# EFFECT OF JIGGER INFESTATION ON AGRICULTURAL PRODUCTIVITY: A CASE STUDY OF MURARANDIA DIVISION

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## DECLARATION

This is my original work and to the best of my knowledge this paper has not been presented for award of a degree in any other university

Signature…… Date…….

Muhoro Benson Wanderi

This paper has been submitted with our approval as university supervisors

Signature…… Date……..

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Signature…… Date……..

DR. MBITHI

## DEDICATION

I dedicate this work to the Almighty God and to my family for their encouragement and support throughout my studies.

## ACKNOWLEDGEMENT

I would like to acknowledge my family members, friends and colleagues whose support made it possible for me to go through the academia process successfully.

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# ACRONYMS

| | |
|---|---|
| **HIV** | Human immunodeficiency virus |
| **TB** | Tuberculosis |
| **SSA** | Sub Saharan Africa |
| **UN** | United Nations |
| **WHO** | World Health Organization |
| **KNBS** | Kenya National Bureau of Statistics |
| **IMF** | International Monetary Fund |
| **AK** | Ahadi Kenya |
| **CAADP** | Comprehensive African Agriculture Development Programme |
| **GAO** | Government Accountability Office |
| **AIDS** | Acquired Immuno Deficiency Syndrome |
| **OSD** | Onchocercal Skin Disease |
| **ILO** | International Labour Organization |
| **IFPR** | International Food Policy Research Institute |
| **SPSS** | Statistical Software for Social Sciences |

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## ABSTRACT

The study investigated the effect of jigger infestation on agricultural productivity among the farmers of Murarandia Sub County in Murang'a County. The study was guided by three specific objectives which are; to establish the extent of jigger infestation in Murarandia in Murang'a County, to analyze the effect of jigger infestation on agricultural productivity in Murarandia in Murang'a County and to provide recommendations on jigger menace handling to government and humanitarian policy makers.

The population of the study consisted of 28,943 households in Murarandia division Murang'a County according to the 2009 Kenya census report. The sample size was 384 households. This study used primary data which was analyzed using STATA. Inferential analysis was achieved using an ordinary least square regression model. T-test was also used to test whether there was a statistical difference in the mean production of infected and uninfected labour.

The study findings revealed that 67.35% of farmers in Murarandia Division in Muranga County are infected with Jiggers. That figure is higher than the prevalence rate of 4.5% of Kenya. Findings also indicated that when uninfected labour is used, then one unit of capital produces 2.072 units of annual production whereas when jigger infested labour is employed, then one unit of capital produces 1.235 units of annual production. The study findings revealed that more output is realized when uninfected labour is used (2.093 versus 1.3171 units). Jigger infested labour produces 0.7759 units less than uninfected labour. The study hence concluded that jigger infestation leads to low agricultural productivity among farmers of Murarandia Division in Muranga County.

The study recommended that Muranga County government should create awareness about effects of jigger infestation through media campaigns. The county government should also have deliberate policies to treat, free of charge, those infested with jiggers. The county government in a bid to reduce the infestation rate should deliver fumigants to residents of the area. The study also recommended that the county government of Muranga should offer extensional training to farmers in a bid to improve agricultural productivity in the County.

# CHAPTER ONE: INTRODUCTION

## 1.1 Background information

Health is an important factor if productive results are to be realized from any activity. Health educators and health professionals worldwide agitate for total commitment to good health as a way of life. Health is the physical, mental and social wellness of a person. According to Kelly and Lewis (1987) an individual cannot be active and productive in his/her day to day activities if they are unhealthy. According to the Kenya Health Policy (2012-2030), the New Constitution of Kenya is a major milestone towards the improvement of health standards, alleviating poverty and addressing inequalities in health among other issues. According to the policy, every Kenyan citizen has a right to the highest attainable standard of health and that includes reasonable standards of sanitation and the right to a clean heath environment even though many segments of the population have minimal access to high-quality healthcare and social services.

Jigger flea, also known as sand flea, Chigoe or Tunga penetrans is an ecto-parasite which causes Jiggers parasitic condition in humans and animals. The flea affects many impoverished populations living in sub-Saharan Africa, the Caribbean and South America. Hundreds of millions of people are at risk of infection in more than 70 nations, mostly in developing countries. The major effect of Tunga infestation is localization in the foot causing serious difficulty in walking, reducing the infected person's ability to work normally. In endemic areas, prevalence ranges from 15-40%.

The flea survives best in sandy and dusty environments. Poverty and powerlessness or inability to do anything about it is the greatest cause of ill health among communities. According to Heukelbach, Frank & Feildmeier (2004), jiggers are

found among communities with limited resources in several countries within America, Asia and Africa. Mutahi(2009) reported that infection rates among native inhabitants of developing countries are much higher than those of developed countries and that some regions often seem to be more prone to jigger infestations than others. In Kenya, a county like Muranga is said to be in pockets of poverty and is likely to harbor the jigger parasite. This reports however failed to give the effects of jigger infestation on agricultural productivity. The main economic activity in Murarandia Division is agriculture. The success of agricultural sector just like any other sector depends on the health of its workforce. The CAADP pillar 3 recognizes the health among the factors leading to food security challenges in Africa, “The wealth of a nation is the health of its people.” The Commission on Macroeconomics and Health (2001) further agreed that diseases are a barrier to economic growth and hence also adversely affects agriculture. It (Commission on Macroeconomics and Health) stated that some of the solutions to addressing hunger and malnutrition may lie outside of direct agricultural interventions and that not all households will attain food security through agricultural production, but that widespread agricultural growth depends on active and healthy people, and that agricultural growth has widespread indirect benefits”, AU/NEPAD (2009).

In the U.S,Government Accountability Office (GAO, 2008) cites the impact of poor health of the agricultural workforce as one of the major causes of chronic malnourishment (food insecurity) in Sub-Saharan Africa. In Kenya, the government and donor investments into health have been on a consistent rise though still insufficient momentum.

Health affects agricultural output, particularly its demand. Malnutrition and disease patterns influence market demand for food quantity, quality, diversity, and the price people are able or willing to pay. Nutrition affects people’s health and is an important factor in farm labor productivity. Sur et al (1999) noted that past

nutritional status predicts the probability of developing chronic diseases and consequently influences labor force participation. The nutrition and health status of adults affect the duration of labor force participation and the intensity of work effort (Antle et al, 1994). As pointed by the World Bank (2007), death and illness arising as a result of HIV/AIDS, TB, malaria and other diseases reduce agricultural productivity because of the knowledge of productive adults, loss of labor and lack of assets to cope with illness. For Lipton and de Kadt (1988), the lack of coordination of policymaking between agriculture and health undermines efforts to overcome ill health among the rural poor and gives short shrift to agriculture's role in alleviating many of the world's most serious health problems.

According to Ahadi Trust (2011), over 2.6 million people in Kenya are infested with jiggers and 1.5 million of them are children of school going age. The disabling jigger effects that commit the victims and their caregivers to home and house arrest due to the inability to walk keeps them from getting informed, an aspect that has made them either drop out of work, school or any other livelihood and thus not participate actively in national building. In order to realize the Millennium Development Goals (MDG) and Vision 2030 and eradicate poverty and hunger,this problem of jigger infestation needs to be solved. Of the eight provinces in Kenya, Central province is the most affected by the jigger menace. In Nyahururu district, three people succumbed to jigger infestation in the month of October 2009, while four members of one family died of jigger infestation in Murang'a County, in August 2009 (Ahadi Trust reports, 2011). According to Ahadi Trust reports (2012) Murang'a had an estimated 6,200 school going children infested with jiggers. In January 2011, more than twenty jigger victims from Murarandia division were admitted at Maragwa District hospital. Other areas in Central Kenya affected by jigger menace include Othaya, Mukurwe-ini, Nyeri, Laikipia, Mathioya, Kiharu, Maragua, Kandara, Thika, Gatanga, Kiambu, Kigumo and Kikuyu. Agricultural growth depends on active and healthy people and agricultural growth has

widespread indirect benefits. Since jiggers infestation is affecting health of people, then people living in Murarandia division, a division whose main economic activity is agriculture, will be affected, and the agricultural productivity will be affected, if this happens, agricultural benefits will decrease and poverty levels will become worse. Reports have failed to give the effects of jigger infestation on agricultural productivity; such a relationship has not been given much attention. Thus, there was need to conduct an empirical study to find out whether such a relationship existed.

**1.2 Statement of the problem**

According to FAO (2006), 80 per cent of Kenyans depend on agriculture. Agriculture accounts for about 25 per cent of the gross development product. In Murang'a, jigger infested people are not able to participate fully in social, political and economic activities. There is a high number of people who cannot attend to farm duties, children who cannot attend school and caregivers who cannot attend to their duties because of the infestation (Ahadi Kenya, 2011). Ahadi Kenya (2011) reports that in Murang'a County, there was a high rate of stigmatization among the jigger victims and this makes them shy away from seeking treatment because of fear of being recognized.

Studies on health have mainly focused on health conditions such as parasitic infections like Malaria and other conditions like HIV, Tuberculosis, cancer and malnutrition (Makena, 2013). These studies did not establish the effects of poor health on productivity in the agricultural sector. The health conditions looked at was not related to jiggers. Available studies suggest that jigger infestation has a negative impact on people's health (Collins, 2009) but the relationship between jigger infestation and agricultural productivity has not been given much attention. Thus, there was need to conduct an empirical study to find out whether such a relationship existed. This study therefore analyzed the effects of jigger's infestation on agricultural productivity with a focus on Murarandia Division.

### 1.3 Objectives of the study

i) To establish the extent of jigger infestation in Murang'a county.
ii) To analyze the effect of jigger infestation on agricultural productivity within Murang'a county.
iii) To provide recommendations on jigger menace handling to government and humanitarian policy makers.

### 1.4 Hypothesis

The hypotheses are drawn from the objectives of the study. The specific hypotheses tested were as follows:-

H0: Jigger infestation has no effect on agricultural productivity among farmers within Muranga County

H1: Jigger infestation has an effect on Agricultural productivity among farmers within Muranga County.

### 1.5 Significance of the Study

Policy makers will always require adequate, relevant and applicable planning strategies to make sound policies. Already, there has been a ratified positive correlation between health, agricultural productivity, and food security. There are many studies linking various health conditions and labour productivity, however no study has been done linking jigger infestation and agricultural productivity. The findings of this study are expected to be significant to the management of non-governmental organizations in Kenya by providing information regarding the jigger problem needs and consequently help the locals in household empowerment. The findings are also expected to serve the Government agencies and the health ministry to formulate policies of tackling the problem before it turns out to be a national menace or marginalize some regions. The government has not done enough on the

issue and results of this study will be a contribution to the little research done in Kenya on the topic. The findings of the study are expected to be significant to academic institutions and scholars who can obtain information relating to effects of jigger's infestation on agricultural productivity and thus form basis for future studies on jigger's infestation and productivity.

### 1.6 Scope of the Study

The study sought to establish the effects of jigger's infestation on agricultural productivity with a focus on Murarandia Division in Murang'a County. It used primary data collected through questionnaires. This was based on the belief that this data provided an adequate population and sample for the study to give reliable results and findings. Determining the causality between jigger-related health measures and both income and labor productivity remains an ongoing challenge for economists. This paper aimed to answer the question: Does improved population health lead to higher agricultural productivity?

# CHAPTER TWO

## 2.1 Introduction

This chapter provides the available literature that has been reviewed for the study. The literature deals with effects of jigger infestation on agricultural productivity with a focus on Murarandia in Murang'a County. The section also contains the empirical review, research gap, critical review, summary of the literature and a conceptual framework.

## 2.2 Theoretical literature

This section focuses on theories relevant to the study.

### 2.2.1 The Human Capital Theory: Health as a Human Capital

According to Grossman (1972) the human capital theory states that an increase in the knowledge of an individual and also their health leads to an increase in their market and non-market productivity. The time of labour available to them is determined by health while the knowledge they have affects their productivity.

According to the theory, human capital, just like any other type of capital, depreciates and hence investments should be made to it in order to restore it. The investment can come in form of nutrition, health care, education, training and exercises. Becker (1962) stated that proper model for managing the health benefits are provided for by the human capital theory. The essential idea is that human beings can be regarded, among other things, as a stock of capital. According to the theory, workers who are not functional impose costs through labour time lost through absenteeism. A worker's productivity levels can be improved through therapeutic and preventive health care services which lead to an increase in the stock of human capital. A healthy person has more time to provide labour service (Mushkin, 1962). They have higher mental acuity and stamina to work as compared

to unhealthy workers. This underlies the reason behind investing in proper health care through curing and preventing diseases. Incentives to invest in health capital are therefore powerful, just as they are by investing in education and job training. Investment in health compliments investments in education and training because healthy people will work at a higher level of intensity. Their returns will also be higher if they are educated and healthy (Gillis, Malcolm, Dwight, Michael and Donald, 1987).

The relevance of this theory to the current study stems from the observation that jigger infestation affects the health of the farmers. By extension it may have a negative effect on productivity. Other aspects of health that may impact on productivity include chronic and non-chronic diseases. Training by extension officers and the level of education are important aspects of the human capital theory. They may also influence productivity in similar fashion to jigger infestation.

### 2.2.2 Production Functions

A production function relates the physical output of a production process to physical inputs or factors of production. It is one of the key concepts of mainstream neoclassical theories. Its main purpose is to address allocative efficiency in the use of factor inputs in production and the resulting output of the factors (Daly, 1997). An example is the Cobb-Douglas Production function. The Cobb–Douglas production function is widely used to represent the technological relationship between the amounts of two or more inputs, like physical capital and labor, and the output that can be produced by those inputs (Cobb and Douglas, 1928).

Cobb Douglas production function is a mathematical expression describing a relationship between a measure of output and two or more inputs (such as employed labour and capital).

The Cobb Douglas production function is as shown in the equation below.

Y=F (K, L)

$$Y_t = A_t L_t^{\alpha} \quad K_t^{\beta} + e \qquad (2)$$

Where A represents technological advancement, L represents Labour and K represents Capital.

The function is significant to the study because the study investigated different amounts of agricultural production realized from the use of different inputs including two different sets of labour; that is, infected and uninfected labour.

**2.3 Empirical literature review**

Based on field data collected from rural households in 21 villages between 1997 and 1999, Audibert et al. (2003a, 2003b, 2009) studied the economic effect of malaria in Cote d'Ivoire. The study however found less consistent results. The results of the first two studies found out that malaria is a limiting factor for property accumulation because it reduces the living standards of households. The study also found out that malaria negatively affected the farmer's technical efficiency. The second study, Audibert et al. (2009), however found no effect of malaria on coffee and cocoa productions.

Available literature seems to show that not all types of diseases have significant negative labor productivity effects. A study was conducted in Santa Lucia to examine the effects of parasitic diseases on agricultural productivity. Productivity was measured in terms of earnings per week. The results of the study indicated that parasitic infections, except schistosomiasis, cause a statistically significant adverse effects on agricultural labor productivity while others do not (Baldwin and Weisbrod, 1974).

Audibert and Etard (2003) used longitudinal data in a quasi-experimental design to estimate worker productivity benefits of health. The study assumed imperfect substitution between hired labor and family members working in the fields. The study observed an increase of 26 percent of the production per family labor person per day in the experimental group as compared to the control group.

Fox et al. (2004) also conducted a study to find out the attendance and productivity of tea estates in the western part of Kenya. The findings of the study revealed that those workers who were not infected with HIV/AIDS plucked between 4.11 and 7.93 Kgs more than those infected with HIV/AIDS. Looking at the number of sick leaves requested for, the study established that those workers who were not infected with HIV/AIDS used 9.2 and 11.0 days less for sick leave and 6.4 and 8.3 less annual leave days. The study also found out that the earnings of pickers whose contract was terminated because of HIV/AIDS earned 18 percent less in the final year before their termination.

Girardin et al. (2004) sought to investigate the effect of malaria on farm yields of farmers in Côte d'Ivoire. The findings of the study revealed that the farmers who were suffering from malaria produced half the yields and incomes which those not suffering from produced.

In another study which used Cobb Douglas production function, Kim et al (1997) investigated the impact of jiggers on coffee productivity in south western part of Ethiopia. The findings of the study revealed that those male farmers suffering from jigger infestation suffered significant losses in economic productivity. The study also found out that, those farmers above the age of 35 years suffered the most loss in productivity in terms of diminished earnings.

Another study was carried out by Nyagero, et al; (2012) to investigate the effects of jigger infestation Murang'a County. The study used a cross-sectional descriptive study design on a sample size of 271 household. The study findings revealed that higher odds of jigger infestation were associated with low productivity.

A stochastic production function was used by Ulimwengu (2009) in Ethiopia to analyze the effect of farmers' health impediments on agricultural production efficiency. The study findings revealed that Healthy farmers produced more per unit of inputs and also supply more labor than those affected by sickness. The study also indicated that inefficiency in production increase significantly with the number of days lost to physical incapacitation or sickness.

In a study to examine the impact of health conditions on productivity of farmers in north central part of Nigeria, Ajani and Ugwu (2008) used inputs, income and health indices as the variables. The study established that a one percent improvement in a farmer's health condition led to a 31 percent increase in agricultural productivity.

**2.4 Overview of Literature Review and Research Gaps**

This chapter reviewed the theory of Human capital and explained how health as a human capital directly links to productivity. There is a reduction in productivity because ill and dysfunctional workers impose costs through work absences. The chapter also looked at the neoclassical growth theory that narrowed down to Solow-Swan model. The model explains long-run economic growth by looking at capital accumulation and labor or population growth. The model has been applied to explain the Solow residual. Existing Literature was also reviewed in the chapter. It is evident from literature review that health is an important component in labour productivity. Health affects agricultural systems in that poor health results into loss of work days or decrease worker capacity, decrease innovation ability and ability to explore diverse farming

practices and that makes farmers to rely on farm specific knowledge. From the reviewed studies, it was evident that in Africa, agriculture is labour intensive and that agriculture is also the greatest source of livelihood for many. Therefore, poor health has an effect on labour availability, which affects agricultural productivity.

The review of literature indicated that many studies have been conducted on the effect of health related factors on agricultural productivity in Africa. Some of the health related factors that have been studied on include Malaria, HIV/AIDS and chronic diseases. Only one of the reviewed studies, a study by Kim et al (1997), was conducted on the effect of jigger's infestation on agricultural productivity. The study was however conducted in Ethiopia. No study has been conducted on the effect of jigger infestation on agricultural productivity in Murarandia Division in Kenya. Therefore motivated by this research gap, the current study sought to investigate the effect of jigger infestation on agricultural productivity in Murarandia Division in Murang'a County.

# CHAPTER THREE: RESEARCH METHODOLOGY

## 3.0 Introduction

This section presents the model, how it is estimated and how it can be used to determine effects of jigger infestation on agricultural productivity.

## 3.1 Model Description

This study presents both the theoretical model and empirical model. The theoretical model is a collection of concepts and their hypothetical interrelationships. Theoretical model borrowed heavily from theories presented in literature review. The empirical model on the other hand is the econometric model that is modified from theory.

## 3.2 Theoretical Model

A production function describes the output that can be produced from different combinations of inputs using a given technology. The study adopted Cobb-Douglas Production function. This is because the study investigated different amounts of agricultural production realized from the use of different inputs including two different sets of labour; that is, infected and uninfected labour. Since production is involved, Cobb Douglas production function was most suitable for this study. The function was also used because it had been previously used in a similar study conducted by Kim et al (1997) to analyze the impact of jiggers on productivity at a coffee plantation in southwest Ethiopia.

Cobb Douglas production function describes the relationship between a measure of output and two or more inputs (such as employed labour and capital).
Its general equation is as presented below:

$$Y=F(K, L) \quad \ldots\ldots (1)$$

To analyze the productivity levels between jigger infested and uninfected labour, the study compared the output (production) of the two sets of labour when combined with other inputs. The general model adopted is shown in equation 2.

$$Y_t = A_t L_t^{\alpha} \quad K_t^{\beta} + e \qquad (2)$$

**3.3 Empirical Model**

The study used the following empirical model. Labour was divided into two using dummy variables. Labour was divided into jigger infested labour and uninfected labour.

Production=$\alpha+\beta_1$Capital+$\beta_2$Labour + e. (3)

$Y = \alpha+\beta_1 K+\beta_2 L+ e$ …… (4)

Where;

Y= Annual production in Kenya Shillings

K = Capital.

L = Labour (Dummy variable; 1 is infested with Jiggers labour, 0 is not infected with jiggers)

$\beta_1$and $\beta 2$ are the output elasticities of capital and Labour respectively.

e= error term

The relationship between output and its determinants in equation 4 was extended by adding other variables to explain the link between health outcomes and productivity.

$Y= \alpha+\beta_1 K+\beta_2 L+ \beta_3 X_1 + \beta_4 X_2+ \beta_5 X_3+ \beta_6 X_4+ \beta_7 X_5+ \beta_8 X_6 + e$……Equation (5)

$X_1$= Gender

$X_2$ =Age

$X_3$= Marital status

$X_4$= Education

$X_5$= Extension training

$X_6$= chronic diseases

e= error term

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$ , $\beta_7$ and $\beta_8$ are the beta coefficients.

### 3.4 Measurement of Variable

Various variables included in the model were measured and operationalized. Variables were categorized according to the type of variable, measurement whether dependent /independent and their relationship with output.

**Table 3.1: Operationalization of Variables**

| **Variable** | **Measurement** | **Dependent/ Independent** | **Relationship with output** |
|---|---|---|---|
| Output | Kenya shillings | Dependent | |
| Capital | Kenya shillings | independent | Positive |
| Labour | Binary( Jigger infested or not) | independent | Positive for uninfected and negative for jigger infested |
| Gender | Binary(Male/female) | independent | Positive |
| Age | Number of years | independent | Positive |
| Marital status | Married/Single /Divorced | independent | Positive |
| Education | Academic institutional category | independent | Positive |
| Extension Training | Frequency of receiving the training | independent | Positive |
| Chronic diseases | Binary(Yes/No) | independent | Negative |

### 3.5 Sample size and sampling technique

The target population was 28,943 Households in Murarandia division in Murang'a County according to the 2009 Kenya census report. The study used stratified random sampling technique and convenience sampling to come up with the sample. According to Mugenda and Mugenda (2003) a large population requires a formula to come up with the sample. The sample size of 384 was selected based on Fisher formula where n was the desired sample, Z was the Z score at 95 level of confidence, d was the degree of accuracy and p was 50% proportion of the population.

$n = (z_2pq)/d^2$

$$n = \frac{1.96^2(0.5) * (0.5)}{0.05^2} = 384$$

### 3.6 Data Sources

This study used questionnaires to collect primary data. The questionnaire used in the study is presented in Appendix V. The researcher administered the questionnaires individually to all respondents of the study. The respondents were heads of the households. The study exercised care and control to ensure all questionnaires issued to the respondents were received and to achieve this, the study maintained a register of questionnaires which were given to the research assistants.

#### 3.7.1 Validity

Validity can be explained as the degree to which results obtained from the analysis of the data actually represent the phenomenon under study. Validity was ensured by having objective questions included in the questionnaire. Pilot study also ensured validity since it was conducted in the five homes with similar background with the same instrument which was used in the actual study. This helped to establish if the instrument was able to measure what it was intended to measure.

### 3.7.2 Reliability

Reliability was investigated using Cronbach's alpha. A coefficient greater than or equal to 0.7 is considered acceptable and is a good indication of construct reliability (Nunnally, 1978).

# CHAPTER FOUR
# RESULTS AND DISCUSSION

## 4.0 Introduction

The findings of the study are presented in the Chapter. The descriptive statistics and inferential analysis are presented together with the discussion.

## 4.1 Descriptive statistics

A response rate of 195/384 (50.7%) was obtained for the study. The response rate was considered adequate given the logistical and geographical diversity of the study area.

**Table 4.1 Descriptive Statistics (Frequency and Percentage)**

| Variable | Frequency | Percentage |
|---|---|---|
| Gender | | |
| Female | 90 | 46.43 |
| Male | 105 | 53.57 |
| Jigger Infestation | | |
| Not infected | 64 | 32.65 |
| Infected | 131 | 67.35 |
| Chronic Diseases | | |
| Suffering | 61 | 31.12 |
| Not suffering | 134 | 68.88 |
| Education level | | |
| Primary | 128 | 65.31 |
| Secondary | 53 | 27.55 |
| College | 14 | 7.14 |
| Marital status | | |
| Single | 2 | 1.02 |
| Married | 170 | 86.73 |
| Widowed | 20 | 10.71 |
| Divorced | 3 | 1.53 |

Descriptive results in Table 4.1 indicated that 67.35% of farmers who responded are infected with Jiggers. This implies that prevalence of jigger infestation among farmers in Murarandia Division in Muranga County is higher than the prevalence rate of 4.5% of Kenya. Descriptive results also indicated that only 46% of the respondents were female implying that the majority (54%) of the respondents were male. This implies that majority heads of households in the division are men. Only 31.12% of the respondents suffer from chronic diseases. In relation to education level of the respondents, majority of the respondents (65.31%) had primary education as the highest level of education, 27.55% had secondary education as the highest level of education while only 7.14% had college education as the highest level of education. This implies that majority of the respondents were poorly educated. Majority (87%) of the respondents were married while 11% were widowed.

**Table 4.2 Descriptive statistics (Mean and Standard deviation)**

| Variable \| | Observation | Mean | std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Age | 196 | 47.22 | 10.34 | 29 | 64 |
| Capital | 196 | 43234.69 | 53672.51 | 3500 | 190700 |
| Annual Production | 196 | 213840.60 | 174364.20 | 28551 | 700000 |
| Training frequency | 195 | 0.94 | 1.20 | 0 | 3 |

The results in Table 4.2 indicate that the average age of respondents who participated in the study was 47.22 years with a standard deviation of 10.34 which implies that age was varied among respondents. The average number of times that the respondents received extensional training is 0.94 times per year with the maximum number of times being 3 and minimum being 0 times. This can imply that high poverty levels among the farmers hinder access to such training. The results can also imply that extensional agricultural officers in the division are reluctant to offer the services. The standard deviation of 1.20 indicates that the responses were

varied among the respondents. On average, the annual agricultural production was 213,840.60 Kenya shillings with maximum amount being 700000 Kenya shillings and minimum being 28551 Kenya shillings. This implies that far more farmers realize yields that are below average.

The results also revealed that the average amount of money used for capital annually was 43234.69 Kenya shillings. When compared to the mean annual production realized using this capital, the ratio of capital used to output realized is 1:5.This implies that for every Kenya shilling used as capital, 4.95 Kenya shillings worth of output is realized. This is a show of better utilization of capital.

**4.2 Regression analysis.**

Before running the regression model, multicollinearity was tested using both correlation matrix and variance inflation factors. No variable recorded VIF values greater than 10 hence there was no problem of multicollinearity (Appendices I and II). The Normality of the residuals was also tested using the graphical method and the residuals were found to be normally distributed (Appendix III).

Regression was run with jigger infested labour and with uninfected labour so as to compare the two.

**Table 4.3 Regression Results with uninfected labour**

| | | | | Number of observations =64 | | |
|---|---|---|---|---|---|---|
| | | | | F(10, 53) | | 4.96 |
| | | | | Prob > F | | 0.000 |
| | | | | R-squared | | 0.4834 |
| | | | | Adjusted R-squared | | 0.3859 |
| Annual production | Coefficients | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
| Age | -1257.71 | 2068.729 | -0.61 | 0.546 | -5407.05 | 2891.638 |
| Gender (Male) | 46766.25 | 45391.93 | 1.03 | 0.308 | -44278.4 | 137810.9 |
| Education level | | | | | | |
| Secondary | 216417.4 | 46256.5 | 4.68 | 0.000 | 123638.6 | 309196.2 |
| Tertiary | 181213.8 | 126184.5 | 1.44 | 0.157 | -71880.1 | 434307.8 |
| marital status | | | | | | |
| Divorced | -91584.1 | 135339.2 | -0.68 | 0.502 | -363040 | 179871.9 |
| Married | -124917 | 223493.9 | -0.56 | 0.579 | -573189 | 323354.7 |
| capital | 2.093054 | 0.481301 | 4.35 | 0.000 | 1.127687 | 3.058421 |
| Training frequency | -10089.5 | 22102.73 | -0.46 | 0.65 | -54422 | 34242.96 |
| chronic | -99776.6 | 119571.3 | -0.83 | 0.408 | -339606 | 140053 |
| Constant | 255544.1 | 173651.2 | 1.47 | 0.147 | -92756.1 | 603844.2 |

The regression model with uninfected labour has a coefficient of determination of 0.4834 which implies that 48.34 % of changes in the amount of production is explained by the predictor variables. The results also indicate that when jigger un infested labour is used; secondary level of education and capital used significantly

affect annual production. Secondary level of education has a positive and significant relationship with annual production.

The relationship between capital and annual production is also positive and significant. The results indicate that when uninfected labour is used, then one unit of capital produces 2.0 units of annual production. Regression was also run using jigger infested labour and the results are as presented in Table 4.4.

**Table 4.4 Regression Results with jigger infested labour**

| | | | | Number of observation =131 | | |
|---|---|---|---|---|---|---|
| | | | | F(9, 121) | | 17.87 |
| | | | | Prob > F | | 0.00 |
| | | | | R-squared | | 0.5707 |
| | | | | Adjusted $R^2$ | | 0.5387 |
| Annual production | Coefficients | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
| age | 98.8485 | 864.0286 | 0.11 | 0.909 | -1611.72 | 1809.421 |
| Gender(Male) | -9157.774 | 17294.88 | -0.53 | 0.597 | -43397.6 | 25082 |
| Education level | | | | | | |
| Secondary | 149072.8 | 21372.07 | 6.98 | 0.000 | 106761.1 | 191384.5 |
| Tertiary | 52554.26 | 31218.58 | 1.68 | 0.095 | -9251.16 | 114359.7 |
| Marital status | | | | | | |
| Divorced | 27067.81 | 28732.06 | 0.94 | 0.348 | -29814.9 | 83950.51 |
| Married | -260298.2 | 71958.9 | -3.62 | 0.000 | -402760 | -117837 |
| capital | 1.317113 | 0.163108 | 8.08 | 0.000 | 0.994197 | 1.640029 |
| Training frequency | 9263.331 | 9318.186 | 0.99 | 0.322 | -9184.48 | 27711.14 |
| chronic | -11410.76 | 25433.49 | -0.45 | 0.654 | -61763.1 | 38941.54 |
| constant | 78592.58 | 45313.13 | 1.73 | 0.085 | -11116.7 | 168301.9 |

The regression model with jigger infested labour has a coefficient of determination of 0.5707 which implies that 57.07% of changes in the amount of production is explained by the predictor variables. The results further indicate that Secondary level of education; married marital status and capital are significantly related to annual production.

The relationship between capital and annual production when jigger infested labour is employed is positive and significant. The results indicate that one unit of capital produces 1.3171 units of annual production.

The comparison between the uninfected labour and jigger infected labour reveals that more output is realized when uninfected labour is used (2.093 versus 1.3171 units). Jigger infested labour produces 0.7759 units less than uninfected labour. The implication is that, jigger infestation leads to low agricultural productivity.

### 4.3 T-test to compare mean annual production of jigger infested and uninfected labour

The study also conducted t-test to test for statistical difference between the mean annual production of jigger infested labour and that of uninfected labour so as to ascertain the productivity of the two groups.

**Table 4.5 T-test**

| Two sample t test with equal variances | | | | | | | |
|---|---|---|---|---|---|---|---|
| Group | Observations | Mean | Std. Err. | Std. Dev. | Null hypothesis | P value | Decision |
| Uninfected | 64 | 294701.4 | 25850.26 | 206802.1 | H0: There is no difference in mean | Pr (T>t)=0.000 | Reject null hypothesis |
| Infected | 131 | 175396 | 12362.87 | 141499.5 | | | |
| combined | 195 | 214552.6 | 12498.14 | 174527.1 | | | |
| diff | | 119305.5 | 25265.99 | | | | |

Results in Table 4.5 indicates that jigger infected labour has a mean annual production of 175396 Kenya shillings while uninfected labour has a mean annual production of 294701.4 Kenya shillings despite the fact that infected respondents were more than uninfected. The results indicate that there is a statistical difference between the mean annual production of infected and uninfected labour. Jigger infested labour produces Kshs. 119305.5 less than uninfected labour. This therefore leads to the conclusion that the productivity of jigger infested labour is lower as compared to uninfected labour.

# CHAPTER FIVE
# CONCLUSIONS AND POLICY ISSUES

## 5.1 Summary of the Study Findings

The study findings indicated that 46% of the respondents were female implying that the majority (54%) of the respondents were male. A percentage number of 67.35% of farmers who responded are infected with Jiggers and only 31.12% of the respondents suffer from chronic diseases. In relation to education level, majority of the respondents (65.31%) had primary education as the highest level of education, 27.55% had secondary education as the highest level of education while only 7.14% had college education as the highest level of education and regarding marital status, 87% of the respondents were married while 11% were widowed.

The average age of respondents who participated in the study was 47.22 years with a standard deviation of 10.34 which implies that age was varied among respondents. The average number of times that the respondents received extensional training is 0.94 times per year with the maximum number of times being 3 and minimum being 0 times. The study findings also revealed that, on average, the annual agricultural production was 213,840.60 Kenya shillings with maximum amount being 700000 Kenya shillings and minimum being 28551 Kenya shillings. When the production is compared to the average amount of money used for capital annually of 43234.69 Kenya shillings, then the ratio of capital used to output realized is 1:5.

Findings from the regression model revealed that when jigger infested labour is used, secondary level of education and capital used significantly affect annual production. Secondary level of education has a positive and significant relationship with annual production. The relationship between capital and annual production is also positive and significant. The results indicate that when uninfected labour is used, then one unit of capital produces 2.0 units of annual production.

The study findings further revealed that the regression model with jigger infested labour results in Secondary level of education; married marital status and capital being significantly related to annual production. The relationship between capital and annual production when jigger infested labour is employed is positive and significant. The results indicate that one unit of capital produces 1.3 units of annual production. The comparison between the uninfected labour and jigger infected labour reveals that more output is realized when uninfected labour is used (2.0 versus 1.3units). Jigger infested labour produces 0.7 units less than uninfected labour. The implication is that, jigger infestation leads to low agricultural productivity. The findings from the t test further supported the argument by indicating that there is a statistical difference between the mean annual production of infected and uninfected labour. Jigger infested labour produces Kshs. 119305.5 less than uninfected labour.

**5.2 Conclusions**

The study sought to establish the effect of jigger infestation on agricultural productivity among farmers of Murarandia Division in Muranga County.

The first objective of the study was to establish the extent of jigger infestation in Murarandia Division in Murang'a County. Study findings indicated that 67.35% of farmers who responded are infected with Jiggers. This implies that prevalence of jigger infestation among farmers in Murarandia Division in Muranga County is higher than the prevalence rate of 4.5% of Kenya.

The study also sought to analyze the effect of jigger infestation on agricultural productivity in Murarandia Division in Muranga County. Findings indicated that when uninfected labour is used, then one unit of capital produces 2.072 units of annual production whereas when jigger infested labour is employed, then one unit

of capital produces 1.235 units of annual production. The study findings revealed that more output is realized when uninfected labour is used (2.072 versus 1.235 units). Jigger infested labour produces 0.837 units less than uninfected labour. The study hence concluded that jigger infestation leads to low agricultural productivity among farmers of Murarandia Division in Muranga County.

### 5.3 Recommendations and Policy Implication

The County government of Muranga should liase with its health department in a bid to reduce jigger infestation in the county. There is need to eradicate jigger infestation because it negatively affects the agricultural productivity in the area as it has negative effects on health. Among the ways to eradicate jigger infestation is creation of awareness through the media. The county government should have campaigns to educate the residents on importance of clean environment free from dust which are incubating grounds for jiggers. The residents should also be educated on different ways of controlling and treating infestation.

The county government should also have deliberate policies to treat, free of charge, those infested with jiggers. It should be noted in all hospitals that treatment of jigger infested patients requires no payment. The county government in a bid to reduce the infestation rate should deliver fumigants to residents of the area. The county government should have a deliberate policy to freely supply the fumigants to infected families.

### 5.4 Areas of Further Study Limitations of the study

A comparative study should be done between various Divisions within Muranga County as well as other Counties to compare and contrast the findings as far as effects of jigger infestation on agricultural productivity are concerned. Other studies should also focus on the effect of jigger infestation on other sectors of the economy apart from the agricultural sector.

Future studies should also focus on the effect of other health related factors on agricultural productivity in the county as well as other counties in Kenya. The study faced some limitations as some of the respondents' were not willing to disclose information about jigger infestation as they thought it is shameful to be infested with that parasite. The accuracy of the results was also limited to the extent that the respondents were honest with their responses. Some respondents had difficulty in relaying information regarding the annual agricultural production. Finally, the ability to apply the results to the whole of Muranga County as well as other neighboring counties is limited by the small population and sample size. This is because the study focused on the farmers in Murarandia Division only while there were other farmers in other Division.

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# APPENDICES

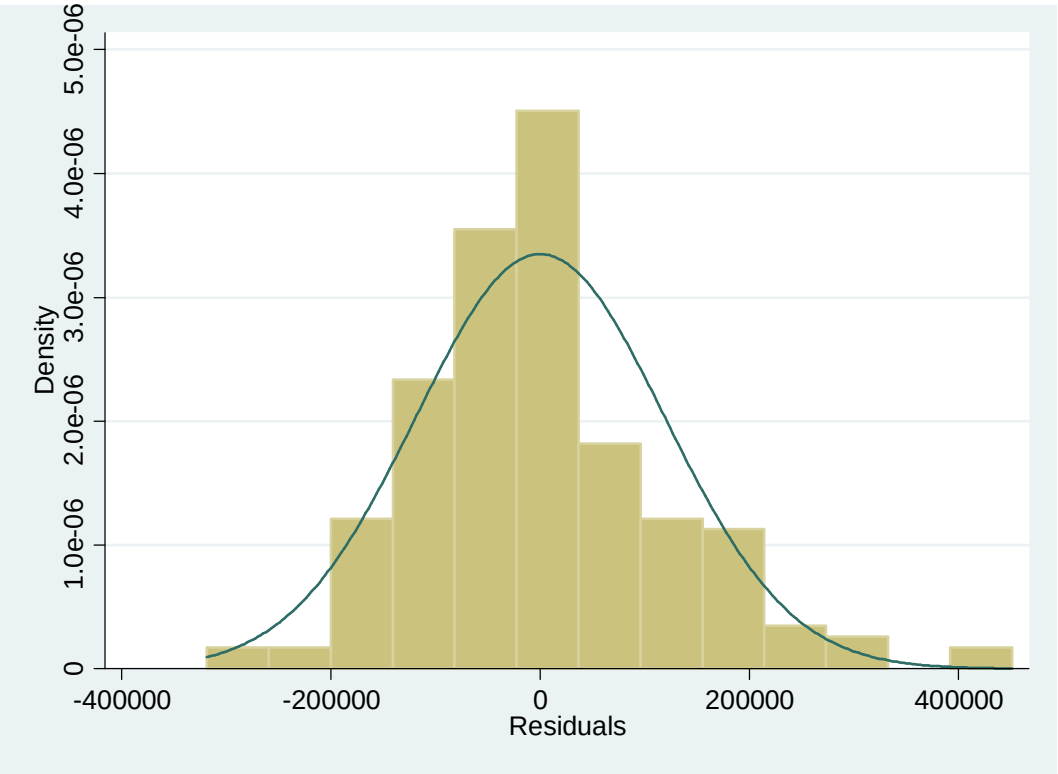
## APPENDIX I: Multicollinearity (Correlation Matrix)

| | age | gender | education level | Marital status | capital | Jigger infestation | Training frequency | chronic |
|---|---|---|---|---|---|---|---|---|
| age | 1 | | | | | | | |
| gender | -0.0318 | 1 | | | | | | |
| education level | -0.0302 | 0.1329 | 1 | | | | | |
| Marital status | -0.0939 | 0.117 | -0.0501 | 1 | | | | |
| capital | -0.078 | -0.0356 | 0.0214 | 0.223 | 1 | | | |
| Jigger infestation | 0.00258 | -0.1284 | 0.0278 | 0.0055 | -0.0916 | 1 | | |
| Training frequency | 0.081 | -0.015 | -0.1434 | 0.0411 | 0.0964 | -0.4288 | 1 | |
| chronic | 0.0597 | -0.0769 | -0.0296 | -0.1145 | -0.2899 | 0.1644 | -0.129 | 1 |

## APPENDIX II: Multicollinearity (VIF)

| variable | VIF | 1/VIF |
|---|---|---|
| Age | 1.06 | 0.943 |
| Gender(Male) | 1.08 | 0.924 |
| Education Level | | |
| Secondary | 1.11 | 0.897 |
| college | 1.09 | 0.915 |
| Marital status | | |
| Married | 12.3 | 0.081 |
| Widowed | 10.96 | 0.091 |
| Divorced | 2.75 | 0.364 |
| capital | 1.21 | 0.828 |
| training frequency | 1.31 | 0.764 |
| Chronic | 1.16 | 0.861 |
| Jigger infestation | 1.31 | 0.763 |
| mean VIF | 3.21 | |

**APPENDIX III: Normality test of residuals**



## Appendix IV: INTRODUCTORY LETTER

University of Nairobi

School of Economics

This questionnaire has been developed to collect information for academic purposes. All information will be treated with strict confidentiality and will only be used for this purpose only.

Kindly answer the questions as objectively and honestly as possible.

Thank you,

*Benson Muhoro.*

*Researcher*

*Cell–……*

*Student Number: X50/76536/2012*

**Appendix V: QUESTIONNAIRE.**

**FARMERS CHARACTERISTICS**

Name (Optional) **...**……

1. What is your year of birth? **.....**

2. Are you the head of the household?

   a) Yes ☐

   b) No ☐

3. What is your gender?(Tick one)

   Female ☐

   Male ☐

3. What is the level of education of the household head? (Tick one)

   Primary ☐

   Secondary ☐

   College ☐

   University ☐

4. What is your marital status? (Tick one)

   Single ☐

   Married ☐

   Widowed ☐

   Divorced/Separated ☐

**Factors of Production**

5. What is the main agricultural activity in the household?

   a) Crop farming ☐

b) Livestock farming ☐

c) Others specify……

7. At what cost did you buy any of the following work equipment? If the work equipment are nonexistent, put zero value

| **Farming Equipment** | **Cost** |
|---|---|
| Pangas and Hoes | |
| Wheel barrow | |
| Motor Cycle | |
| Irrigation equipment (jets and water pipes) | |

8. What is the size of land in acres (owned or rented) that you use for agricultural activities?

……

9. What was the cost of Fertilizers used in the last one year? Cost in Kshs

……

10. What was the cost of seeds in the last one year? Cost in Kshs ……

11. What was the cost of Herbicides and Pesticides used in the last one year? Cost in Kshs

……

12. a) How many members and non members of the household participated in agricultural activities ?(Write number)

……

**Human Capital Characteristics**

13. Is there any member of the household infected with jiggers? (Tick appropriately)

Yes ☐

No ☐

14. Is there any member of your household who has receives training and advice from agricultural officers? (Tick appropriately)

Yes ☐

No ☐

15. If yes, how many times was/were they trained in last year? (Write number)

……

16. Is there a member of the household who suffers from chronic diseases and also participates in the agricultural activities of the household? (Tick appropriately)

Yes ☐

No ☐

17. If yes, how many times in the last one year did they seek medical attention from a doctor? (Write number)

……

18. What is the distance in KMs to nearest agrovet shop which stocks pesticides, herbicides, fertilizers and seeds?

19. What was the total value of farm harvests and/or any other produce from the household's agricultural activities in the last one year?

……

***Thank you for participating.***