships on the required investment for cassava production.

5.2.3 Recommendations for further research

The study suggests that the following areas of further study should be considered;

- The socio-economic implications of access to credit of farmers on technical efficiency
- Economic analysis of cassava production in Tanzania and policy consideration.

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APPENDICES

Appendix 1: Survey Questionnaire for Cassava Farmers

Questionnaire number………. Date of interview…………………

Name of interviewer…………………………………….

Please, you are kindly asked to provide sincerely information on the following questions.

All information provided will strictly be treated confidentially.

A: Household particulars.

(*For question 4 to 8 below, put a tick on respective answer*)

1. Name of respondent…………… 2.Village………. 3. Ward……………

4. Respondent age

a. Less than 18 years ( )

b. 18-35 years ( )

c. 36-55 years ( )

d.>55 years ( )

5. Sex

a. Male ( )

b. Female ( )

6. Marital status

a. Married ( ) b. Divorced ( ) c. Widowed ( ) d. Never married ( )

e. Single parent ( )

7. Education attained

a. Primary four ( ) b. Primary seven ( ) c. Secondary ( ) d. Collage ( )

e. University ( ) f. Never attended ( ) g. Adult education ( )

8. Main occupation

a. Farmer ( ) b. Employed ( ) c. Trader ( )

d. Fisher ( ) e. Others (Specify) ……………………

9. Household composition

a. Adult: Male……… b. Female……….. c. Children: Boys…………. d. Girls………

B. Household agriculture production description

10. Do you practice agriculture? Yes/ No

If yes, which crops are you growing?

Type of crop	Area (ha)	Quantity obtained	Cash generated	Total income per year

11. What is the number of adults and children participants in cassava farming?

a. Male adults…… b. Female adults…… c.Children 12-17 years……

d. Children <11 years……….

12. Has an agricultural extension officer ever visited your farm this year? (tick one)

a. Not a single day ( ) b. Once ( ) c. Twice ( )

d. Thrice ( ) e. Several times ( )

13. Does your household own land for agriculture? ----------- (Yes/No)

14. If yes, what is the size (In acres) before infection and after infection of it? Put (√) a. Less than 5 ( ) b. Between 6 and 15 ( ) c. More than 15 ( )

15. If No, how did you acquire your farm land for agriculture? put (√)

a. Rented ( ) b. purchased ( ) c. Given as a gift ( )

d. Inherited ( ) e. Given by government ( )

16. Where do you get cassava stem cuttings for planting? (tick)

a. From your own farm, ( )

b. Researchers and extension agents ( )

c. Purchase from other farmers ( )

d. Other sources (specify) ( )

17. What type of farming system do you practice in your farming?

a. Mono cropping ( )

b. Mixed cropping ( )

18. Is there any improvements in terms of food availability and income in your household (Yes/No)? If yes. How many bags (viroba) of cassava can you harvest per acre? ----------

Note: 50kg kiroba volume = 70-80kg, 25 kiroba volume = 40-50 kg.

19. If No. Have you ever experienced losses in your cassava production? Put (√)

a. Deterioration of roots in the field ( )

b. Harvesting very thin roots that do not get market ( )

c. Cutting and bruising of roots during harvesting ( )

f. Others (Specify) ( )

20. Are you aware and able to control cassava diseases? ------------- (Yes/No), if yes go to question no.21,

21. Mansion type of cassava disease and measures undertaken by the farmer:

S/no.	Type of disease	Year of occurrence	Advisor	Control measure undertaken
1. 2. 3. 4.				

C. Contribution of cassava products to the household economy

22. Do you sell some of the cassava product obtained from the farm? Yes/ No

If yes, where do your main customers come from? (Respondent should mention those places) ……………………………………………………………………………………

23. If your customers do not come from outside your village/ ward, what are the reasons behind that?…………………………………………………………………….

24. Who set or decide the price of cassava products during each season?

a. Middleman ( )
b. traders ( )
C.Through negotiation ( )
d. Government ( )

25. What is the price of the cassava product obtained during infection and after infection?

Cassava products	Price during infection	Price before infection

26. Please mention those costs that you incurred and the returns (in Tshs) for cassava production in previous year?

Activities (per acre)	**Cost & income (**Family labour)	**Hired labour**
i. land clearing		
ii. Destumping		

iii. Ploughing		
iv. Planting materials		
v. Weeding (two times)		
vi. Harvesting		
vii. Packaging		
viii. transportation		

Note ;(The cost will be for both family labour and hired labour, capacity will be bag/kiroba 50kg).

27 Which other benefits do you get from cassava products?..

D. Contribution from other existing livelihood practices.

28. Do you practice livestock keeping? Yes { } No { }

If yes, fill the following table. If no answer the next question

Type of livestock	quantity	Estimated value	Cash/qnty	Total income/yr.
Cattle				
Goat				
Sheep				
Hen/Chickens				
Ducks				
Total				

29. Give out the reasons for not practicing.

…………………………………………………………………………………………………

30. Which other income strengthening and economic potentials do you think are not fully utilized?...

31. Is there any government department, organization, Institution that provide training, technical services to your community? (tick) Yes / No { }

If yes, fill in the table below.

Name of department or organization	Type of training/ technical service provider
1.	
2.	
3.	

E. Social services available to community members.

(For question 32 to 37 below, put a tick and status on respective answer)

Status: 1. Very good 2. Good 3. Moderate 4.Poor 5. Very poor

32. Type of the road access; a. Sandy { } b. Tarmac { } c. Morum road { }, Road status, ( )

33. Health services access a. Dispensary { } b. Health centre { } c. No service { }, Health status, ( )

34. Education access a. Primary school { } b. secondary school { } c. No school { } Status, ( )

35. Water for consumption; a. Drilled wells { } b. Dams { } c. Natural spring { } others (specify), status ( )

36. Housing materials used by household members; a. Iron sheets { } b. Thatched materials { } c. Grasses { } others (specify) ( )

37. Which other constraints do you think hinder to improve your income?

……………………..

Appendix 2: Checklist for Key informants

1. Location: Ward ………………. Village ………………. Position …………..............

2. Age……………

3. Sex: Male/ Female ( )

4. Level of education………………..

5. Is there any profitability for producing cassava……………………………………......

6. If there is a profit what are the major constraints…………………………………..........

7. Suggest the economic strategies to improve those constraints……………………….......

8. How government rules and regulations supports farmers' doughty? ………………....

9. Do you think those rules and regulations hinder or promote people 's participation in the production? (a) Yes (b) No ( ) How………………………………...................

10. How do you view the extent of government interventions on solving cassava farmers' Problems?..

11. What other economic and livelihood potential on cassava production are not taken into consideration?...;.....................