DETERMINANTS OF BOMBYX SILKWORM COCOON MARKET AT FARM LEVEL IN CHAARIA SERICULURE VILLAGE, MERU COUNTY IN KENYA
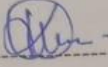
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A RESEARCH PROJECT SUBMITTED TO THE SCHOOL OF BUSINESS IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF BACHELOR OF COMMERCE IN MARKETING OF GRETSA UNIVERSITY

NOVEMBER 2022

DECLARATION

DECLARATION

This research project is my original work and has not been presented for a ward of a student pursuing a Bachelor's Degree or for any similar purpose in any other institution

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This Project proposal has been submitted with my approval as University supervisor

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ACKNOWLEGEMENTS

DEDICATION

This project is dedicated to Mr Edwin Maina my dear husband, Hilda Wambui and Amelia Muthoni my daughters, Gretsa University Director and all staffs of Gretsa University, the Institute Director (ABIRI) Dr.Muo Kasina, Centre Director KALRO- NSRC Thika, Mrs Noel Makete and all staffs of KALRO National Sericulture Research Centre whose support and understanding enabled me to undertake this task.

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ABBREVIATIONS AND ACRONYMS

NSRC – National Sericulture Research Centre

JICA – Japan International Corporation Agency

GOK- Government of Kenya

ICIPE – International Centre of Insect Physiology and Ecology

KALRO – Kenya Agricultural and Livestock Research Organization

OPERATIONAL DEFINATIONS

Bombyx – Is a domesticated lepidopteran caterpillar used in silk production.

Cocoon – Is an envelope often largely of silk which insect larva forms about itself and in which it passes the pupa stage.

Cocoon market - A place where buyers and sellers are required to transact cocoons by open auction under the regulation of law.

Dupion - An irregular, rough silk reeled from double cocoons.

Green Cocoon - Freshly harvested cocoons with live pupa inside.

Metamorphosis - Complete change of morphology during the life cycle of the insects.

Mountage - It is a device used for support of making cocoons by the silkworm larvae.

Pupa- A stage in the life cycle of insect.

Raw silk - Fibre made with combination of filaments from several cocoons.

Reelers - People who convert cocoons into silk yarn.

Sericulture – is the rearing of silkworms to produce silk.

Spinning – Is the process by which silkworms produce cocoons of silk around themselves as part of their life cycle.

ABSTRACT

Raw silk is Globally decreasing at a very high rate hence this creates a great opportunity for Kenyan farmers to venture in sericulture farming to fetch some income for their living. The research project seeks to investigate and outlay an important economic activity which is underutilized that is sericulture. Silk production in Kenya still lies underutilized due to the fact that market and marketing of cocoon products is rarely put into consideration. The study has a majority role of providing necessary and ambient evidence of understanding so that willing investors to earn and make a fortune. The research has employed descriptive research method because of its confidence of providing the needed information. The research has employed various data collection techniques like observation, questionnaire, and also secondary materials will be of greater importance. The sample of the study was three sericulture farmers in Chaaria sericulture village in Meru County who have been into sericulture for more than two years. The data gathered during reeling was tabulated and analyzed using descriptive statistics which included standard size deviation and maximum size deviation and regression method to analyze the relationship of the dependent and independent variables. The purpose of this study, was to research the determinants of Bombyx silkworm cocoon market at farm level in Chaaria sericulture village, Meru County in Kenya and the farmers were Consolata, Lawrence and Robert who have been into sericulture farming for more than two years. This study revealed that there was a difference in the quality of cocoon grade and the quality of raw silk grade across the three farmers brought about by farm operations, harvesting operations and post-harvest operations. Consolata had the highest Raw silk grade of 5A and cocoon grade 1 of 90.5 points, Lawrence had the second raw silk grade of 4A with cocoon grade 1 of 91 points and lastly Robert whose raw silk grade was 1A (very poor grade) with cocoon grade 2 of 89.5 points.) Results also established that the longest silk filament length was from Consolata, with 1021m, followed by Lawrence with 980m and lastly Robert with 786m. Cleanliness test done in terms of percentages where different among the sericulture farmers and notably Robert cleanliness percentages were higher with 98.95 points followed by Consolata with 97.75 points and finally Lawrence with 96.25 points on average. This study recommends KALRO Sericulture Research Centre Thika to train and make follow-ups on Kenyan sericulture farmers from farm operations, harvest operations and post-harvest operations as this operations affects the quality of cocoon grade and raw silk grades resulting to major problem in the marketing of the cocoons. In addition, KALRO NSRC should provide good silkworm seed to the sericulture farmers to improve on cocoon grade and raw silk quality for both cottage industries and export markets.

CHAPTER ONE: INTRODUCTION

1.0 Introduction

Many of the smallholder farmers are isolated from markets and lack knowledge about sericulture farming and, thus, find themselves mostly trapped in a cycle of subsistence farming, resulting to not producing enough surplus to make additional income to reinvest in adopting other kinds of farming to increase their income hence improving their living standards. KALRO –NSRC has been fully into task to ensuring that all sericulture farmers are able to market their cocoons directly to the market without interference of the middlemen so as to help them earn more money to improve their living standards.

Agricultural information especially in sericulture farming is a critical ingredient to improving small-scale agricultural production through linking farmers to profitable markets. This translates to better rural livelihoods of farmers in terms of food security both locally and regionally. Improved productivity in Bombyx silkworm cocoons is be realized when farmers are linked to market information (Rogaly, Harriss-White, & Bose, 2017). However, in most rural regions, the smallholder farmers and small-scale entrepreneurs are consistently incapacitated by lack of information on prevailing market prices before they sell their cocoons to the market. This has been occasioned by poor communication facilities forcing majority of farmers to often rely on middlemen who take advantage to exploit them. Poorly organized marketing activities has also resulted to inadequate marketing experience hence further exacerbated farmers' woes in the cottage industries in Kenya (Munyua, 2020)

The relationship of industrial crops e.g. cotton and Bombyx cocoon is very enormous in terms of demand and market availability after the Government of Kenya had a collaboration with JICA in 2015 to help sericulture farmers to sell their cocoons directly to the market. There has been high demand for Bombyx silkworm cocoons for production of silk in the market for textile industries in Kenya and also globally. Generally it is very easy to venture into sericulture farming than doing cotton farming because its silk fabrics are very expensive with less cost of production.

1.1 Background of the study

There are many Kenyan farmers who willing to venture into sericulture farming but the problem of where to market their cocoons have been a major challenge to many farmers despite the good climatic conditions for sericulture farming. The research studied the determinants of Bombyx silkworm cocoon market at farm level which hinder the marketing of Bombyx silkworm cocoons in Chaaria sericulture village, Meru County in Kenya. There are different channels of silk goods which consists of mainly three stages whereby marketing /market takes place. I.e.

 Cocoon stage,

Raw silk stage and

Fabric stage.

Major focus of Sericulture was sensitization and formation of sericulture villages to commercialise the sector in Kenya due to high demand of silk in the cottage industries. Sericulture performance has been quite low for a long time and silk available has remained also a cottage industry activity in Kenya. Most of the times, the Kenyan industries has not been getting enough Bombyx silkworm cocoons and has relied more on imports (FAO Bulletins (2017). In March 2015, sericulture greatly advanced in doing more activities like establishment of mulberry Gene bank, silkworm rearing for both research and commercial production, silk processing and marketing Bombyx silkworm cocoons through buying wet weight cocoons from sericulture villages. Sericulture in Kenya is currently in transition from Bombyx silkworm cocoon production to marketing which is the major interest of sericulture farmers in Kenya. The major purpose of the KALRO-NSRC (National Sericulture Research Centre) is to generate and promote knowledge, information and technology transfers at farm level for all sericulture farmers.

Mostly sericulture farmers in Kenya rely more on rain-fed agriculture, which in most cases is unpredictable and unreliable due to gradual climatic changes which has led to many farmers facing a lot of financial problems leading to poor living standards. Farmers engaging in sericulture farming is one way of improving their living standards through rearing of Bombyx silkworms and earning money in less than a month, as silkworms takes 25-28days from first day of feeding to spinning.to produce cocoons. Mostly Bombyx silkworm cocoons are delivered to the sericulture farmers at fourth instar, meaning that the farmers feeds the silkworms for only two weeks plus one week for spinning. I.e. three weeks for the rearing to be complete.

Bombyx silkworm cocoons are graded into 3 grades at farm level i.e. Grade 1 (Reelable cocoons), Grade 2 (defective cocoons to be used for spun silk) and Grade 3 are all thin, flimsy and stained cocoons which are not good for market in the cottage industries.

1.2 Problem statement

Sericulture is a long term investment, and since the development of sericulture in Kenya has been constrained due to lack of sufficient technological expertise in the market and marketing of Bombyx silkworm cocoons. These have been affected by all farm operations, harvesting operations and post-harvest operations not been put into considerations when rearing silkworms for cocoon production for marketing. Further, it appears there has been no study carried out in Kenya, to evaluate the determinants of Bombyx silkworm cocoons at farm level in Chaaria sericulture village, Meru County in Kenya Therefore there was need to carry out research and evaluate the farm operations, harvesting operations

and post- harvest operations which hinder marketing of Bombyx silkworm cocoons in Kenya. This study sought to fill this gap.

There was need to also study and determine the suitability of B. mori silkworm strains (ATK1F15) available in Kenya for silk production. This enabled the improvement of certain practical aspects like silkworm rearing and mounting which contribute to the production of quality cocoons for raw silk production which is a requirement in the market and , hence this study. This in the long run will enable Kenyan silk to compete in the international, regional and local silk market (E.Nguku (2010)

1.3 Purpose of the Study

The research seeks to study the determinants of Bombyx silkworm cocoon market at farm level in Chaaria sericulture village, Meru County in Kenya.

1.4 Conceptual Framework

Majhi et al., (1994), noted that the maximum production of raw silk from Bombyx cocoons is an important aspect of sericulture and largely depends upon several factors but primarily on the quality of cocoons hence affecting the market for raw silk. All the operations from farm operations, harvesting operations and post – harvest operations have a great impact on the market requirements for raw silk if not well done. Dependent and independent variables were identified and a framework on the interaction of these variables formulated. The conceptual framework for this study asserts that the farm operations, harvesting operations and post- harvest handling operations have impact on the market requirement raw silk of the Bombyx silkworm cocoon. (Fig 1.)

Figure 1: Conceptual Framework

Independent variables   **Dependent variable**

```
┌─────────────────────────────┐
│  Farm (production) Operations│ ────────────────┐
│                             │                  │
│   • Mulberry management     │                  │
│   • Silkworm rearing        │                  │
│     house                   │                  │
│   • Silkworm rearing        │                  ▼
└─────────────────────────────┘        ┌──────────────────────┐
                                       │  Market Requirements │
┌─────────────────────────────┐        │                      │
│  Harvesting Operations       │ ──────▶│   • Cocoon grade     │
│                             │        │   • Raw silk grade   │
│   • Cocoon Handling         │        │                      │
│   • Deflossing              │        └──────────────────────┘
│   • Sorting and Grading     │                  ▲
│   • Cocoon Weighing         │                  │
└─────────────────────────────┘                  │
                                                 │
┌─────────────────────────────┐                  │
│  Post - Harvest Handling     │                 │
│                             │                  │
│   • Cocoon handling and     │ ─────────────────┘
│     transportation          │
│   • Cocoon storage          │
└─────────────────────────────┘
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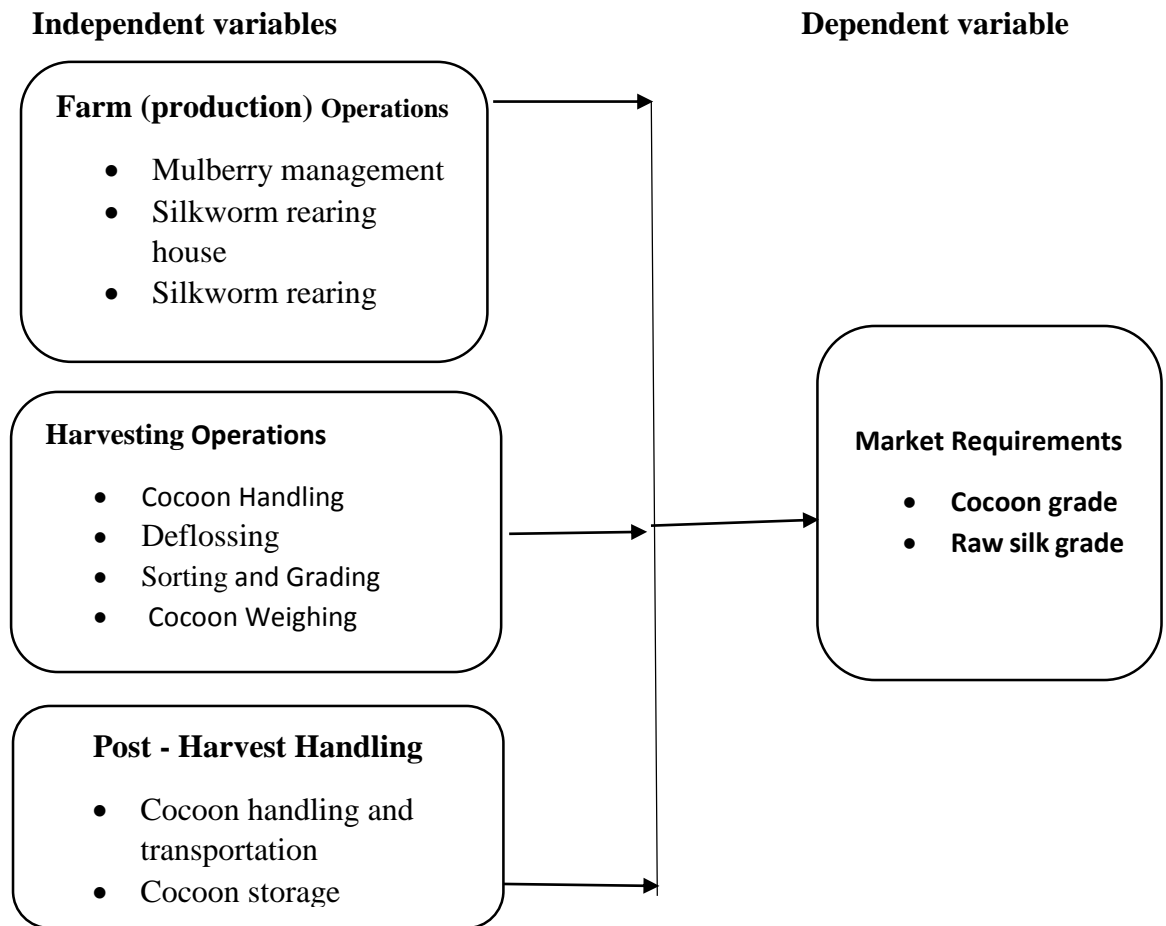
1.5 Research Questions

1. How has farm operations interfered with market of Bombyx silkworm cocoon?
2. How has harvesting operations affected the market of Bombyx silkworm cocoon?
3. How post harvesting operations has affected Bombyx silkworm cocoon market.

1.6 General Objective

Determinants of Bombyx silkworm cocoon at farm level in Chaaria sericulture village, Meru County in Kenya.

1.7 Specific Objective

1. To find out how farm operations might affect Bombyx silkworm cocoon market and marketing.
2. To find out how harvesting operations might affect Bombyx silkworm cocoon market.
3. To find out how post-harvest operations might affect Bombyx silkworm cocoon market.

1.8 Hypothesis of the Study

Ho1: There is a relationship between farm operations and market requirement for raw silk.

Ho2: There is a relationship between harvesting operations and Market requirement for raw silk

Ho3: There is a relationship between Post –harvest handling operations and Market requirement for raw silk

1.9 Significance of the Study

The study generated sources of challenges and advice further and train about the Bombyx silkworm farming at farm level in Chaaria sericulture village, Meru County in Kenya. The research has also provided sufficient market information and market to Bombyx silkworm farmers at farm level in Chaaria sericulture village, Meru County in Kenya.

1.10 Limitations of the study

Personal preferences that Bombyx silkworms are scary and getting into the farming was a little bit scary.The study confined itself to only 3 randomly selected sericulture farmers in Chaaria sericulture village, Meru County in Kenya who's rearing was done in January - February 2022. As such, generalization to other sericulture farmers in Kenya should be done with caution.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

The supply of raw silk is decreasing at a very high rate globally hence been an opportunity for Kenya to fully engage in the market. To achieve these, mulberry farming should be well practiced to produce quality mulberry crops as it's the only feed used for rearing Bombyx silkworms so as to produce good quality cocoons. There is a very high demand for Bombyx silkworm cocoons to produce silk for making silk fabrics in the textile and cottage industries in Kenya but the supply is very low hence making the silk materials very expensive as compared to cotton in the market for cottage industries.

Several studies have been carried out in different countries like China, Japan, India, Philippines among others, on the performance of Bombyx silkworm strains producing the best quality cocoons for marketing purposes. These studies indicate that it is important to carry out similar studies locally to enable for the improvement of certain practical aspects like farm operations, harvesting operations, post-harvest operations, silkworm rearing and mounting of mature silkworms which contribute to the production quality cocoons and quality raw silk. This will enable Kenyan silk to compete internationally in the silk market.

2.1 Evolution of Cocoon Farming

Sericulture farming is one of the rural-based activities in the cottage industries with global reach. Sericulture Sector has unique features which are its rural nature, economically and ecologically sustainable activity for the small and marginal farmers, poor, agricultural labour and women in particular. Sericulture is a highly labour-intensive industry in all its phases.

The industrial production of raw silk and fabric employs a large number of semi - skilled, and semiliterate poor workers throughout the year. Although, a large portion of the cost incurred in the conversion of soil to silk reaches poor workers who are involved in the value addition at each stage e.g. cocoon production, silk reeling, fabric production, dying and printing. Sericulture industry therefore, is discretely helping in the building of an egalitarian society in highly populous countries like India and China. Sericulture plays a very important role in the transformation of rural economy, as it assures regular employment and periodic returns round the year. Tamil Nadu is one of the progressive states of India with great potential development for mulberry crops. The state is blessed with the agro-climatic region suitable for growing variety of mulberry all around the year in Tamil Nadu. The total area under

mulberry has increased to 16,852.20 hectares in 2013-2014 (Handlooms, Handicrafts, Textiles and Khadi Department, Tamil Nadu). Therefore, the present study was aimed at following objectives. 1. To find out how farm operations might affect Bombyx silkworm cocoon market and marketing. 2. To find out how harvesting operations might affect Bombyx silkworm cocoon market. 3. To find out how post-harvest operations might affect Bombyx silkworm cocoon market.

Over 30 countries produce silk globally, 16 of which are in the Asian continent, accounting for about 90% of the total world silk production. India is the second largest producer of raw silk after China and is also the biggest consumer of silk (FAO Bulletins (2017)

2.2 Cocoon farming in Kenya

The potentiality of sericulture farming in Kenya is multi-fold, and is yet to be fully tapped up to date. Sericulture farming in Kenya was established in 1972, through collaboration of the Government of Kenya (GOK) and the Japanese International Cooperation Agency (JICA). With the current acreage under mulberry standing at 250 acres, spread over the rearing destinations. More farmers have continued to engage themselves in sericulture farming sericulture villages for easy cocoon collection. The mulberry crop in Kenya performs well under good management and the expected Bombyx silkworm cocoon yield is 640kgs/acre/year (FAO Bulletins (2017).

All the raw silk produced in Kenya is consumed locally and doesn't even meet the demand in the cottage industry, there is also a bigger export market which are really demanding for quality Bombyx silkworm cocoons for raw silk production. Major consumers are the cottage industries in Kenya, which also use cotton and wool for making fabrics. Majority of the weaver's in Kenya use hard looms to weave beautiful fabrics, which are purchased locally by tourists and which are also sold abroad. A survey which was carried out showed that the finer silk fibre found in the shops is imported and this is an indication that there is market for Bombyx silkworm cocoons for making silk fabrics and silk fibre in Kenya. Below is a list of silk market outlets in Kenya

2.3 Cocoon silk market in Kenya

Silk also known as queen of textiles, produced in Kenya is not sufficient for the textile industries hence all is consumed locally despite the bigger export market. Major consumers of the silk are the cottage industries which also use cotton and wool whereby the weavers use hand looms to weave fabric which

are purchased locally by tourist and others sold abroad. Appendix 1shows the list of silk market outlets in Kenya.

2.4 Theoretical framework

In the recent years, many attempts in research have been made to improve the quality and quantity of raw silk (Hiware and Ambedkar, 2016), through enhancing the leaves with nutrients, spraying with antibiotics, juvenile hormone, plant products, with JH-mimic principles or using extracts of plants. Mulberry leaves have been supplemented with various nutrients for silkworm feeding to promote raw silk quality and quantity to the market

The conceptual framework shows the relationships between farm (production) operations (i.e. Mulberry management), harvesting operations (i.e. Cocoon handling, Deflossing, Basic sorting and grading and Weighing) and post-harvest operations (i.e. Cocoon packaging, Transportation and Storage) in relation to Bombyx silkworm cocoon market requirements for cocoons for raw silk (i.e. Reelability, Cocoons not irregular, not double, not thin, not stained etc., Filament length, Neatness and cleanness, Cocoon grade, Raw silk percentage, more so, sericulture farming has an effect on market requirements.

The independent variable in the model includes 3 operation practises. The dependent variable is the Bombyx cocoon market requirements for raw silk. The connection between the dependent variables and independent variable are directly dependent on each other from farm operations, harvesting operations and post-harvest operations to market requirements.

2.5 Research gap

A critical review of past literature showed several research gaps. For example there was limited published on determinants of Bombyx silkworm cocoon market at farm level in Kenya, most of the research done were for instance on factors influencing the adoption of silk raw materials for sustainable growth (Rosemary (2010) and assessment of the properties of silk fibre and fabric produced by Bivoltine silkworm mori (E.Nguku 2010) which both does not focus on how to help farmers to achieve quality cocoons to produce quality raw silk but the focus was more on the consumers (silk weavers) interest when buying cocoons for raw silk production.

CHAPTER THREE: RESEARCH METHODOLOGY

3.0 Introduction

This chapter explains the research methods that were employed out in carrying out the general assessment on the prevailing topic of study. This chapter highlighted the following elements: Research design, Target population, Sample techniques, Sample size, Data collection techniques, Data analysis, logistical and ethical considerations.

3.1 Research Design

Orodho (2003) defines research as a systematic and a well detailed plan aimed at gathering information from a place. The research design used was primary data which used simple random sampling method since it give confidence of efficiency in gathering much information in need.

3.2 Study Area

The research was restricted on a sericulture farming in Chaaria sericulture village, Meru County in Kenya. The study was chosen in this area since it has a good climatic conditions which are favorable for silkworm rearing and also the farmers have done several rearing of Bombyx silkworms and sold their cocoons to the cottage industry. They also have one collection center for their Bombyx cocoons where sorting and grading is done before dispatch to the market.

3.3 Target Population

The research targeted sericulture farmers in Chaaria sericulture village, Meru County in Kenya with 25 farmers who are seriously doing sericulture as a business.

3.4 Sample Size

The sample size focused only on three farmers in Chaaria sericulture village who have been into sericulture farming for more than 2 years.

3.5 Research Instruments.

The research entailed on collection of primary data and due to this questionnaires, interviews, observation, and participation to ensure abundancy and collectiveness of data collected were used. The questionnaire were closed – ended to ensure uniformity in the responses

.

Table 1 Sampling Technique

Independent Variables	Indicators	Scale
Farm operations	quality	Nominal
Harvesting operations	kilograms	Nominal
Post-harvest handling	Storage conditions	Nominal

3.6 Validity of the Instruments

According to Mugenda (2003) validity is how accurate is a method able to measure what is intended to be measured. For this research project, validity of the instruments was enhanced by keen consideration of any viable information I get.

3.7 Reliability of the Instruments

Reliability refers to the consistency of a research instrument to provide similar results when subjected to repeated trials (Kothari, 2012). Here, split half technique was of more importance as it was used to test the reliability of the instruments. It also involved the administration of questionnaires to the targeted respondents.

3.8 Data Analysis

The data collected was both qualitative and quantitative, the qualitative data was analyzed through frequency distribution tables and quantitative data used the regression method ($Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3$) to establish the relationship between the variables.

3.9 Logical and Ethical Considerations

3.9.1 Logical considerations

Due to African norms and beliefs it was more important to seek relevant approvals from the targeted research area before collection of data and also other logistics to be included: the questionnaires, budget planning, pretesting, data collection, editing, coding.

3.9.2 Ethical Considerations

Research ethics provides guidelines, proper conduct of the research (Bryman & Bell, 2017). To minimize possible undesirable events, that may arise in the process of carrying out research an informed consent was sought and obtained from the respondents before the informed consent containing the reason why the respondent has to take part in the research study, the methods used, and the possible results. Confidentiality was also highly ascertained through the use of anonymous questionnaires whereby responses obtained were used only for academic purposes only.

CHAPTER FOUR: FINDINGS AND DISCUSSION

1.0 Introduction

The main purpose of this study was to determine the determinants of Bombyx silkworm cocoon market at farm level in Chaaria sericulture village, Meru County in Kenya. The study, also sort to test three hypotheses; there is a relationship between farm operations and market requirement for raw silk; there is a relationship between harvesting operations and market requirement for raw silk; there is a relationship between post – harvesting operations and market requirement for raw silk and. In order to perform the above, a random selection of three farmers (Consolata, Lawrence and Robert) who have been seriously into sericulture business for more than two years was done. The selected farmers had reared Bombyx silkworm strain (ATK1F15 Commercial) in January – February 2022.Consolata had reared 3 cases (equivalent to 60,000 silkworms), Lawrence reared 2 cases (equivalent to 40,000 silkworms) and Robert 2 ½ cases (equivalent to 30,000 silkworms). Everyone farmer worked towards achieving 100% conversion of the silkworms to production of quality cocoons. Under good mulberry management and good rearing conditions a case produces at most 35kgs of wet (fresh) cocoons.

This chapter discusses the results of tests performed at KALRO NSRC Thika, silk processing lab, on Bombyx silkworm cocoons harvested by three Chaaria sericulture farmers in Meru County in Kenya to determine their cocoon grades and raw silk quality grades, which hinder farmers from reaching out to a good market hence not fetching a lot of money for their living. The analysis has given out the results in form of tables and figures in relation to the market requirements for raw silk through cocoon grading and reeling.

4.1 Farm operations affecting Bombyx cocoon market for raw silk

The study focused on mulberry management, silk worm rearing house and silkworm rearing.

4.1.1 Mulberry crop management

Mulberry crop is grown for Bombyx silkworm rearing. Mulberry management is an important activity which need to be done properly in order to produce good quality healthy leaves for feeding silkworms. The farmers had managed their mulberries very well during the day of data collection. The management involved: application of well decomposed farm yard manure which is a pre-requisite for leaf quality after pruning of mulberry crop. Basal application of fertilizers of NPK 23:23:23 to boost the quality and yield was also done; Good pruning was done which ensured uniformity of the crop for silkworm rearing, the farmers were also doing irrigation especially during the dry spell to ensure continuity of leave

production to be enable them to rear at least four times in a year, also minimum tillage was done to ensure minimal soil disturbance e.g. slashing and mowing. Poor mulberry crop management when feed to the silkworms produced poor quality cocoons which cannot be sold in the market.

Figure 2 Chaaria sericulture mulberry farms

| **Consolata farm** | **Lawrence farm** | **Robert farm** |

4.1.2 Silk worm rearing house

Bombyx silkworm is a domesticated silkworm and is reared in houses which are well ventilated, with enough light. The sericulture farmer's rearing houses were built away from farm animals' housing to avoid drifting of chemicals during spraying of the animals as this may result to high mortality rates of the silkworms hence demoralising the sericulture farmer. Also the rearing houses were near the mulberry fields hence the farmers minimized the transportation distance thus cutting down on wilting of leaves. The doors and windows of the rearing houses faced North-South direction to avoid direct sunlight into the room which could raise the room temperatures and thus cause leaves to dry fast.

The size of the rearing houses were determined by number of mulberry crops that each farmer had which also determined the amount of silkworms reared. The sericulture farmers build their rearing houses with locally available building materials such as off cuts, timber, mud and bricks to build the walls and iron sheets at the roof. Consolata and Lawrence rearing houses were build with bricks and this ensured easy regulation of temperatures during the day and night and Roberts rearing house was build with timber and this was a challenge especially controlling the temperature during the night hence resulted to the worms not feeding well all through there larval cycle and also the silkworms had great impact of the coldness during spinning. The building material used for building a rearing house determines greatly on the easiness to regulate the temperature and humidity as this is what mostly affects the quality of the cocoon for marketing.

4.1.3 Silkworm rearing

The rearing of silkworms to produce silk is called sericulture and it entails a process whereby the silkworms are reared at an appropriate temperatures and humidity to get silk filament from the cocoons. The rearing of silkworms from first instar to third instar was done at KALRO NSRC Thika where quality seed was selected for the farmers.

Timing of the sericulture farmers mulberry crops was done and the eggs incubated for hatching, brushing of the silkworms was done to start first feeding. Then silkworms were taken to the farmers when they were at fourth instar day one. Before delivery of the silk worms the farmers ensured that their rearing houses were ready by cleaning and disinfecting their houses and the rearing beds with slaked line to kill diseases which causes mortalities of the silkworms especially during spinning.

At fourth instar the silkworms are usually susceptible to diseases and are feed on their rearing beds through shoot rearing which is a less labor intensive activity for only two weeks (morning and evening). Towards the end of second week the larvae stops eating the mulberry leaves and excrete their waste and the body start turning yellowish a sign of maturity that the worm is ready to spin. The farmers collected the mature silkworms by hand and moved them to a prepared plastic or reeds mountages to spin. Sometimes incase if feeding not well done the silkworms produce very small cocoons which can't be sold to the market also the spinning mountages should be properly placed and avoid overcrowding of the silkworms as this results into many defective cocoon hence huge loss.

Figure 3 Rearing of Bombyx silkworms and silkworm spinning

a) **Silkworm rearing**   b) **Silkworms spinning**

4.2 harvesting operations affecting market requirement for raw silk

The harvesting operations entailed: cocoon handling; Cocoon deflossing; sorting and grading and cocoon weighing.

4.2.1 Cocoon handling

This is an activity that comes after silkworms have completely spun their cocoons. Also known as cocoon harvesting. The farmers harvested their cocoon by hand, first they removed left-overs of leaves, flimsy, melted, dead or un-spun larva from the mountage as they may spoil the good cocoons by spilling stain.

Harvesting of premature cocoons lead to loss of silk content of the cocoons as a result of incomplete spinning. Killing of pupa or tender early pupa inside the cocoon leads to stained cocoons, hence not good for reeling. To avoid this problem, the cocoons were harvested at 7^{th} day counted from day one when silkworms start spinning to ensure quality cocoons after complete pupation. This condition was suitable for safe handling and transportation of cocoons to the market. Green cocoons release moisture even after completion of spinning and delayed harvesting results to weight loss of cocoons.

 Harvesting of cocoons early leads to high moisture content of the pupa which increases humidity hence poor cocoon quality for marketing.

4.2.2 Cocoon Deflossing

This is the process of removing of the flossy layer from the cocoon. The farmers deflossed their cocoons by hand which is a labour intensive work. Some of the cocoons were not properly deflossed hence created a lot of waste during reeling lowering the quality of the raw silk. Deflossed cocoons usually fetch high prices at the market as the buyer is able to assess the quality and silk content very quickly.

2.3 Sorting and grading

After deflossing the cocoons, farmers spread their cocoons on the table and selection of all defective cocoons done. Removal of defective cocoons from the good cocoons is called sorting. Defective cocoons highly affect the reeling performance and quality of the raw silk and therefore, unsuitable cocoons were sorted out from the good cocoons so as to get optimum results during reeling. The cocoons were sorted into three groups:

 a) Good

 b) Defective

 c) Thin shelled or incomplete spinning.

 Sorting generally was done to improve on cocoon image for good marketability. Reelers prefer cocoons of uniform shape in every batch of cocoons received as this improves the reeling performance and raw silk quality. Sorted out defective cocoons were also sold at lower price and were used by Reelers to make spun silk.

4.2.4 Cocoon weighing

Cocoons produced by the farmers were weighed at farm level and labelling done showing the names of the farmer and the quantity of good cocoons produced before they were taken to the market. The following were considered when assessing the cocoons at farm level.

1) **Cocoon Weight**: The average weights of single cocoons from each of the three farmers ranged between 1.6- 1.7g. This was an excellent weight since cocoons are sold on weight basis. The marketing of fresh cocoons should be done very fast as weight of the cocoons gradually decreases due to moisture loss. Therefore, immediately after cocoons were harvested, they were deflossed, sorted, and weighed the good cocoons and a label tagged on the packaged cocoons indicating Farmers name, strain, date of spinning and green weight.

2) **Assessment of Cocoons for Defective Cocoon Percentage:**

The assessment of defective cocoons was done after cocoon sorting was done**.**

$$\text{Defective cocoon (\%)} = \frac{\text{Wt. of defective in one kg}}{\text{Wt. of cocoon taken 1(kg.)}} * 100$$

3) **Shell ratio (%):** This was done to indicate the quantity of raw silk in terms of cocoon weight when expressed in percentage. This value gave an indication of the quantity of raw silk to be reeled from a lot of fresh cocoons and also it's used by silk markets to help in price fixation.

$$\text{Shell ratio (\%)} = \frac{\text{Shell weight}}{\text{Cocoon weight}} * 100$$

4.2.5 Examples of defective cocoons.

Defective cocoons are cocoons whose filament are not continuous and affect the performance of reeling and quality of raw silk.

Melted and Stained Cocoons:

This cocoons are caused by spinning larvae or pupae dyeing inside the cocoon during spinning or transportation, which causes inner soiling. This affects the reelability performance of the cocoons hence affecting the sericin characteristics which are as a results to under cooked cocoons hence frequent dropping of the cocoons and poor grouping efficiency during reeling.

Flimsy or Thin Shelled Cocoons:

Caused by weak silkworms or parasited silkworms when they spin less compact cocoons or loose cocoons. These cocoons become flimsy or thin shelled. Reelability of these cocoons is poor since the cocoons are usually overcooked hence cleanness defects due to slugs during reeling.

Deformed/ unshaped Cocoons:

Caused by weak silkworm or improper cocooning mountage causes deformed cocoons. These cocoons affect the smooth unwinding of the filament causing more dropping of the cocoons during.

Thin-end Cocoons:

Thin end cocoons may be due to silkworm strain and also poor temperatures and humidity during spinning. These cocoons affect reelability performance and the quality of raw silk.

Pierced Cocoons:

Pierced cocoons are due to the emergence of maggots of parasitic Uzi fly or emergence of silkworm moth and are unsuitable for reeling

Double Cocoons:

Double cocoons are caused by overcrowding of over mature silkworms during mounting and improper mounting frames. The cocoons are abnormally large with oval shape with two or more pupae inside.

4.3 Post harvest operations affecting market requirement for raw silk

These entails further cocoon handling i.e. handling during packaging of cocoons, minor sorting to remove some defective cocoons left before transportation

4.3.1 Transportation of cocoon to the market

Transportation is a very important factor because often affects the quality of cocoons. The sericulture farmers pack their cocoons and store them loosely in cotton material bags or plastic crates or plastic nets. The farmers' usually transport their cocoons during the early cool hours since the live pupa inside might die and melt leading to staining of the cocoons. This lowers the quality of cocoons. The farmers transport their cocoons to the market by a counter.

4.4 Market requirements for raw silk

Silk farming being a profitable business, sericulture farmers in Kenya, have not yet met the demand for raw silk by supplying adequate quality cocoons in the cottage industries. Among the textile fibres, silk is the most priced due to its lustrous appearance, light weight, luxurious feel, resilient and its strength.

Cocoon marketing entails supplying quality cocoons in the market and signing a contact between the sericulture farmer and the cocoon buyer when the cocoons are still fresh. The pricing of the cocoons are depended on the quality of the cocoon grades and raw silk grades.The study focused more on the determinants of Bombyx silkworm cocoons at farm level, Chaaria sericulture village, Meru County in Kenya. The study analyzed at two parameters which are cocoon grading and reeling, the major factors which determine the quality of the cocoons after all operations from the farm, harvesting and post-harvesting which determine the quality of cocoon for marketing.

The cocoons as a marketable product are classified into three groups and the research analysis was done only for group 1 at KALRO NSRC THIKA, which were good cocoons for marketing both locally and export market. i.e.

Group 1 – Reelable cocoons/ good cocoons for raw silk.

Group 2 – Defective cocoons (double, stained, irregular, framed) for spun silk

Group 3 - Thin cocoons, incomplete spinning, melted cocoons etc. (All discarded)

4.5 Cocoon Quality

It is very difficult to tell the quality of cocoon by just looking at the physical appearance. Cocoon quality influences the productivity in silk reeling and raw silk quality. The rearing technology done by Chaaria sericulture farmers and the atmospheric condition during spinning stage affected the cocoon quality.

The quality characteristics of cocoons was influenced by the farm operations, harvesting operation and post-harvest operations which were more depended on silkworm strain(ATK1F15 commercial),rearing house and temperature conditions during spinning stage. The good cocoons were almost of the same size

and shape and the general analysis was done through grading and sorting the cocoons of the three sericulture farmers with labels of their names and the quantities produced.

Table 2 Quantities of harvested cocoons in Jan- Feb rearing 2022.

Names of the farmer	Group1 Good cocoons	Group 2 Defective cocoons	Group 3 Thin, melted cocoons etc.
Consolata	90kg	10kg	5kg
Lawrence	57kg	8kg	5kg
Robert	27kg	10kg	15kg

4.6 Silk Reeling

Silk reeling is the process of unwinding a number of cocoons together to produce a single filament using an automatic silk reeling machine or a multi-end silk reeling machine. The analysis of cocoon and raw silk grades were achieved through using automatic silk reeling machine where a 21denier sensor was used to ensure constant thickness of the filament during reeling process.

4.7 Cocoon grading and sampling procedure

The analysis of the cocoon grading were done for Consolata, Lawrence and Robert respectively.

Procedure

Random selection of 200 wet cocoons were taken from each farmers flesh cocoons delivered for testing and their weights taken separately.

Cocoons were dried to kill the pupa and lower the moisture content to ease reelability.

Then dry weight taken separately for all the farmers.

Reeling done to get the cocoon grade.

Formula for;

Cocoon Filament Length = Raw silk Length * Average cocoon number

$$\text{Reeling Cocoon Number}$$

Reelability % = Reeling Cocoon Number

$$\text{Casting number}$$

Cocoon Filament size (denier) = True raw silk weight * 9000

$$\text{Raw silk length * Average cocoon number during reeling}$$

Table 3 Comparison of cocoon grading results

Name of the farmer	Cocoon shell w.t	Cocoon shell ratio %	Reelability %	Cocoon filament length	Raw silk %	Cocoon filament w.t	Cocoon filament size.
Consolata	0.43g	24.36%	96%	1021m	19.2%	0.363g	3.20d
Lawrence	0.39g	24.93%	98%	980m	19.5%	0.310g	2.85d
Robert	0.35g	22.97%	96%	786m	16.4%	0.256g	2.94d

The cocoon shell weight for Consolata was high due to feeding quality mulberry leaves to the Bombyx silkworms (feeding done three times per day) and the cocoon shell ratio % was lower that Lawrence to due to improper regulation of temperature and humidity during the spinning stage. Lawrence cocoon shell weight was failure to feed the right amount of mulberry leaves i.e. underfeeding to the silkworms despite having quality mulberry crop but still managed to get the highest shell ratio % because temperature and humidity were properly maintained. Lastly Robert managed to get the lowest cocoon shell weight which was as a result of feeding the silkworms with unfertilized mulberry leaves which were of poor quality despite ensuring enough mulberry leaves for the silkworms, also the cocoon shell ratio % was very low since it was difficult for him to control the temperatures especially at night since

his rearing house build with timber allowed air to penetrate inside the house hence the silkworms were unable to spin properly.

Results also indicated that Consolata cocoons had the highest cocoon filament length, cocoon filament weight and cocoon filament size. It was noted that Consolata Cocoons had a good reelability than the others. Cocoon quality was determined by 5 grades, as indicated in Annex A, with grade E (Excellent) being the best quality and grade 4 the lowest. It was noted that silk worm feeding with poor mulberry leaves, underfeeding the silk worms, temperature and humidity affected the cocoon quality. In addition, it was noted that cocoons reared by Consolata were larger in size than those reared by Lawrence and Robert respectively; however there was no big difference. The study also established that rearing houses had effect on the cocoon filament length and reelability since the houses were built from different building materials despite the same climatic condition of the area. The cocoon grading was achieved by summation of cocoon grading points on cocoon filament length and cocoon grading points on reelability.

Table 4. Cocoon grading results

Name of the farmer	Cocoon grading points on cocoon filament length points	Cocoon grading points on reelability %	Total points	Cocoon grades
Consolata	39.0	51.5	90.5	1stgrade
Lawrence	39.0	51.5	90.5	1stgrade
Robert	38.0	51.5	89.5	2ndgrade

4.8 Raw Silk testing / grading

Testing of raw silk was based on International Silk Association procedure (I.S.A) procedures. Since it was very difficult to tell the quality of cocoon through its external appearance alone. Cocoon testing samples were done to test for cocoon grades and raw silk grades.

4.8.1 Procedure for raw silk grading

Drying of fresh cocoons was done to 40 degrees to lower the moisture content of the cocoon and kill the pupa.

Cocoon cooking using automatic cooking machine was done - to soften the sericin (gum) produced by the silkworm during spinning.

Reeling of the cocoons was done using automatic reeling machine – to unwind the cocoon filament into raw silk using a 21 denier sensor to ensure even thickness of the raw silk.

Re-reeling the raw silk was done using re-reeling machine to increase the circumference of the raw silk and also to enhance easy handling.

Conditioning of the raw silk in an air conditioned room for 12hours was also done.

Rewinding the raw silk to the bobbins using bobbin winding machine was done and used for making small skeins for calculating the size deviation and standard size deviation and other bobbins still wounded with raw silk for the farmers were used in the seriplane illumination apparatus for cleanness and neatness tests.

All the six steps procedure were used to determine the grades of the raw silk from the cocoon samples collected from the three farmers. Cocoon testing is a factor that contributes to pricing of the cocoons. Good quality cocoons are sold at high prices as compared to low quality cocoons

Raw silk grading of the sericulture farmer cocoons was very important since it represented results of many sericulture farmers doing sericulture as a business in Kenya. There are two grades for raw silk grading i.e. grade A and grade B. In grade A there are six grades (6A, 5A, 4A, 3A, 2A,1A and B). 6Ais the highest grade while 1A is the lowest and grade B is a poor grade. Appendix 3 shows Raw silk grading table.

4.9 Quality test

The research used both visual test and mechanical tests in doing the quality tests of the three sericulture farmers.

4.9.1 Visual tests

The test was separately conducted on the whole lot of raw silk. The tests were carried out in an inspection room which is well illuminated. The inspection was based on cleanness and neatness of the raw silk on a seriplane board.

4.9.2 Mechanical tests

The test done included:

Winding test – this was done using a bobbin winding machine and bobbins to determine the number of breaks which occurred within a certain winding period of a skein;

Figure 4. Bobbin winding machine
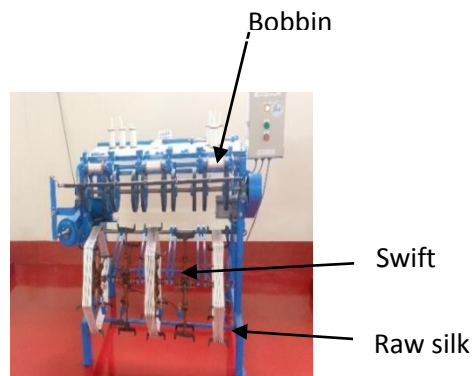
Size deviation test – This test was done to test for average size deviation whose objective was tow as to determine the degree of variations of the test pieces of the small skeins of same length of raw silk while maximum size deviation test was done to determine the extreme degree of variation. The equipment's used was a measuring metre (112.5mtrs circumference) for making constant revolutions of the skeins (100 revolutions) and an analytical weighing scale was used to weigh 30 small skeins prepared for each farmer.

Seriplane test – A seriplane winding machine was used to would the raw silk on inspection board with same spacing and speed of 100 revolutions/ m. the tests were conducted with the help of seriplane winding machine, seriplane inspection board and illumination apparatus standard photo graph. The seriplane test was done visually to check for cleanness and neatness test by use of 10 samples from the seriplane board for every farmer.

Figure 5.Seriplane winding machine

Raw silk wounded on Seriplane board
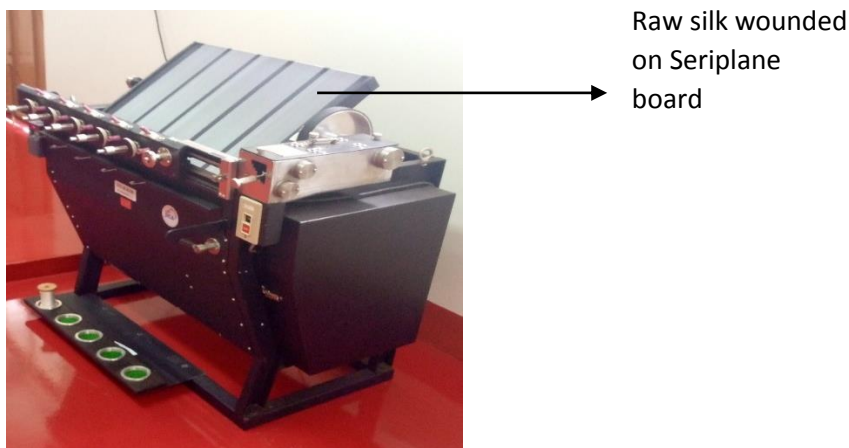
Figure 6 Standard photo for cleanliness and neatness in an inspection dark room

Seriplane board under inspection

Standard Photo for Neatness and cleanness
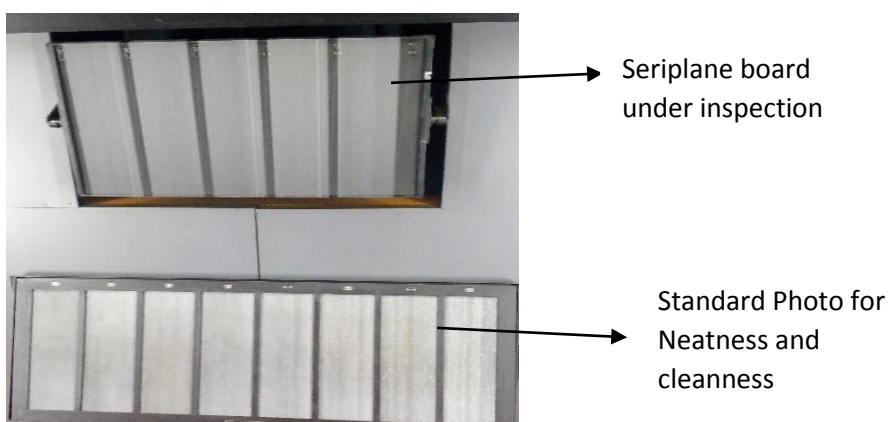
Table 5 Raw silk test results for Consolata, Lawrence and Robert

Name of the farmer	Average wt. of the small skeins	Avarage denier size	Standard size deviation	Maxmum size deviation	Cleanness /neatness points	Raw silk grade
Consolata	0.266g	21.29	1.006	2.79	97.75	5A
Lawrence	0.262g	20.96	0.763	2.3	96.25	4A
Robert	0.284g	22.69	2.335	6.76	98.95	1A

From the above table Consolata had the highest Raw silk grade of 5A, followed by Lawrence with grade 4A then finally Robert with grade 1A (poor grade). Maximum size deviation and standard size deviation were depended on cooking of the cocoons, reelability and the maintenance of the appropriate number of cocoons per end during reeling.

In conclusion, there were differences in the overall performance between the three Chaaria sericulture farmers cocoon tests and raw silk tests that were carried out, with Consolata having best cocoon and raw silk quality as compared to the other farmers. These was reflected in the length of the silk filament and the raw silk grade an important cocoon property for determining cocoon price. The nutritive value of the mulberry on the other hand, played a significant role in determining production of quality cocoons. This study verified that the overall performance of the silkworm strain reared was mainly related to the quality of the mulberry crop and environmental conditions hence it is possible to formulate appropriate silkworm rearing procedures suitable for sericulture farmers in Kenya, and advise silk farmers on the appropriate operations from the farm to post-harvest handling affecting cocoon quality and raw silk quality at farm level and rearing conditions for optimum cocoon production in both Kenyan and export market.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter highlights the summary of the study, discussions conclusions drawn and recommendations derived from the research carried out on the determinants of Bombyx silkworm cocoon marketing Chaaria sericulture village, Meru County in Kenya. In addition, suggestions for further research have been made.

5.1 Summary

This study sought to evaluate the determinants of Bombyx silkworm cocoons at farm level in Chaaria sericulture village, Meru County in Kenya. The study also sought to verify if there were differences in cocoon quality grades and raw silk grades a factor that determines pricing of cocoons in the market for sericulture farmers in relation to their cocoon grades and raw silk grades from the three selected farmers.

5.2 Conclusions

From the findings above the study concluded that marketing of Bombyx silkworm cocoons were determined by the farm operations, harvesting operation and post- harvest operations evident in the analysis results for cocoon and raw silk grade. There was need to sensitize farmers on how to improve the quality of their cocoons for better market from mulberry crop management to spinning of Bombyx silkworm. There was lack of awareness on the farm operations since there was no technical staffs to make fall-ups when the farmers reared their silkworms

In Kenya sericulture is at infancy with encountered many constraints. However, KALRO NSRC Thika has the mandate to ensuring that the sericulture sector grows rapidly in Kenya

Textile industries are increasingly becoming competitive environment and cottage industries plays an important role in Kenya. This can be facilitated through improving and monitoring of farm operations, harvesting operations and post-harvesting operations through creation of awareness and sensitization on sericulture farming, frequent farmer training, provision of technical staffs in sericulture villages and making follow-ups of the farmers all the time when rearing is ongoing as this builds confidence and experience to the farmer to improve on the production of quality cocoon for marketing.

5.3 Recommendations

Quality production of silkworm cocoons needs to be combined with proper farm operations, harvesting operations and post-harvest operations. This therefore calls for training of technicians and farmers in the cottage industry in pre cocoon and post-harvest technologies. KALRO National Sericulture Research Centre Thika is involved in some of these trainings. However there is need for training extension workers/ officers especially in silkworm rearing, the backbone of sericulture.

High-quality silkworm varieties are adaptable to the Kenyan environment and it's a very important method when increasing cocoon yield, improving cocoon, and enhancing profits. The need for research institutions to embark more on silkworm hybridization hence high quality cocoon producing silkworm strains suitable for producing quality cocoon.

There is also significant potential for employment, e.g. off farm at every stage of the sericulture process. It's practical for income generation and has high potential to address food security needs and income.

5.4. Recommendations for a further research

The study aimed to investigate the determinants of Bombyx silkworm cocoon market at farm level in Chaaria sericulture village, Meru County in Kenya. This called for only sericulture farmers in Meru County and the qualities of the cocoon and raw silk grades which determines the pricing of cocoons in the market. Area of further study could consider other sericulture farmers in other counties in Kenya with the same climatic condition for silkworm rearing (warm and hot climate) and make comparison with Chaaria, Meru County sericulture farmers.

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Appendix 1: Cover Letter

The Center Director

National Sericulture Research Centre

P.O.BOX 7816 - 001000

Thika,

Dear Madam,

Ref: REQUEST ROR APPROVAL TO CONDUCT A RESEARCH

My name is Aurelia Kamanthe Nzyoki. Am a student at Gretsa University pursuing Bachelor Degree of Commerce, Marketing option. As a requirement for the achievement of the my degree, I hereby wish to conduct a research project on the **determinants of Bombyx silkworm cocoon market at farm level, Chaaria sericulture village, Meru County in Kenya**

I am requesting your help to assist in obtaining data for my study in one of your sericulture farming site i.e. Chaaria sericulture village in Meru County whereby sericulture villages is fully established and rearing has already been done. Your acceptance for my research work will be highly appreciated. All responses provided will be treated with utmost confidentiality and will only be used for the need of the study. Looking forward for your positive feedback.

Yours faithfully,

Aurelia K. Nzyoki

Appendix 2: List of silk market outlets in Kenya.

No.	Silk market outlets in Kenya
1	National Sericulture Research Centre, Thika
2	International Centre for Insect Physiology and Entomology(ICIPE)
3	Kakamega Forest Silk Market Center, in Kakamega
4	Pendeza Weavers, in Kisumu
5	Spin Weave, in Nairobi
6	Gramwa, in Kiambu
7	Mwingi Silk Market place, in Mwingi
8	Arabuko Sokoke Silk Market place, in Malindi
9	Molo Weavers, in Elburgon
10	Rivatex, in Eldoret (Perspective large scale buyer)
11	Kimahuri Youth group in Nyeri County
12	Sara Jane in Nairobi.

FAO Bulletins (2015)

Appendix 3 Cocoon Grading Table

Cocoon Grading Table										
[1] Grading of Cocoon Filament Length (m)										
Cocoon Filament	<890	891 to 960	961 to 1030	1031 to 1100	1101 to 1170	1171 to 1240	1241 to 1310	1311 to 1380	1381 to 1450	1451>
Points	38.0	38.5	39	39.5	40.0	40.5	41.0	41.5	42.0	42.5
[2] Grading of Cocoon Reelability Percentage										
Reelability %	<39	40 to 46	47 to 53	54 to 60	61 to 65	66 to 70	71 to 76	77 to 80	81 to 85	86>
Points	47	47.5	48	48.5	49	49.5	50	50.5	51	51.5

[3] Final Grade([1]+[2])					
Grade	Excellent	1st Grade	2nd Grade	3rd Grade	4th Grade
Total Points	>91.5	91 & 90.5	90.0 & 89.5 & 89.0	88.5 & 88.0	<87.5

Appendix 4: Raw Silk grading table

Grade		6A	5A	4A	3A	2A	1A	B
Standard Size Deviation	Denier	<	<	<	<	<	<	>
	18 Below	0.75	0.85	1	1.2	1.4	1.65	1.65
	19-23	0.95	1.1	1.3	1.55	1.8	2.15	2.15
	24-28	1.15	1.35	1.55	1.8	2.15	2.55	2.55
	29-33	1.25	1.45	1.7	2	2.35	2.8	2.8
	34-39	1.7o	2	2.3	2.6	3.1	3.65	3.65
	50 above	2.15	2.75	3.25	3.75	4.4	5.2	5.2
Maximum Deviation	Denier	<	<	<	<	<	<	>
	18 Below	2.3	2.6	3	3.6	4.2	5	5
	19-23	2.9	3.3	3.9	4.7	5.4	6.5	6.5
	24-28	3.5	4.1	4.7	5.4	6.5	7.7	7.7
	29-33	3.8	4.4	5.1	6	7.1	8.4	8.4
	34-39	5	6	7	8	9.5	11	11
	50 above	7	8.5	10	11.5	13	15.5	15.5
Neatness/Cleanliness		98>	97>	96>	95>	92>	88>	88<

Appendix 5. Questionnaire

The purpose of this research is to study the determinants of Bombyx silkworm cocoon market at farm level in Kenya. Please answer all questions to the best of your ability. There is no absolute desired answer. What matters is your individual opinion. The survey should take approximately 15 minutes. Please tick (✓) the extent to which you agree with each statement corresponding to your personal experience on one option for each statement. This study is strictly for academic research and confidentiality shall be observed

PART 1. Identification of the sericulture farmer

Q1. Answer the following questions about the farmer

Surname……………………..First name…..…………….Middle name…..……………….

Q2 Gender
- o   Male
- o   Female

Q3 Personal Id of the farmer. :……………………
a).County. ……………………
b).Sub County ………………
c).Name of the Sericulture village ……………

PART 2. Mulberry production during the reference period

Q1. Does the farmer have quality mulberry during the reference period?
- o   Yes
- o   No

Q2. What is the size of the mulberry farm?
- o   ¼ Acre
- o   ½ Acre
- o   1 Acre
- o   More than one Acre

Q3. Is the farmer able to produce enough mulberry?

- o Yes
- o No

Q4. What kind of irrigation does the farmer use?

- o Rain feed
- o Irrigation
- o Both

PART 3. The condition/ status of the rearing house

Q1. What are the building materials of the rearing house?

- o Timber
- o Bricks
- o Mud
- o Cement

Q2. Is the house sufficient enough to rear silkworms as a business?

- o Yes
- o No

Q3. How long has the famer been doing sericulture?

- o 0 - 1 year
- o 1-2 years
- o Above 2 years

Q4. Has the farmer been trained on importance of the rearing house?

- o Yes
- o No

PART 4. Cocoon harvesting / sorting

Q1.Has the farmer received trainings on cocoon harvesting / sorting

- o Yes
- o No

Q2. What is the average quantities the farmer gets from each season of rearing?

- o 0 – 10kg
- o 10 – 20kg
- o Above 20kg

PART 5. Cocoon packaging and transportation

Q1. Where are the cocoons packed after harvesting?

- o Cotton bags

- o Crates

- o Cartons

Q2. What is the most used means of transporting the cocoons?

- o Pick-up

- o Lorry

- o Cantor

PART.6 Cocoon marketing

Q1. Has the farmer been struggling with marketing his/her cocoons?

- o Yes

- o No

Q2. Has the farmer signed an agreement with the market (buyer?)

- o Yes

- o No

Q3. What is the convenient mode of payment for the cocoons?

- o Yes

- o No

Q4. Is the farmer happy with the price setting per kg of the cocoons?

- o Yes

- o No