



# **UNIVERSITY OF NAIROBI**

**SCHOOL OF COMPUTING AND INFORMATICS**

**MSc INFORMATION SYSTEMS**

**RESEARCH PROJECT**

***PROJECT TITLE***

**INFORMATION FRAMEWORK FOR SMALL SCALE TEA FARMERS USING CELLULAR TECHNOLOGY!**

**A CASE STUDY OF ICTs IN THE TEA INDUSTRY IN WESTERN REGION OF KENYA**

**BY**

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P/56/P/7388/2006**

**PROJECT SUPERVISER**

**THEURI P. M.**

**Submitted in partial fulfilment of the requirement of the Master of Science in Information Systems**

***August 2010***

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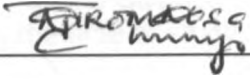
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### Declaration

I Omwoyo Jairo Maosa do declare that this research project as presented in this report is my Original work and to the best of my knowledge has not been presented for any University Award.

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This research project has been submitted as partial fulfilment of requirements for Masters in Information Systems of University of Nairobi with My approval as the University Supervisor:

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Date: 13/09/2010

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### Dedication

Special dedication is to:

My Almighty Father Lord the King who has granted me good life, strength and environment to work through this study and answering my prayer.

My wife Pamela for the encouragement and provision of a conducive environment during the study.

My children, Cynthia Moraa, Pauline Bosibori , Kencarlos Omaa, and Steve Omwoyo for their perseverance during the time of study.

My Supervisor Mr. Theuri for his tireless dedication and guidance he provided

My colleagues for the support accorded.

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### Acronyms and Abbreviations

APN	-	Access private Network
EATTA	-	East African Tea Trade Association
ICT	-	Information and Communication Technology
IPAR	-	Institute of Policy Analysis and Research
KTDA	-	Kenya Tea Development Authority
KTGA	-	Kenya Tea Growers Association
NAC	-	Network Access Controller
NTZDC	-	Nyayo Tea Zones Development Corporation
POS	-	Point of Sale
SMS	-	Short Message Service
TRFK	-	Tea Research Foundation of Kenya
VSAT	-	Very Small Aperture Terminal



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### Abstract

Kenya Tea Development Authority (KTDA) is a management agency for small scale farmers. It is responsible of the management of smallholder tea through provision of extension services, production inputs, green leaf collection, processing and marketing of processed tea on behalf of the smallholders. KTDA Ltd. currently manages 53 tea factories in the smallholder sub-sector serving over 400,000 growers.

It has been observed in many years that farmers complain of poor service especially in communication and information flow between farmers and factory management who are representatives of KTDA.

The purpose of this study is to Design ICT based communication architecture for tea delivery and processing of Payments using cellular technology.

The methodology of the study focuses on analyzing the system delivery of the KTDA and the impacts of the services on tea production. The method used to gather secondary and primary data was through document review, interviews, observation and questionnaires

The main finding of the study is that tea collection records are manually entered in farmers' cards and on tea buying clerk record book. There is no proper coordination of transport management especially during tea collection that leads to uncollected tea at tea buying centres.

The key contribution of the study was to design a framework to solve farmers' issues relating to the communication breakdown in the delivery and processing of tea products.

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### 1.0 INTRODUCTION

#### 1.1 Background

About 60% of the total tea in Kenya is produced by smallholder growers who process and market their crop through their own management agency, the Kenya Tea Development Authority (KTDA). The balance of 40% is produced by large scale estates which are managed by major multinational firms associated with tea in the world.

KTDA Ltd is the management agency of the smallholder tea growers, a state corporation, incorporated as a private company in June 2000. The agency is responsible for the management of smallholder tea through provision of extension services, production inputs, green leaf collection, processing and marketing of processed tea on behalf of the smallholders. KTDA Ltd. currently manages 53 tea factories in the smallholder sub-sector serving over 400,000 growers. Of these factories western part of Kenya has a total of ten factories

##### 1.1.1 Green Leaves Tea Collection.

Green leaf tea collection is done through designated tea buying centres put across the tea buying areas. Each farmer delivers his proceeds to a specific tea buying centre where the green leaves are then collected to the factory by the use of tracks specifically designed for the task.

##### 1.1.2 Payment Process

Payment to farmers is done on regular monthly basis and at the end of each financial year; Farmers are paid monthly although there is a delay of two months as from the time the green leaves are taken to the factory and the payment period. Farmers are also paid total proceeds from their tea less overhead costs annually. This payment is generally referred to as "tea bonus".

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### 1.1.2 Use of Cellular Technology in Rural Areas

Most of the rural poor currently use mobile phones mostly for Voice communication, but the visions for the poor to be able to access a wide range of useful data services will benefit from improved services.

Mobile technology has brought reprieve to the Agricultural industry especially on the introduction and implementation of SMS banking. However challenges still remain in Branch connectivity especially branches in remote areas whether either there is no wired technology or undeveloped wired technology.

Most banks in the country run centralized systems, however some of the banks have tried to introduce distributed processing but due to non availability of adequate links this has not been fully implemented. Of importance to note, Bank branches that are in remote locations do not have communication infrastructure to enable them to be online real-time.

### **1.2 Problem Definition**

Peasant farmers in the tea industry face a number of challenges in the dissemination of information. The following are the Identified problems:

- i. The manual process for recording tea proceeds in tea buying centers creates delay and causes errors of omission and / or commission.
- ii. Rigid processes that only allows a farmer to sell green leaves of tea in only one buying center.
- iii. Lack of transparence especially in recording of farmers proceeds. Farmers do not have a facility of checking the buying clerk's forwarded records verses their manual records in their disposal.
- iv. Inadequate information flow between farmers and KTDA. Farmers do not appear to understand and appreciate the costs of the services they receive from KTDA and how much the same services would cost if supplied from other providers.
- v. Inappropriate provision of services to farmers especially in payments, tea collection.

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- vi. Complaints over tea payments are due to lack of transparency on the part of the KTDA on the determinants of payments to farmers and the major causes for differences among factories. These include Labor cost, exchange rates during auction and marketing to mention a few.

### 1.3 Project Objective:

Design an ICT based communication architecture for tea delivery and processing of Payments using cellular technology.

Cellular technology through Mobile service providers has the potential of providing the infrastructure for online selling, payments and banking in Remote areas besides the provision of SMS banking. The study will come up with a framework of using mobile service providers to rural tea agricultural areas.

### 1.4 Related Questions and Hypothesis

#### 1.4.1 Hypothesis

There has been a decline in small scale tea farming that has been attributed to lack of proper delivery process in tea buying centres and lack of information dissemination and delayed payments to the farmers.

#### 1.4.2 Research Questions.

The study sought to answer the following three questions;

1. What communication challenges do Tea Farmers in Kenya face during delivery of Green tea leaves to factories?
2. How is the communication between farmers and KTDA Factory management done? How are farmer's problems solved by the KTDA Management?
3. What communication systems are used and how can they be improved?

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### 1.5 Problem Justification

Despite the remarkable growth in the tea industry compared to other sectors the development of the industry has experienced some drawbacks over the years. After the phenomenal growth in the decades to 1990, the successes in the development of the smallholder sub-sector began to slow down in the 1990s dropping tea yields far below those of the estate sector. The factors responsible for the stagnation are management of tea selling and payments in different factories and communication breakdown on factory activities among others. Factors that have affected the tea industry are as follows:

- i. Previously farmers used to be paid through mobile payment centres at designate areas on specific times. If the farmer failed to collect their monthly tea earnings then these amount used to be returned to the KTDA headquarters, follow-up for such payments used to delay for at least three months. This is not currently acceptable.
- ii. The calculation on farmer's tea proceeds is usually calculated manually through cards provided to each farmer every month. This is usually not only inaccurate but is also prone to abuse.
- iii. Information to farmers is communicated to farmers through tea buying clerks at buying centres. This is not only inefficient but also delays information flow.
- iv. The mode of processing Farmers payment is mostly manual. Payroll Data is processed at the factory but sent to headquarters for further processing and dispatch of payments.
- v. Farmers sometimes do not get information on the pay date and at times farmers continue checking at their factories. Causing unnecessary assignments hence reducing national development.
- vi. Currently most farmers are paid through small farmers SACCOS at the rural areas. The farmer is not able to access the cash except by visiting the SACCOs and during banking hours only.

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### CHAPTER 2 Literature Review

#### 2.0 Introduction

This chapter discusses on the previous work done on Provision of service delivery on Agricultural industry. The chapter is divided into three sections, Section One discusses on ICTs in the Agricultural Industry, Section Two discusses on existing models and section three discusses on tea industry in Kenya.

#### 2.1 ICTs in the Agricultural Industry

A number of researches have been done on the Area of wireless technology:

- i. Institute of Policy Analysis and Research (IPAR) authored by *H. Nyangito and J. Kimura* made a publication titled Provision of Agricultural Services in a Liberalised Economy: The Case of the Smallholder Tea Sub-Sector in Kenya.

This paper analyses the provision of services to smallholder tea farmers under liberalisation, performance of the organisations involved and impacts on tea production. A new institutional economics framework whereby focus is on market co-ordination, exchange processes and transaction costs involved in provision of services is used. The extent to which these systems have developed and their impacts on smallholder tea production is not yet clear.

- ii. Howard Rheingol researched on Farmers, Phones and Markets: Mobile Technology in Rural Development the following issues Were researched on: What would a small-scale farmer in Africa, Peru or India want with a mobile phone or a Wi-Fi kiosk? Market information. Timely knowledge about who is buying agricultural produce, what the buyers are willing to pay and where they are located.
- iii. Australian communications and media authority sponsored by Australian government produced a paper on Telecommunications Today. The paper discusses on technology and farming attitudes to take up and use. This study has three main objectives:
  1. To identify the levels of take-up and use of various telecommunications services by the farming sector.
  2. To explore consumer attitudes in the farming sector to voice and data services.
  3. To ascertain how location, farming sector and farm size influence consumer take-up and use of telecommunications services.

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This paper focuses on the internet usage as the preferred technology.

- iv. The paper on Technology for Small-scale Economic Activities to Address the Basic Needs of Low-income Populations from the internet discusses on the need for technological changes in the Food and Agriculture Organization, Basic production, rural industry, Farming systems and Food handling and processing sectors.

The paper also highlights on the future issues of technology that deals with technological education that will help the farmers to provide better produce.

- v. An article on adoption of ICT in agricultural management in the United Kingdom on use and rural Management University of Plymouth United Kingdom has researched on ICTs in rural context ranging from Enterprise management information systems through personal computers and internet technologies to new processes such as e-commerce and e-government.

The paper highlights on the role of ICTs coupled with its complexity for its diffusion processes.

- vi. Knip and S. Kafka published an item detailing using technology of data collection and data processing in precision farming. The document highlights on data collection and Data presentation and Data application in the system imprecision farming. This is to create a suitable environment not only for data collection but also for high quality distribution of information to customers. The paper provides an internet based solution which demonstrates improved effectiveness of forestry and agriculture. The wireless information solution is based on university of Minesotta map Server open source development environment.
- vii. Use of Point of Sale Systems is largely used in supermarkets and banks to offer credit based transactions. However very little research has been done on how to use the equipments for data capture and information processing in the agricultural sector.

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- viii. *The Economic Journal*, Vol. 84, No. 335 (Sep., 1974), pp. 491-542  
doi:10.2307/2231038 Talks about the choice of technology and techniques, Econometric estimates, appropriate technology, and capital utilization.

The introduction of mobile technology will ensure that the rural poor benefits from access to financial services, enabled through mobile phone operators into the reform of financial services will accelerate the introduction of electronic services to the rural poor. Mobile technology offers means of accessing information through Voice and Text.

The advent of the Internet has revolutionized the way the financial services industry conducts business, empowering organizations with new business models and new ways to offer 24x7 accessibility to their customers.

The ability to offer financial transactions online has also created new players in the financial services industry, such as online banks, online brokers and wealth managers who offer personalized services, although such players still account for a tiny percentage of the industry.

With mobile technology, banks can offer a wide range of services to their customers such as doing funds transfer while travelling, receiving online updates of stock price or even performing stock trading while being stuck in traffic.

A wide spectrum of Mobile/branchless banking models is evolving. These models are Bank-focused model, Bank-led model and Non-bank-led model.

### 2.1.2 Challenges for a Mobile Banking Solution

#### **2.1.2.1 Interoperability**

There is a lack of common technology standards for mobile banking. Many protocols are being used for mobile banking – HTML, WAP, SOAP, XML to name a few

#### **2.1.2.2 Security**

Security of financial transaction, being executed from some remote location and transmission of financial information over the air, are the most complicated challenges that need to be addressed jointly by mobile application developers, wireless network service providers and the bank's IT department.



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### 2.2 Existing tea processing Models

Research in the information flow process in the tea industry has been done in various countries. To note in many models is that farmers do not get enough information on the market trend as well as feedback from factories.

Among the existing models in my literature review are Japan, Bangladesh and Sir Lanka. The current information flow is as follows:

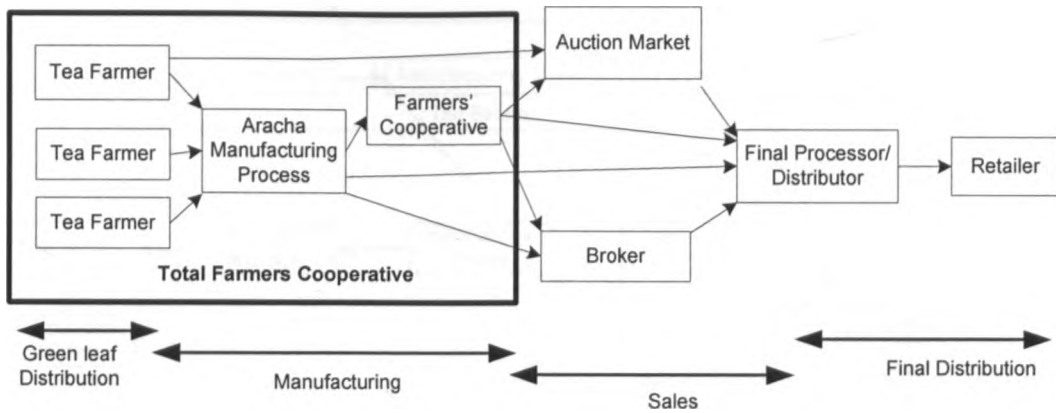
#### 2.2.1 Japan

- i. This model was developed to investigate the structure of value chain in the tea industry and associated problems in developing countries.
- ii. Tea industry in Japan is harvested four times in a year.
- iii. The value chain of Japanese tea industry begins from tea farmer and tea processing plant. It belongs to a group of farmers who runs the business with cooperative farming system.
- iv. Farmers pluck green leaves depending on the capacity of the processing plants on a specific day. This is determined by designated managers.
- v. The manufacturing plants processes green leaves and the agent keeps in touch with the processing plant to fix the price and rank the quality of the processed tea.
- vi. The agents keep in contact with the processing companies / distributors and also the cooperative farming association who sells the tea.
- vii. The distributor does further processing then grade them and finally sell them to retailers
- viii. Communication medium is internet based.

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Figure 1 Japan Tea Processing Model

SHIZUOKA PREFECTURE TEA MARKET VALUE CHAIN

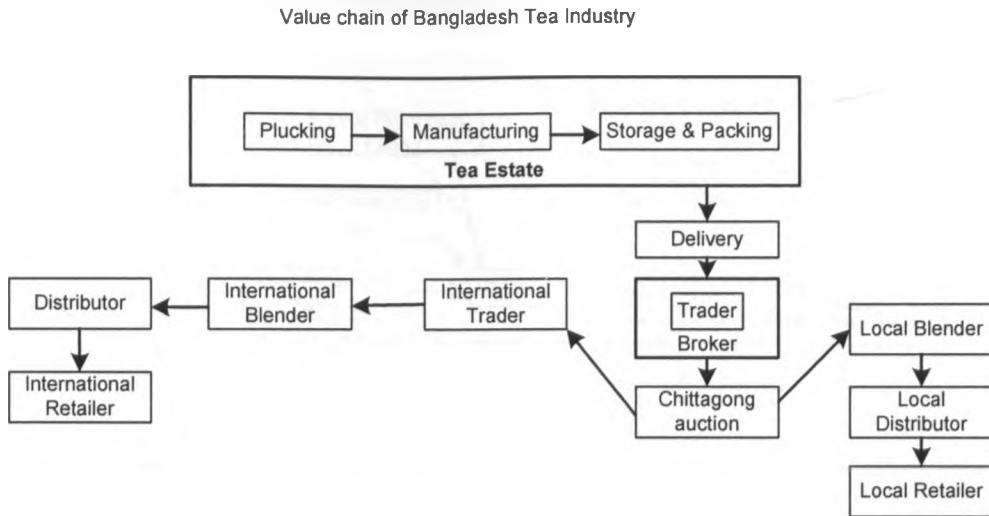


2.2.2 Bangladesh

- i. Tea industry in Bangladesh is concentrated on tea estates than farmers cooperative mechanism
- ii. Most tea Estates have tea manufacturing plants, therefore each tea Estate is involved in the process of plucking tea leaves up to the delivery of product to broker's premises .
- iii. After bulk packaging on premises of the tea estate black tea is sent to broker's warehouse. The delivery and partial storage cost off the broker's warehouse is carried by the individual tea estate.
- iv. There is no cooperative farming in Bangladesh which is quite opposite of Japanese industry. The cooperative manufacturing systems helps to share the leaf production risk among farmers; currently each company takes all risks.
- v. Bangladesh black tea is sold through auction market by open bidding.
- vi. There is no information on the communication channel in the current model however internet based model has been proposed.

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Figure 2 Bangladesh tea Processing model



Strategic Value chain Modification in Bangladesh.

- i. Proposal has been given to Bangladesh farmers to have strategic cooperative alliances among the tea Estates as depicted in the model below.
- ii. The central leaf manufacturing facility will have a buying place equipped with quality measurement device.
- iii. The proposed model uses a common leaf processing facility established by strategic cooperative alliance farms. This will reduce the cost of having multiple factories.

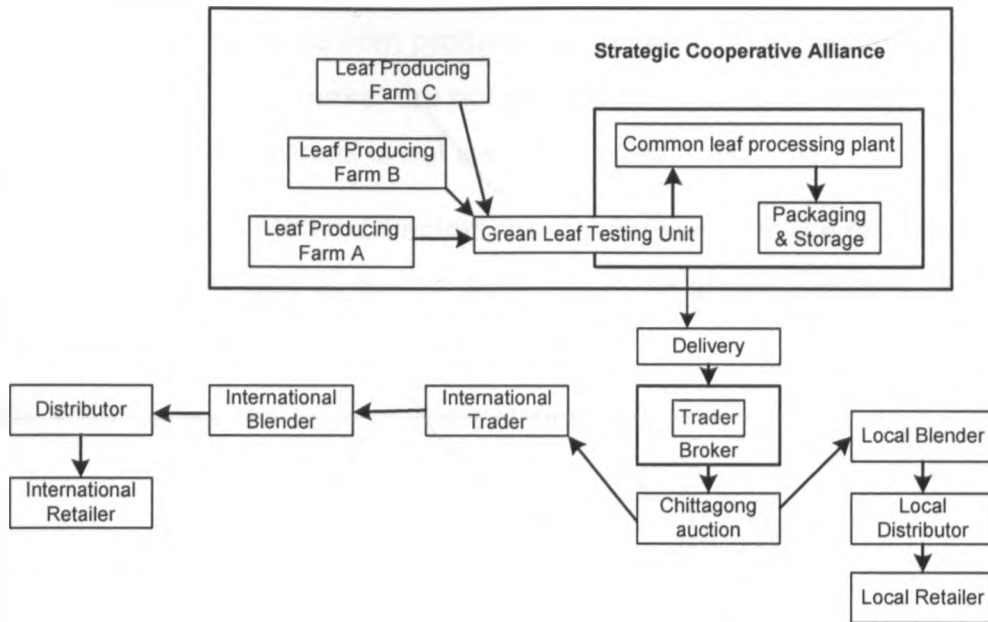
Proposed Model is as below:

Figure 2.3 Bangladesh tea Processing Model - Modified

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Modified Strategic Value chain in Bangladesh

**Figure 3 Bangladesh tea Processing Model - Modified**



**2.2.3 Sri Lanka**

Sri Lanka is one of the major producers of tea in the world.

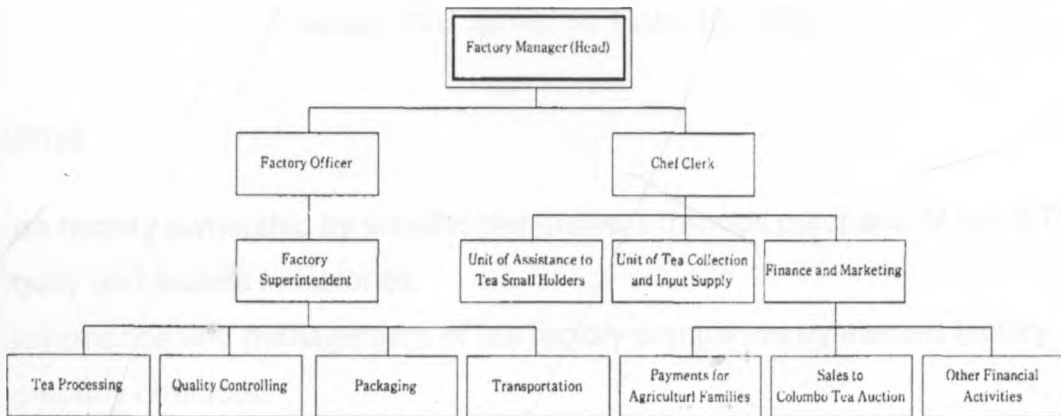
- i. Sri Lanka is the leading tea exporter in the world market and mainly produces and Exports bulk tea
- ii. The country has about 210,000 smallholdings of less than 20 ha with an additional 30,000 with the average size of the units being 0.4 ha or a little less than one acre
- iii. They account for 44% of the total area, with the remaining tea lands coming under the control of 404 large estates managed by the state and the privatized companies.
- iv. Farmers supply tea to the factories on weekly basis throughout the year. The farmers have societies.
- v. The smallholder only grows, whereas the estate sector both grows and manufactures. In other words, the main difference between the two is that the former ends up with a raw material or an intermediate product (green leaf),

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while the latter's activity culminates in an end product (made tea) that is ready for sale as a beverage for human consumption.

- vi. Quite often, the gains from productivity and profitability which arise in processing for the market are not passed on to the smallholder. Thus the communication channel is not well developed.
- vii. The Sir Lanka's Model, Directors are not chosen from the farmers but people with fast knowledge of modern business in the global economy as well as the country's agriculture. The model is as below:

**Figure 4 Sir Lanka tea organisation structure**



**Organizational Structure of the Small Industry.**

Source : Field Survey, Sri Lanka, Mar 2001.

Market security has been created by purchasing of unlimited amount of green leaves from its members leading to income securities for farmers, income increase and income stabilization.

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Figure 5 Tea Processing and payment Model



Mechanism of Rural Development through Small Industries

Source : Field Survey, Sri Lanka, May 2001.

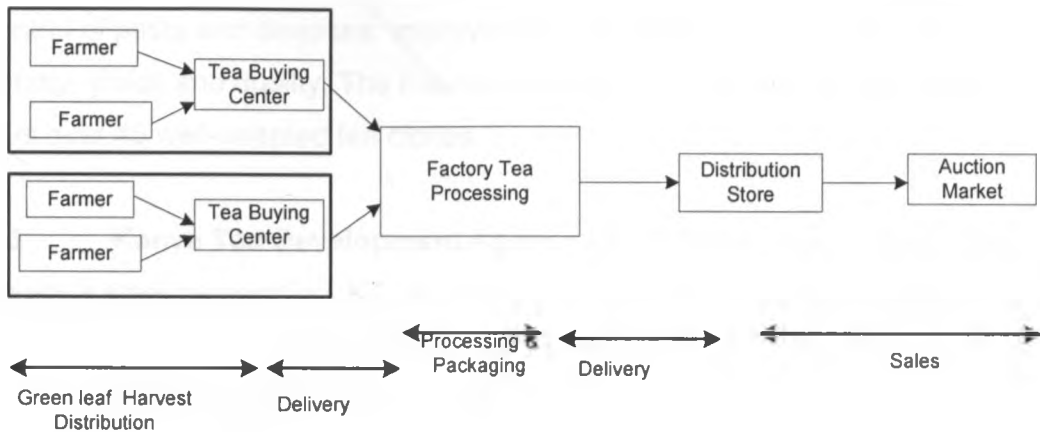
2.2.4 Kenya

- i. Tea factory ownership by smallholder growers through purchase of any KTDA equity and shares in factories;
- ii. Governance and management of tea factory companies by elected factory company directors;
- iii. Redefinition of KTDA's role as a management agent for tea collection and processing but also with control over marketing of made tea.
- iv. The problem with the KTDA system is that there is poor co-ordination and supervision between farmers and the factory company Boards of Directors on one hand, and the KTDA Board on the other hand in the delivery of services to farmers.
- v. There is uneven information distribution regarding tea marketing, earnings and transfer of ownership of tea between farmers and the KTDA Board.
- vi. The KTDA has superiority in access to market information way beyond its fair bargaining power with farmers. Furthermore, there is no farmer friendly agreement between the farmers and the KTDA with regard to final payments which are considered to take far too long before they reach farmers. This has created conflicts of interest between the factory directors and the KTDA directors to the disadvantage of farmers.

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vii. KTDA involvement and transparency on auction prices, marketing charges including brokerage fees to factory directors is not there therefore brings the existing mistrust between KTDA and farmers.

**Figure 6 Existing Model in Kenya**



**2.3 Tea Industry in Kenya**

**2.3.1 Key Institutions and Their Role in the Tea Industry**

Jacinta N Kinyilli has written a paper on Diagnostic of tea industry in Kenya, the paper indicates that there are a number of institutions involved in different activities within the tea industry. This include, Government, Tea Board of Kenya, Tea Research foundation, KTDA, Kenya Teas Growers association, Nyayo tea Zones, East African Tea Trade Association (EATTA to name a few. Below is a brief description:

**2.3.1.1 The Tea Board of Kenya, [www.teaboard.or.ke](http://www.teaboard.or.ke)**

The Tea Board of Kenya was established in 1950 under the Tea Act (Cap 343) of the laws of Kenya. It is mandated to regulate the tea industry in all aspects of tea growing, research, manufacture, trade and promotion in both the local and the international markets. The Board also disseminates information relating to tea and advises the Government on all policy matters regarding the tea industry through the Ministry of Agriculture.

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**2.3.1.2 Tea Research Foundation of Kenya (TRFK),**  
**[www.tearesearchkenya.org](http://www.tearesearchkenya.org)**

Located in the lush green tea carpet of Kericho, TRFK is the technical arm of the Tea Board of Kenya. It is mandated to carry out research on tea and advise growers on the control of pests and diseases, improvement of planting material, general husbandry, yields and quality. The Foundation has so far developed and released to growers over 45 well-adapted tea clones.

**2.3.1.3 Kenya Tea Development Agency Ltd (KTDA), [www.ktdateas.com](http://www.ktdateas.com)**

Previously a state corporation, KTDA was incorporated as a private company in June 2000. KTDA Ltd is the management agency of the smallholder tea growers. The agency is responsible for the management of smallholder tea through provision of extension services, production inputs, green leaf collection, processing and marketing of processed tea on behalf of the smallholders. KTDA Ltd. currently manages 56 tea factories in the smallholder sub-sector serving over 400,000 growers.

**2.3.1.4 Kenya Tea Growers Association (KTGA),**

KTGA is an association of large-scale tea producers established to promote the common interests of the members in the cultivation and manufacture of tea and to promote good industrial relations and sound wage policies for the workers. The plantation/estate sub-sector maintains 39 tea factories.

**2.3.1.5 Nyayo Tea Zones Development Corporation (NTZDC)**

This is a State Corporation established to manage the tea belts around the forest zones planted to create buffer zones meant to protect the natural forests from human encroachment.

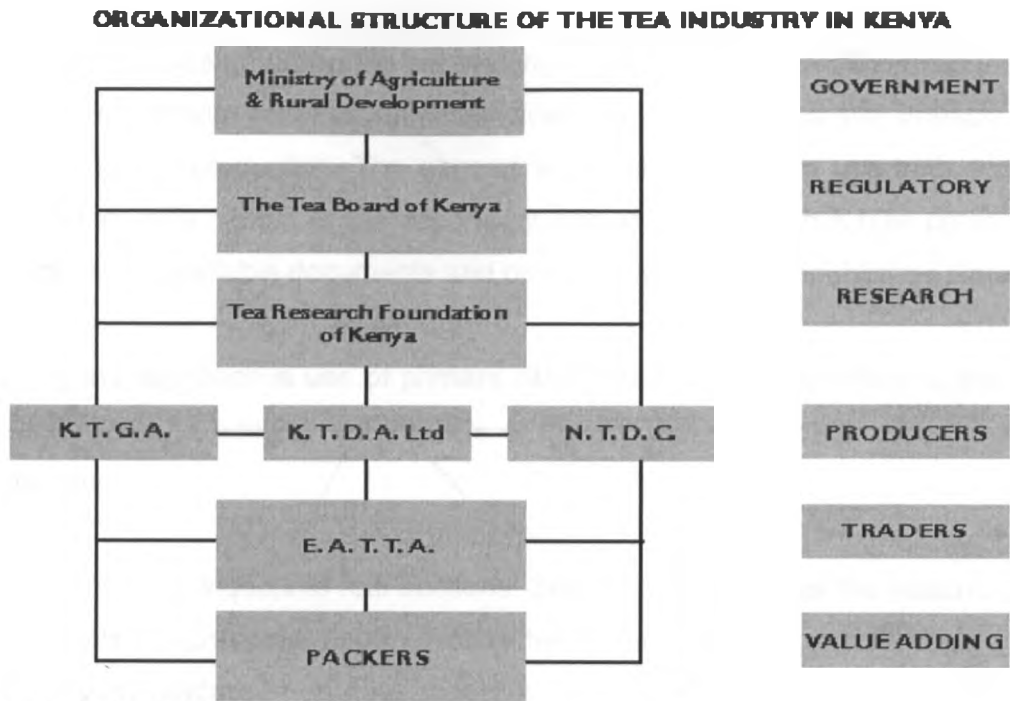
**2.3.1.6 East African Tea Trade Association (EATTA), [www.eatta.co.ke](http://www.eatta.co.ke)**

This is an association of tea producers, brokers buyers and packers and is the auspices under which the Mombasa Tea Auction is conducted.



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**Figure 7 organisation structure of tea industry in Kenya**



Source: Tea Board of Kenya

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### CHAPTER 3 RESEARCH METHODOLOGY

#### 3.0 Introduction

This study focuses on analyzing the system delivery of the KTDA; the main institution involved is offering services to smallholder tea farmers, and the impacts of the services on tea production. The general approach taken is to use both secondary and primary data. Most of the secondary data is dealing with KTDA processes, is collected from available documents and other published and unpublished literature.

The second approach is use of primary data gotten from observation, questionnaire and interviews to analyze the impacts of the KTDA.s information dissemination on tea farming.

This chapter is divided into four sections. Section one discusses the research design and sampling techniques used, Section two will discuss on overall strategy used, Section three discusses on data collection techniques and fourth section deals with administration of the research data.

#### 3.1 Research Design

In this study, an empirical study involves collecting information from a larger number of cases, using questionnaires, interviews and observation and document review. This is described as a survey research design.

In this research the documentation will report how samples were chosen, what response rates were achieved and to comment on the validity and reliability of any instruments used.

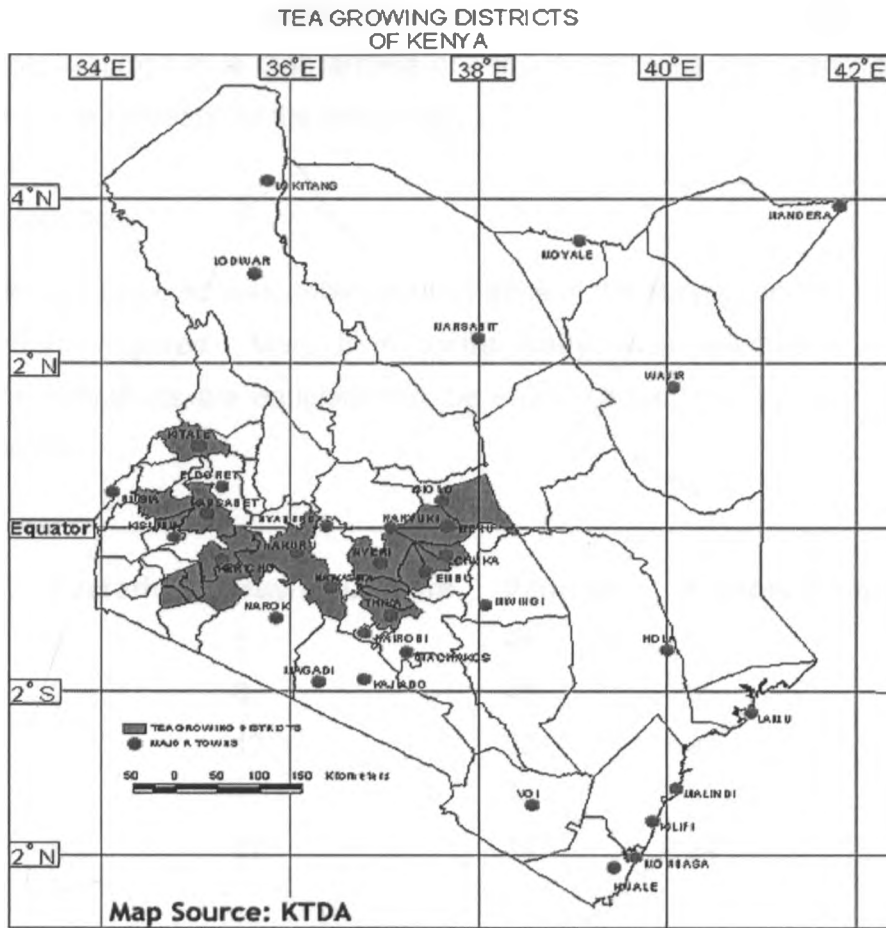
#### 3.2 Population Spread

Tea is mainly grown in high altitude areas with adequate rainfall throughout the year. In Kenya tea is grown in part of Rift Valley, upper Nyanza, Central and part of Eastern provinces mainly in Meru region. Factory distribution is as follows: Central Kenya 26, Nyanza 9, Eastern 11, Rift valley 8 and Western one.

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For the project purpose, data was collected mainly from famers and factories in Kisii, Gucha and Nyamira Districts in Nyanza Province. Data was also collected from two factories from Meru eastern Province for data comparison.

**Figure 8 Tea Growing Districts Of Kenya**



**3.3 Sampling techniques**

The targets of sampling study are tea Farmers and KTDA factory management staff especially the ICT, Field Service coordinator and Factory Production manager. Sampling technologies used are.

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Clustered sampling was used for choosing of Factories due to the spread and regionalization of factories within western Kenya region. The clusters were done according to districts where tea is grown, Due to geographical representation Nyanza was chosen as the area of study.

Stratified sampling used for choosing of Tea Buying Centers ensures that the sample is evenly spread within the factory area of jurisdiction.

Random sampling used to choose farmers so as provide an unbiased selection method. The assumption is that farmers of various attributes are evenly distributed and will be a true reflection of the entire population.

### 3.4 Sample Size

The sample size selected was determined by aims of the survey, degree of precision and the efforts required. Meru from central Kenya was selected to investigate whether the operations are equivalent in the entire Kenya. They can be depicted in the table below:

District	Factories	Buying Centers	Farmers	Factory Management
Meru	2	8	48	6
Kisii	2	8	48	6
Nyamira	3	12	72	9
Gucha	1	4	24	3
<b>Total</b>	<b>8</b>	<b>32</b>	<b>192</b>	<b>24</b>

### 3.5 Data collection techniques

#### 3.5.1 Questionnaires

Questionnaires were used because of the diversified geographical area of study and difficult access. This helped the organisation/ farmer to take time to fill it during their free times and also provide information from a large geographical Area.

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Data was collected using a structured questionnaire administered by enumerators. Questionnaires have been selected to be the main data collection techniques due to the following:

- i. The responses are gathered in a standardized way therefore are more objective.
- ii. Questionnaires are very cost effective when compared to face-to-face interviews. Especially when involving large sample sizes and large geographic areas.
- iii. Questionnaires are easy to analyze. Data entry and tabulation for nearly all surveys can be easily done with many computer software packages.
- iv. Reduce bias. There is uniform question presentation and no middle-man bias. There are no verbal or visual clues to influence the respondent
- v. Generally it is relatively quick to collect information using a questionnaire.

Two sets of Questionnaires were used in this project.

### 3.4.1.1 Farmers Questionnaire

The questionnaire (Appendix 2) targets tea farmers; the questionnaire captures the following details

- i. Farmer
- ii. Tea Buying centre information
- iii. Communication
- iv. Communication channels
- v. Payment

### 3.4.1.2 Factory Questionnaire

This questionnaire (Appendix 3) targets factory management especially the ICT officer and leaf base managers. This was distributed to all factories targeted for this research. Information gathered is in the following category:

- i. General information

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- ii. Receiving of tea leaves from farmers
- iii. Processing of tea
- iv. ICT systems on board

### 3.5.2 Interviews

Interviews and observation were done by the researcher. The researcher booked appointments with the factory management. The interviews took a maximum of one hour.

Initial interview done was at KTDA Headquarters where the researcher interacted with one system administrator and network administrator. This provided an in-depth understanding of current infrastructural design.

A stratified sampling procedure was used to select farmers for interview. First, all the factories in each district were selected. Secondly, buying centers belonging to a particular factory were randomly selected. Finally, at each buying centre six farmers were interviewed using systematic sampling.

Formal and informal interviews were done with ICT managers of various factories. This provided an in-depth understanding and details of required information for coming up with the model.

### 3.5.3 Observation

The researcher did direct observation to get in-depth knowledge on the performance of some of the tea buying centers especially on the recording process for the farmers.

### 3.5.4 Document Review

Document review was done by the researcher. This was used to confirm the documented processes and work instructions.

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Documents that required for review included recordings done at buying center, receiving of tea at factory, factory to warehouse and payment of farmer's documentation. This helped in the design of an optimized communication process.

### 3.6 Administration of Data collection techniques

Questionnaires were distributed to various target groups through enumerators. They were accompanied by a letter of introduction from the University of Nairobi (Appendix 5) that was explaining the objective and purpose of the study.

#### 3.6.1 Piloting of questionnaire administration.

A researcher did piloting of the questionnaires before full rollout to ensure authenticity and correctness. This was done in stages as follows:

- i. Supervisor review to ensure that the questionnaire meets the objectives.
- ii. Five colleagues reviewed to check for consistence and grammatical mistakes.
- iii. Selected farmers at Matongo and Nyansiongo tea buying centers to ensure that the content is what was required and whether there are any omissions.
- iv. Nyansiongo tea Factory field service manager and System Administrator to review as iii. Above.

#### 3.6.2 Factory Management questionnaire

This questionnaire targeted factory management and at each selected tea factory, at least three questionnaires were hand delivered. The target groups were, Factory Manager, Field services coordinator and ICT System Administrators.

#### 3.6.3 Farmers Questionnaire

The questionnaire targeted small scale farmers. The questionnaires were delivered to various tea buying centres where they were administered. Farmers were chosen at a random basis and requested to fill the questionnaire. Enumerators provided

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assistance to farmers whenever required. Each questionnaire took approximately 20 minutes to complete.

**3.7 Analysis of Collected Data**

Data was mainly collected through questionnaires however observation and interviews were used to get more details that were not able to be collected by questionnaire.

Collected questionnaires were assembled in a central place and were entered to the computer system. This were entered by the use of EPI data software and also analysed by the use of SPSS software.

Other method used to supplement the above method is use of Microsoft Excel for tabulation of various graphs. Bar charts, pie charts and narration were used in the analysis to compare various options.

**3.8 Data Analysis and Interpretation**

3.8.1 Background Information

This focuses on the current setup, observation, assessment and analysis of farmers' responses from buying centres and Tea factories.

175 out of 197 questionnaires which represent 89 % of all questionnaires distributed were received back from 8 factories, 32 tea buying centres. All the questionnaires received were fully completed by respondents. This was received as follows:

<b>District</b>	<b>Factories</b>	<b>Buying Centers</b>	<b>Farmers</b>	<b>Factory Management</b>
Meru	2	4	24	6
Kisii	2	8	48	4
Nyamira	3	12	72	5
Gucha	1	4	24	0
<b>Total</b>	<b>8</b>	<b>32</b>	<b>160</b>	<b>15</b>

Response

The results are presented based on the percentage of respondents and the order of presentation was that used in the questionnaire as below:



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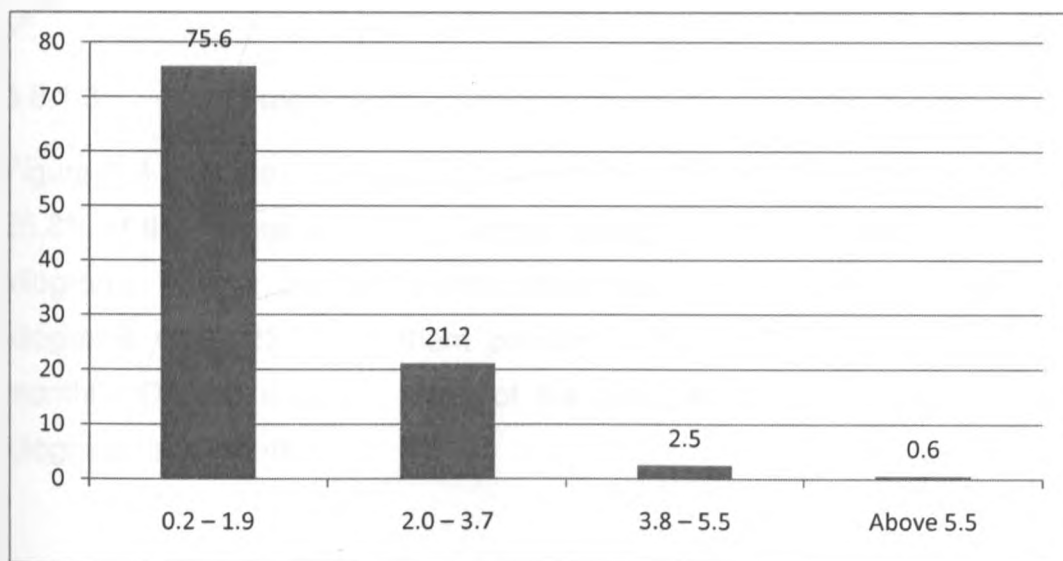
**Table 1- 3.1: Distribution of Respondents from selected Factories**

Factories	Frequency	Percent
Tombe	22	13.9
Kionyo	6	2.5
Imenti	21	13.3
Nyansiongo	24	15.2
Nyamache/Itumbe/ Ogembo	25	15.8
Nyankoba	14	8.9
Kibirigo	24	15.2
Kiamokama	24	15.2
Total	160	100

**3.8.1.1 Acres of land under tea plantation**

Figure 3.1 presents the area of land (in acres) under tea plantation. Approximately, 75.6% of the respondents showed that they have planted tea in about 0.2 to 1.9 acres of their land. On the other hand, 21.2% of the respondents indicated that roughly 2.0 to 3.7 acres of their land is under tea cultivation. Moreover, just about 0.6% of the respondents have tilled tea in over 5.5 acres of land.

**Figure 9 Acres of land under tea plantation**



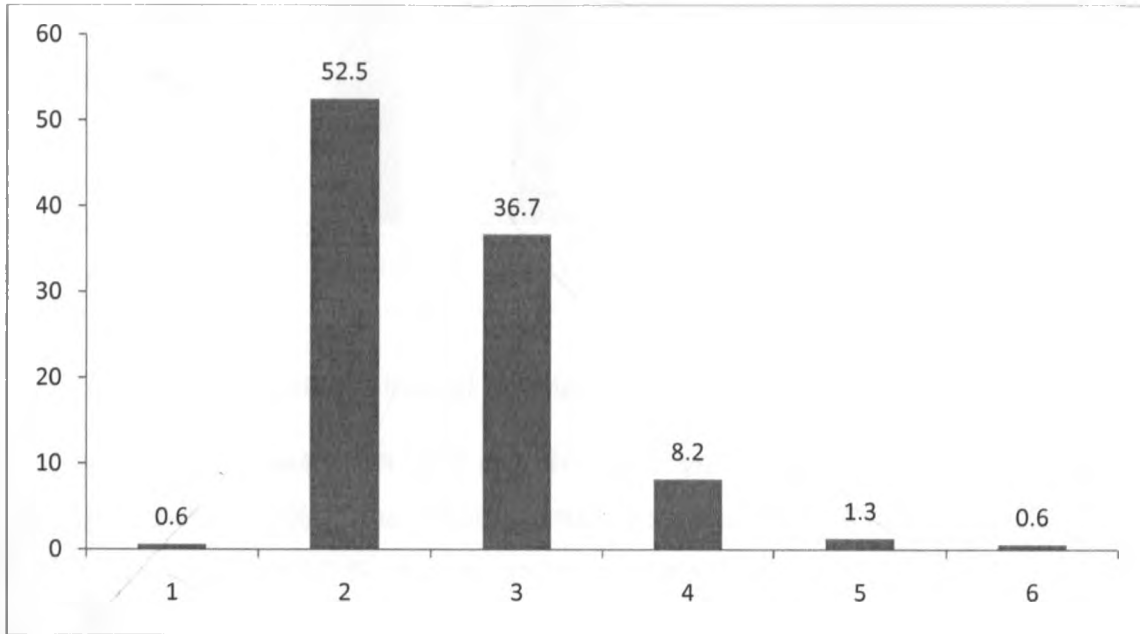
**3.8.1.2 Number of tea harvests in a month**

The number of times tea is harvested in a month is given in table 3.2 above. Slightly above half of the respondents (52.5%) harvest tea twice in a month while 36.7% of

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them reap tea three times within the same duration. Alternatively, 8.2% of the respondents harvest tea approximately four times in one month whereas 0.6% of the respondents gather tea either once or six times in a span of one month respectively.

**Figure 10 Number of tea harvests in a month**

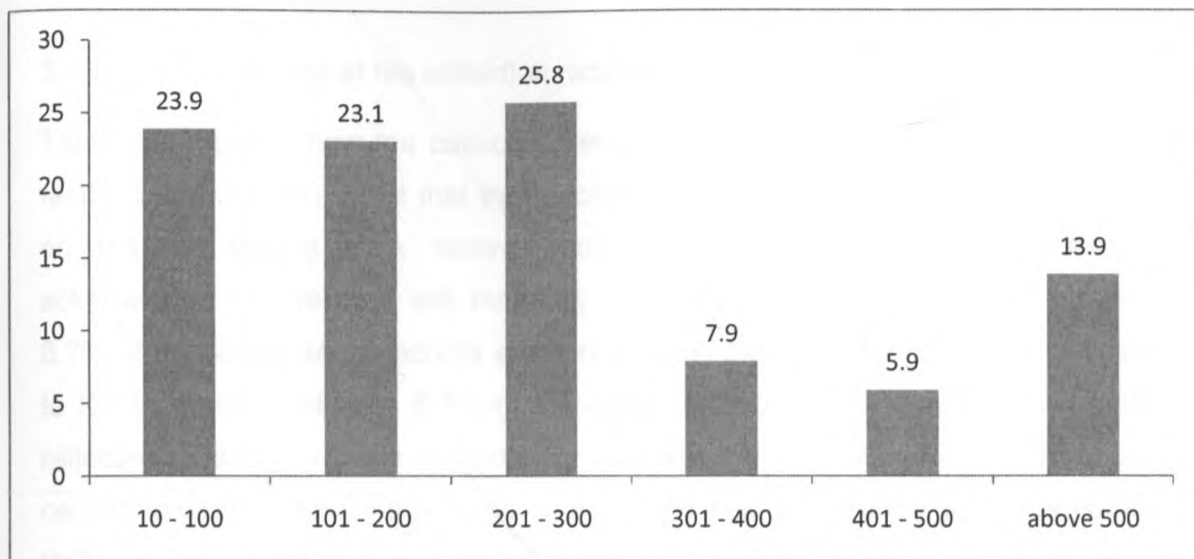


**3.8.1.3 Average weight in (kilograms) of harvested tea in a month**

Figure 3.3 indicates the average weight of harvested tea per month. According to 25.8% of the respondents, the average weight per month lies between 201 and 300 kilograms. Further, almost 24.0% of the respondents harvest an average of 10 -100 kilograms while 23.1% of them produce between 101 and 200 kilograms of tea monthly. On the contrary, 5.9% of the respondents produce about 401 and 500 kilograms in a month.

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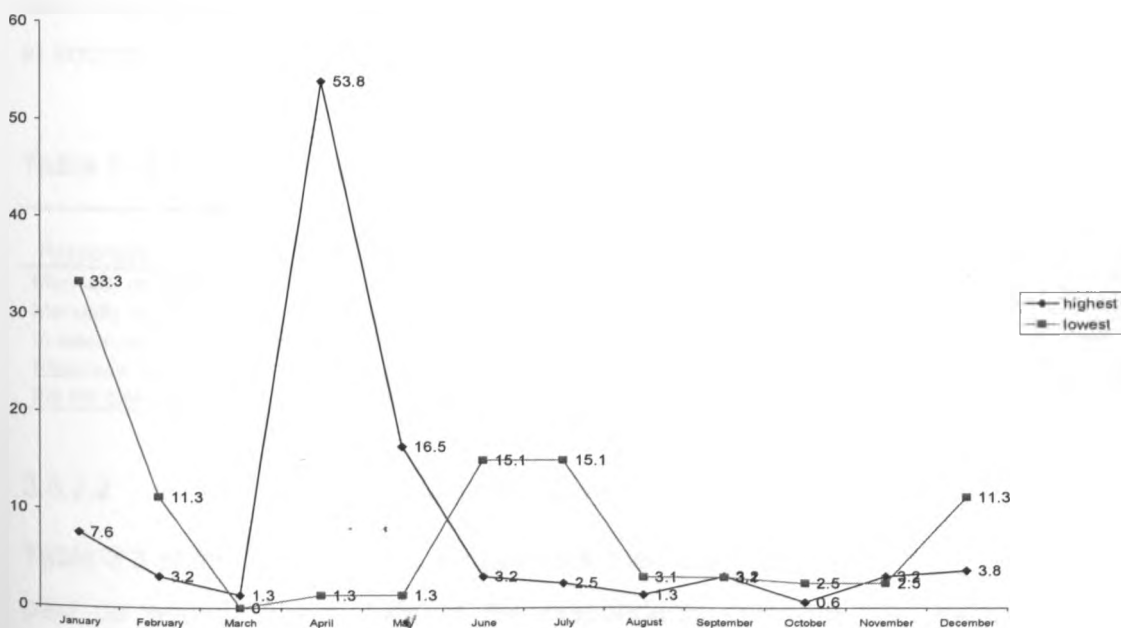
Figure 11 Average weights (kilograms) of harvested tea in a month



3.8.1.4 Highest and lowest tea yields in the year

The highest and lowest tea yield months in the year is illustrated in figure 3.4. Approximately 53.8% of the respondents agree that there is always a boom in tea yield in April while 33.3 % of them are of the opinion that January is when tea yields are lowest.

Figure 12 Highest and lowest tea yields in the year



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**3.8.2 Record keeping**

**3.8.2.1 Keeping of tea collection records**

Table 3.2 explains how tea collection records are kept. Over three quarters of the respondents (85.2%) admit that the records are manually recorded in card and also on the tea buying clerk record book. Similarly, 43.0% of the respondents acknowledge that records are manually recorded in farmer’s card only. However, 8.7% of the respondents records are converted in electronic format and downloaded to KTDA systems while in 8.1% of the cases, the electronic format on real time is reflected to factory servers immediately as the tea clerk captures it from tea buying centre however proper interviewed showed that this is uploaded once tea is being delivered in the factory, therefore batch processing.

The acquisition of monthly summary either from the tea buying clerk or the factory indicates that 81.5% of the respondents get their monthly summary from the tea buying clerk or the factory.

Notably, in all the factories (100.0%) recording is done manually and immediately entered in the computer. Alternatively, in 13.3% of the cases, daily tea received from each buying centre is recorded manually. However, no record is entered in computer at source.

**Table 2- 3.2: Keeping of tea collection records**

Responses	Frequency	Percent
Manually recorded in farmer’s card only	64	43.0
Manually recorded in card and also on tea buying clerk record book	127	85.2
In electronic format and downloaded to KTDA systems	13	8.7
Electronic format on real time reflected to factory servers immediately as the tea clerk captures from tea buying centre	12	8.1

**3.8.2.2 Cross checking monthly delivery weights verses the paid up weight**

Table 3.3 shows how farmers cross check their monthly delivery weights verses the paid up weight. About, 54% of the respondents compare their monthly delivery

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weights with the paid up weights only through the tea buying clerk whereas 25.3% of them indicated that they have their own manual recording done mainly via documentation from tea buying clerk. On the other hand, 20.3% of the respondents make this comparison in weights through factory records.

**Table 3- 3.3: Cross checking monthly delivery weights verses the paid up weight**

	Frequency	Percent
Only through tea buying clerk	32	20.3
Through the factory records	85	53.8
I have my own manual recording through documentation from tea buying clerk	40	25.3
It is not possible to confirm	1	0.6
Total	158	100

The manner in which monthly cumulative weights are kept indicates that manual payment slips are used by 52.9% of the respondents even as 37.6% of them prefer using cards manually. Conversely, 2.5% of the respondents use factory records whereas 7% of them make use of tea buying clerk records.

All the factories acknowledge that they certainly compare total weights as recorded by the tea buying clerk against factory records. Further, three – quarters of the respondents (71.5%) pointed out that the average difference in weight varied between 5 and 10 kilograms. Conversely, in 28.6% of the cases, the average variation in weight exceeded 10 kilograms.

The excess/deficit daily weight is handled when calculating payment as 69.2% of the respondents indicate that, if there is a deficit, the tea buying clerk is surcharged on the deficit difference. On the other hand, 23.1% of the respondents either use the buying centre weight or the end product weight respectively.

### 3.8.3 Tea Buying Centre Information

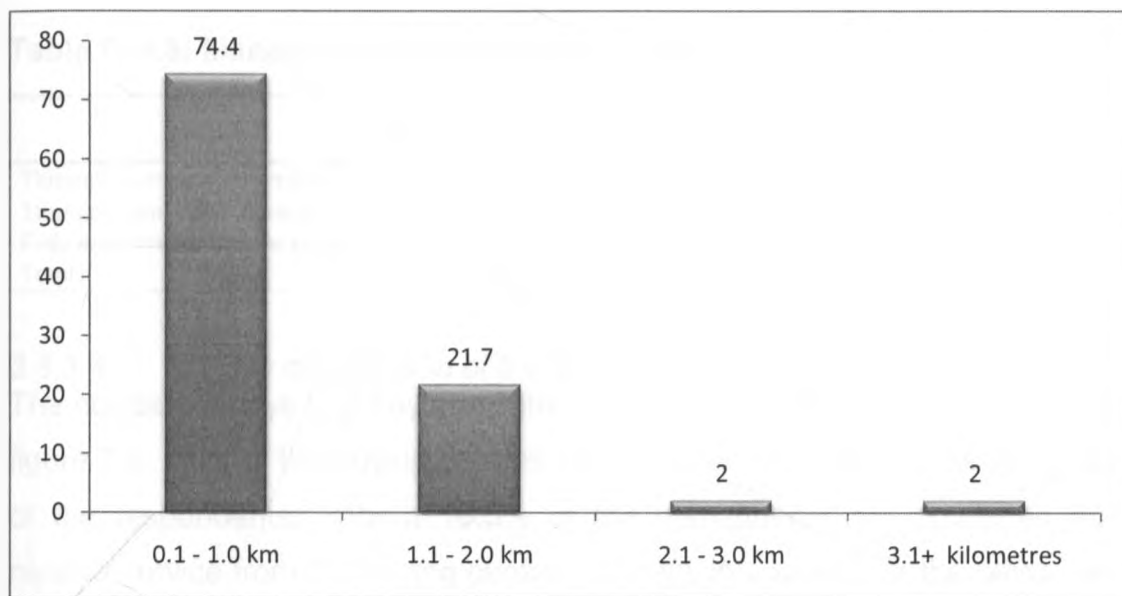
#### *3.8.3.1 Distance of the tea buying centre from the farm*

The study required respondents to indicate how far the tea buying centre is from their farm. About 74% of the respondents have to travel for a distance of between 0.1 to

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said the nearest tea buying centre was in the range of 1.1 to 2.0 kilometres from their farms. However, 2.0% of the respondents have to travel a distance of between 2.1 and 3 kilometres while others are forced to travel for a distance of more than 3 kilometres to reach a buying centre respectively.

**Figure 13 Distance of the tea buying centre from the farm**



**Table 4- 3.4: Tea Acreage, average weight and distance from buying centre.**

Farmers Information					
	N	Minimum	Maximum	Mean	Std. Deviation
Acres planted tea	155	0.2	12.5	1.235	1.3158
Average weight of harvest	152	1	1,800	288.11	247.850
Distance to Tea Buying centers	151	0.1	12.0	1.003	1.1616

There is no correlation on the acreage and distance of buying centre. However there is a higher deviation on average weight that has been attributed to dissemination of information to farmers.

**3.8.3.2. Ownership of tea buying centre**

Ownership of buying centres shows that nearly 90.0% of the respondents acknowledge that the buying centres are owned by farmers who are members of the tea buying centre. However, 10.1% of the respondents the tea buying centre is owned by Kenya Tea Development Authority (KTDA). Nonetheless, none of the tea buying centres is owned by an individual member.

**3.8.3.3 Management of tea buying centre**

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Table 3.5 shows how tea buying centres are managed. Nearly all of the respondents (94.3%) tea buying centre(s) is managed through nominated members done by farmers. On the contrary, 3.8% of the respondents run their centres by way of nomination done by KTDA. In 1.9% of the respondents' cases, the management comprises of fully employed managers by farmers.

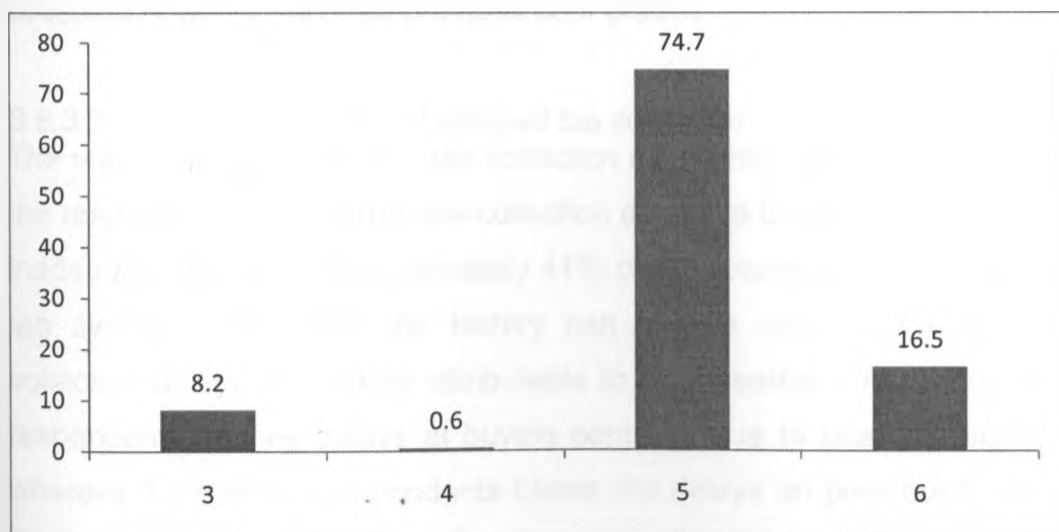
**Table 5- 3.5: Management of tea buying centre**

	Frequency	Percent
Through nominated members done by farmers	149	94.3
Through nomination done by KTDA	6	3.8
Fully employed manager by farmers	3	1.9
Total	158	100

**3.8.3.4 Days of operation of the buying centre per week**

The number of days that buying centres are open per week for operation is shown in figure 7.5. Most of the buying centres are open five days a week as stated by 74.7% of the respondents. About 16.5% of the respondents are privileged enough to receive service from the buying centres six days in a week. On the other hand, 8.2% of the respondents enjoy such services at least three times per week as 0.6% of the respondents said their buying centres are in operation for up to four days each week.

**Figure 14 Days of operation of the buying centre per week**



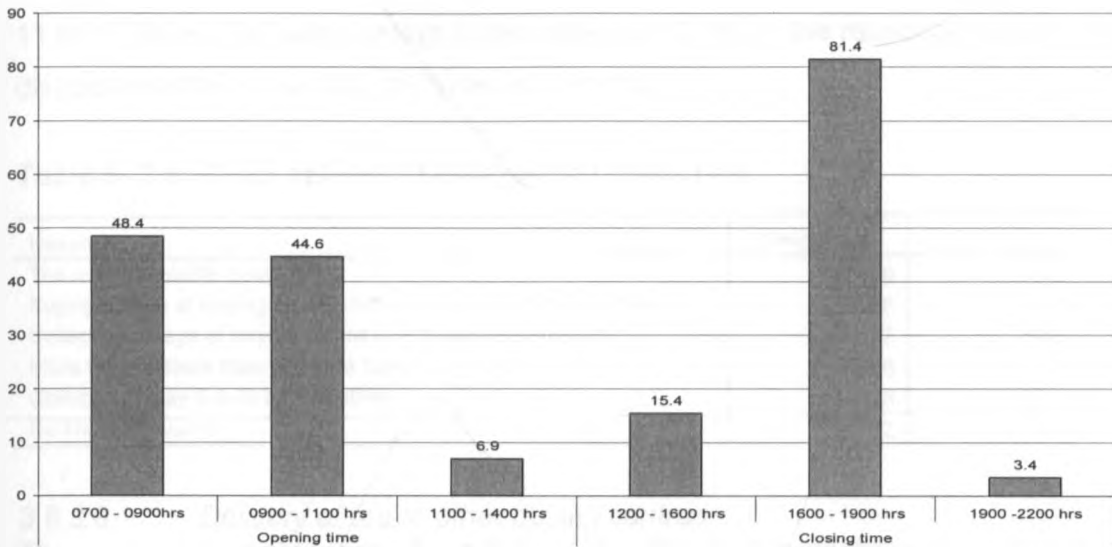
**3.8.3.5 Hours of operation in tea buying centres**

The hours of operation in tea buying centres are illustrated in figure 3.6 below. Most of the tea buying centres operate from 0700hrs to 1100hrs and close between 1600

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hrs and 1900 hrs.

**Figure 15 Hours of operation in tea buying centres**



**3.8.3.6 Longest observed period of uncollected tea**

When tea is left at the tea buying centre for long, it loses its quality. The longest observed duration that tea is not collected on time per month is overnight as indicated by 42% of respondents. On average, 29.3% of the respondents stated that the longest period that tea has remained uncollected is for one day. About 17.2% of the respondents have experienced delays for up to two days. Further, 1.3% of the respondents indicated that they had to wait for over two days before their tea was collected however such tea provides poor grades.

**3.8.3.7 Major causes of delayed tea collection**

The major causes of delay in tea collection are highlighted in table 3.6. About 82% of the respondents believe that the collection delays at buying centres are as a result of inadequate transport. Approximately 41% of the respondents feel that there is more tea available than what the factory can receive while 52.4% of them feel that collection delays are mainly attributable to bad weather. According to 20% of the respondents, buying delays at buying centre is due to unavailability of tea clerk(s) whereas 6.3% of the respondents blame the delays on poor quality of tea which is definitely rejected.

Respondents were asked the number of times tea has is not collected per month. Nearly 85.0% of the respondents agree that in a month, tea is not collected about 1



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Nearly 85.0% of the respondents agree that in a month, tea is not collected about 1 to 5 times. On average, 8% of the respondents' tea has remained uncollected for up to 6 to 10 times. However, 4% of them have been left stranded with their tea about 11 to 15 times. Following delays in tea collection, 2.8% of the respondents have been disappointed for more than 15 times in a month.

**Table 6- 3.6: Major causes of delayed tea collection**

Responses	Frequency	Percent
Tea not acceptable quality	9	6.3
Buying delays at buying centre due to unavailability of tea clerk	28	19.6
Collection delays at buying centre due to lack of transport	117	81.8
More tea available than what the factory can take	58	40.6
Collection delay due to bad weather	75	52.4
No known reasons	2	1.4

### 3.8.3.8 *Delivery of tea to other buying centres*

The percentage distribution of tea delivery to other buying centres shows that almost 60.0% of the respondents are not allowed to deliver their tea to other buying centres other than the one they are registered in. Table 3.7 explains why farmers are not allowed to deliver their tea in other tea buying centres. Buying clerks only recognize registered regular members according to 67.1% of the respondents. Similarly, 24.7% of the respondents stated that they do not have accounts with other buying centres as 2.4% of them confirm that since delivery is made together with ones monthly card, the buying centre will not accept tea from a farmer who does not possess a specific registered number. Approximately 1.2% of the respondents argue that tea buying clerks are different in all the available buying centres; buying clerks are not punctual and the fact that there are transportation problems respectively. Moreover, 2.4% of the respondents feel that the laid down procedure is tedious and time consuming.

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**Table 7- 3.7: Reasons for non – delivery in other buying centres**

Responses	Frequency	Percent
Buying clerks recognize specific regular members	57	67.1
Delivery is done together with your monthly card whereby the buying centre number is indicated	2	2.4
I am not a registered member/I have no account	21	24.7
Tea buying clerks are different in all the available buying centres	1	1.2
Transportation problems	1	1.2
The laid down procedure is tedious and time consuming	2	2.4
Clerks do not keep time	1	1.2

### 3.8.3.9 Ratings on Type of Services at the stations

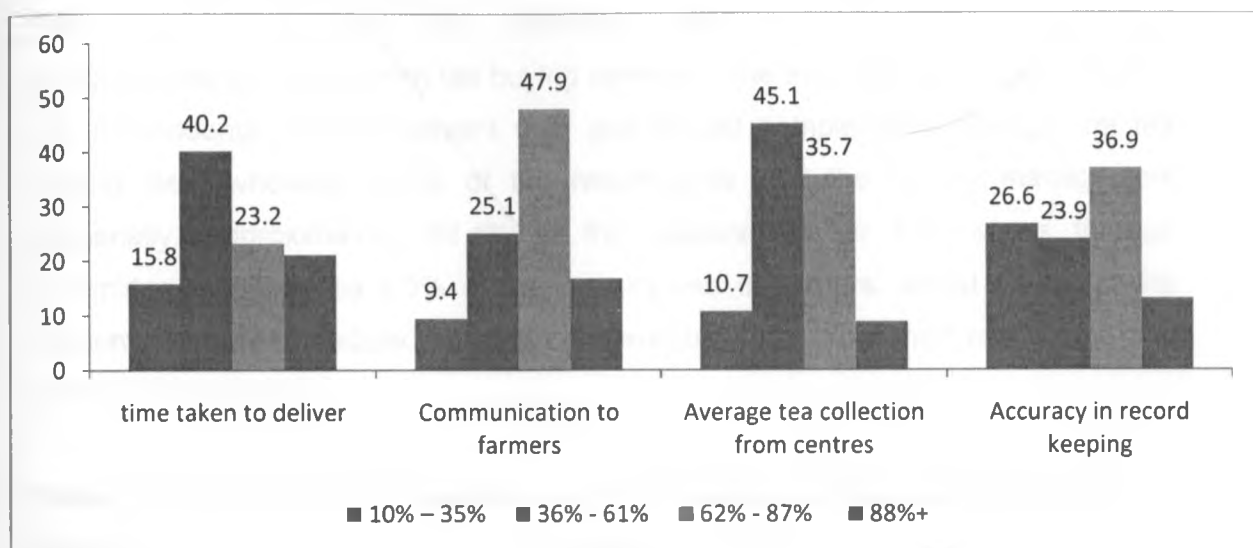
Ratings regarding the time taken to deliver at tea buying stations are provided in figure 3.7. About 40.2% of the respondents have the opinion that the time taken to deliver is not good enough whereas 23.2% of them believe the services are satisfactory. Additionally, 21.1% of the respondents are very happy with the service they are receiving while 15.8% of them differ with this view.

Nearly half of the respondents (47.9%) feel that the overall performance on communication to farmers is okay as 9.4% of them are very dissatisfied with how communication to farmers has been conducted in the past. About 25.1% feel that the channels of communication are average while 16.7% of them believe that the tea buying stations are doing a very good job in the aspect of communication to farmers.

The average tea collection from centres is not satisfactory according to 10.7 % of the respondents. On the contrary, 45.1% of the respondents are satisfied with the current structure of operation while 8.8% of them are very satisfied with the system. The accuracy in record keeping is above average as indicated by 36.9% of the respondents. Additionally, 23.9% of the respondents are happy with the accuracy in the records as approximately 26.6% of them believe the records are not very accurate.

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**Figure 16 Ratings on type of services at the buying stations**



**3.8.4 Communications**

**3.8.4.1 Dissemination of information between farmers and the factory management**

Dissemination of information between farmers and the factory management is presented in table 3.8. About 89% of the respondents communicate through committee members while 78.6% of them get information through the buying clerk. Posters are used by 53.5% of the respondents as 30.8% of the respondents get in touch by word of mouth or through barazas respectively. On the contrary, 27.7% of the respondents visit the factory management in order to get any relevant information while 5.7% of them rely on the radio. Cell phones (mobile phones) are used by about 10.7% of the respondents.

**Table 8- 3.8: Information flow between farmers and the factory management**

Responses	Frequency	percent
Through the buying clerk	125	78.6
Through posters	85	53.5
Through committee members	141	88.7
Members to visit factory management	44	27.7
Radio	9	5.7
Cell phones (mobile phones)	17	10.7
Word of mouth	49	30.8
Baraza	49	30.8
No defined method	1	0.6

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### 3.8.4.2 *Channel for complements/complains to the management from tea buying centres*

Table 3.9 illustrates the channels used by farmers to present complements/complains from tea buying centres to the management. Notably half of the respondents (50.0%) present their grievances/ complements through the tea buying clerk whereas 43.0% of the respondents visit the factory management personally. Approximately, 92.4% of the respondents air their views through committee members as 2.5% of them make use of posters. About 42.4% of the respondents use scheduled meetings an avenue for making their complaints and complements alike.

**Table 9- 3.9: Management Compliments/complains from tea buying centres**

Responses	Frequency	percent
Tea buying clerk	79	50.0
Posters	4	2.5
Through committee members	146	92.4
Members to visit factory management	68	43.0
Through scheduled meetings	67	42.4
No defined method	5	3.2

### 3.8.4.3 *Rate of communication to KTDA management regarding tea collection issues*

The rate at which farmers communicate to KTDA management on tea collection issues is that 56.0% o the respondents stated that they often communicate to the management on tea collection issues usually when issues arise while 32.1% of them communicate about the same issues when holding meetings. Discussions with tea buying clerks at tea buying centres are held by 11.9% of the respondents.

### 3.8.4.4 *Time taken in responding to farmers' complaints*

Table 3.10 shows how long the management takes in responding to farmers' complaints. In about 54% of the respondents, the response comes within one day and a week. However, 25.5% of the respondents admitted that the management rarely gets back to them and when they do it usually is after a very long time. On the contrary, 11.7% of the respondents stated that the management reacts to their grievances within two weeks to one month. However, 2.1% of the respondents believe that it takes about 3 months and 6 to 7 months before the management responds correspondingly. In 1.4% of the respondents this takes up to one year.

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**Table 10- 3.10: Time taken in responding to farmers' complaints**

Response	Frequency	Percent
One day – one week	78	53.8
Rarely/long time	37	25.5
Two weeks to one month	17	11.7
6 – 7 months	3	2.1
2 months	5	3.4
3 months	3	2.1
Yearly	2	1.4
<b>Total</b>	<b>145</b>	<b>100</b>

**3.8.4.5 Meetings in tea buying centres**

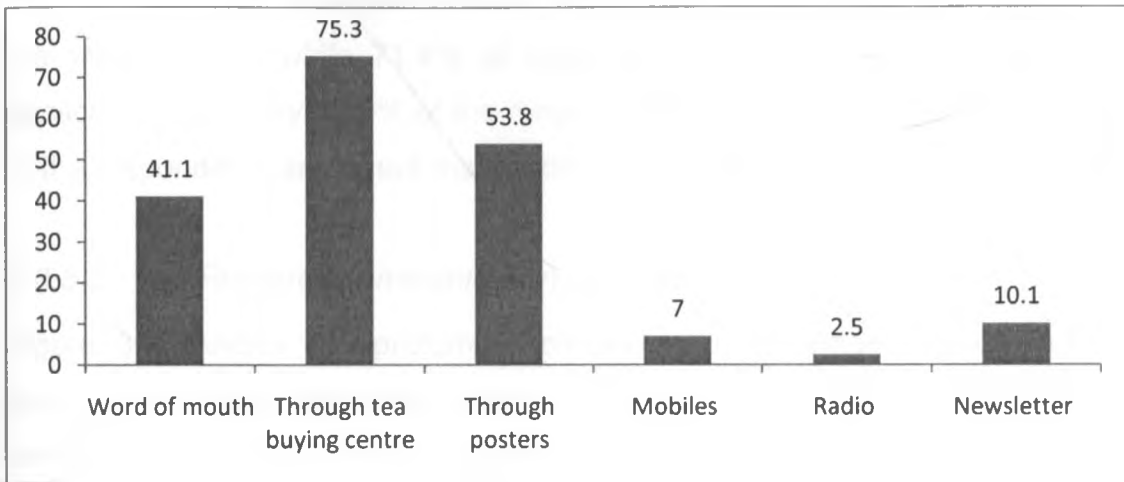
About 38.2% of the respondents indicated that meetings are held on a monthly basis with 17.8% of them holding yearly meetings usually during annual general meetings (AGM) or during elections. Approximately 13.2% of the respondents hold quarterly meetings while 11.2% of the respondents organise meetings after every 2 to 3 months. In 6.6% of the respondents, meetings in the tea buying centres are held semi- annually as 1.3% of them have weekly meetings. Similarly, 10.5% of the respondents call for meetings immediately when need arises.

**3.8.4.6 Main communication channels used for calling meetings**

The main channels of communication used for calling meetings are presented in figure 3.8. Approximately 75% of the respondents use tea buying centres to call for meetings while 53.8% of them use posters. In 41.1% of the respondents, word of mouth is most effective as 7.0% of them prefer mobiles. The radio is used by 2.5% of the respondents.

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**Figure 17 Main communication channels used for calling meetings**

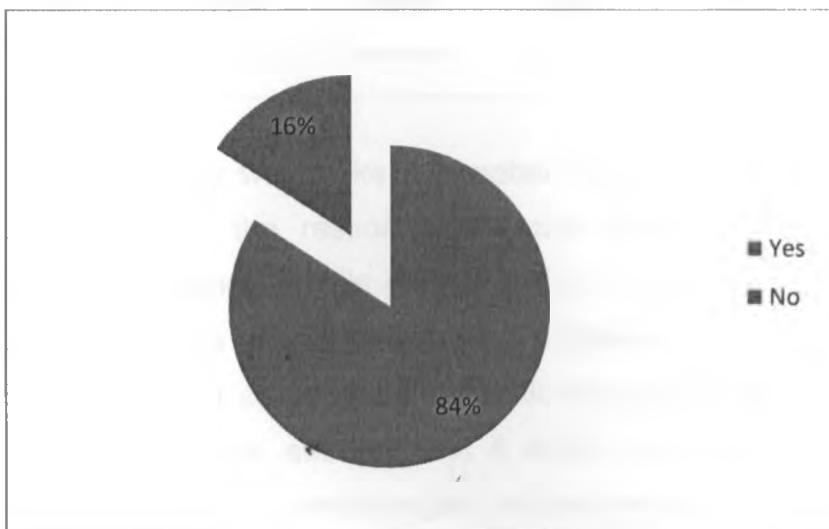


**3.8.5 Communication Channels Available**

**3.8.5.1 Ownership of mobile phones**

Figure 3.9 illustrates the ownership of mobile phones. Apparently, 84.2% of the respondents own mobile phones. This clearly shows that the majority of the respondents have access to the cellular technology. The respondents were asked to show what service provider(s) they have subscribed to. Generally, 82.5% of the respondents are Safaricom subscribers with 51.8% of them indicating connectivity to the Zain network. Telkom/Orange and YU networks have a following in 3.6% and 1.5% of the respondents respectively.

**Figure 18 Ownership of mobile phones**



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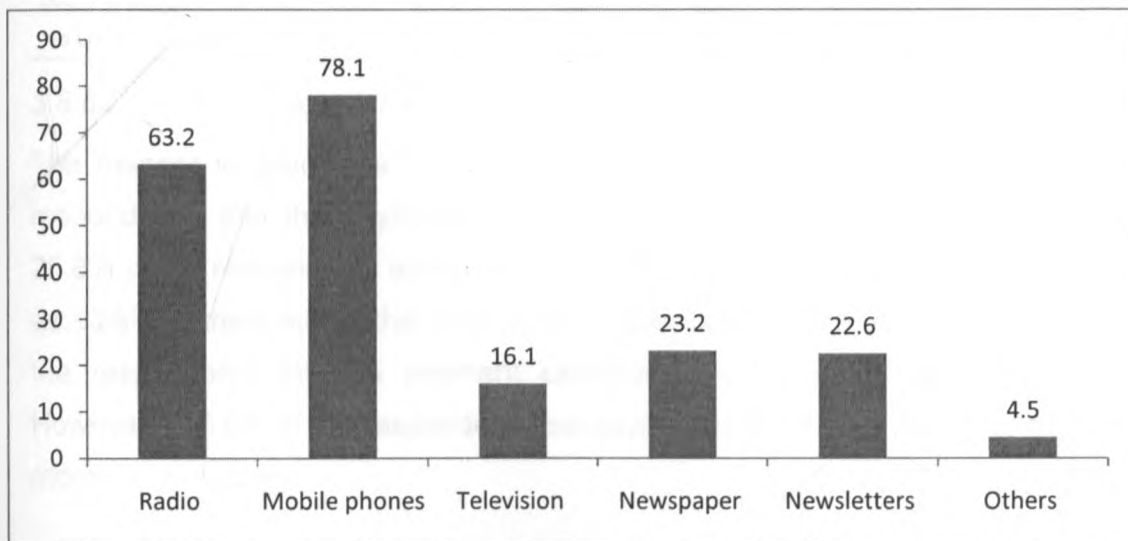
**3.8.5.2 Phone services in use**

The services used in mobile phones are shows that 83.5% of the respondents use the voice service while 71.4% of them use the SMS. On the other hand, data services are used by 12.0% of the respondents. The study further finds out that 60% of the respondents are aware that mobile phone can be used for data transmission.

**3.8.5.3 Preferred communication channels**

Figure 3.10 shows the preferred communication channels. About 78.1% of the respondents mostly use mobile phones while 63.2% of them prefer the radio. On the contrary, about 23.0% of the respondents would use the newspaper and newsletters anytime respectively. Television is the best choice according to 16.1% of the respondents.

**Figure 19 Preferred communication channels**



When asked how they would like information regarding tea delivery dispatched to them, about 61% of the respondents would prefer notifications through short messages (SMS) to their mobile phones while 31.4% would love to get the same information through the radio. Posters are a preference to 62.0% of the respondents as 24% of them would appreciate the traditional way; by word of mouth. However, 4.7% of the respondents affirmed that it does not matter how they are get the information, provided the information gets to them anyway.

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### 3.8.6 Payment Systems

#### 3.8.6.1 *Information on Tea Payment Schedules*

Table 3.11 shows how information concerning tea payment schedules is obtained. In 81.7% of the respondents, this is done through the tea buying clerk. Approximately 60.1% of the respondents are informed of tea payment schedules through the factory as 37.9% of them learn of the same through other farmers. The electronic media and mobile phones are used as communication tools by 1.3% and 10.1% of the respondents respectively. Similarly, 29.1% of the respondents get knowledge of tea payment schedules by word of mouth.

**Table 11- 3.11: Information on Tea Payment Schedules**

Responses	Frequency	Percent
Through tea buying clerk	129	81.7
Through other farmers	60	37.9
Through factory	95	60.1
Through electronic media	2	1.3
Through mobile phone	16	10.1
Word of mouth	46	29.1
No specific media	2	1.3

#### 3.8.6.2 *Tea payment schedule*

The manner in which tea payments are scheduled is indicated by 38.4% of the respondents, that the payments are made every month end. On the other hand, 25.8% of the respondents acknowledge that the monthly schedule is sent to farmers as 13.8% of them stated that they have no specific schedule. According to 17.0% of the respondents the tea payment calendar is indicated in the payment slips. However, in 5.0% of the respondents tea payment is done on a particular date of the month.

#### 3.8.6.3 *Knowledge about exact payment dates*

Table 3.12 indicates how farmers know of exact payment dates in the event that tea payments are not scheduled. Seven in every ten of the respondents (73.9%) learn of the payments through the tea buying clerk while 12.7% of them get news on exact payment dates through visits to the factory. About 19.0% of the respondents stated that the exact payment dates are indicated in the payment slips even as 7.7% of them know of such arrangements through newsletters. Mobiles become



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instrumental when passing such sensitive information according to 1.4% of the respondents.

**Table 12- 3.12: Knowledge about exact payment dates**

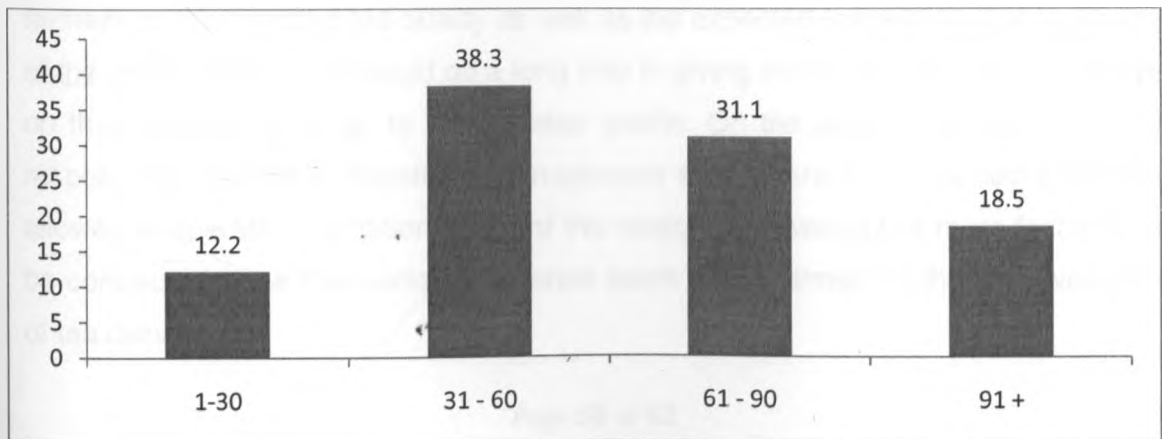
Responses	Frequency	Percent
Through visiting the factory	18	12.7
Through tea buying clerk	105	73.9
Indicated in the payment slips	27	19.0
Through newsletter	11	7.7
Through mobile	2	1.4
Not specific	13	9.2

Dissemination of information on bonus payment rates shows that 55% of the respondents are informed during annual meetings, 34.8% of them through buying clerks and 18.4% of the respondents find out through factory newsletters. Almost 22.0% of the respondents have no definite way of communication as 3.2% of the respondents get knowledge of bonus payment rates through mobiles.

**3.8.6.4 Level of satisfaction on delivery and payment of tea**

Figure 3.11 illustrates the level of satisfaction derived on the delivery and payment of tea. One third of the respondents (31.1%) are satisfied to a large extent with the services they receive on scheduled delivery and payment of tea. On the contrary, 12.2% of the respondents expressed their dissatisfaction of the services delivered. However, 18.5% of the respondents are pleased with the current level of service delivery.

**Figure 20 Level of Satisfaction on Delivery and Payment of Tea**



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### 3.8.7 Recommendations on Improvement of Service delivery

#### 3.8.7.1 *Delivery of tea to buying centres*

Recommendations on the delivery of tea to buying centres include the need for improved infrastructure as stated by 67.1% of the respondents and use of electronic weighing machines according to 11.4% of the respondents. Similarly, 57.1% of the respondents would like farmers to transport their tea in time before it dries up mainly because withering causes the tea to lose its quality. About 42.9% of the respondents would like KTDA to provide more forms of transportation like Lorries from buying centres. Similarly, 38.6% of the respondents recommend employment of more buying clerks per buying centre.

**Table 13- 3.13: Delivery of Tea to Buying Centres**

Response	Frequency	Percent
Farmers to transport their tea in time before it dries up	40	57.1
KTDA to provide more forms of transportation from buying centres	30	42.9
Improved infrastructure	47	67.1
Make the farmers aware of where they can deliver their tea	1	1.4
Using a basic mode of communication to alert farmers of tea collection process	1	1.4
Revise the current delivery times	10	14.3
Employ more buying clerks per buying centre	27	38.6
Lack of tea plucking workers as well as harvesting materials	12	17.1
Use of electronic weighing machines	8	11.4
Organize seminars for tea farmers	1	1.4
Improve the mode of tea leaf collection	1	1.4
Eliminate middlemen in the entire process	1	1.4

#### 3.8.7.2 *Processing of Tea at Factory*

Use of modern machinery would greatly improve the processing standards of tea at the factory according to 77.3% of the respondents. However, 40.0% of the respondents suggest an increase in the number of workers and processing machines in the factory to encourage faster and effective production. KTDA needs to inform farmers on the required tea quality as well as the expected sales as stated by 26.7% of the respondents. This would go a long way in giving the farmers morale to improve on their production so as to make better profits. On the same note, 20.0% of the respondents call for a disciplined management staff where only qualified staffs are allowed to operate. In addition, 8.0% of the respondents would like more factories to be contracted since the available factories seem overwhelmed by the large volumes of tea delivered.

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**Table 14- 3.14: Processing of Tea at Factory**

Response	Frequency	Percent
Increase the number of workers and processing machines in the factory	30	40.0
Improve processing standards by the use of modern machinery	58	77.3
Improved hygiene and working conditions	3	4.0
Disciplined management staff	15	20.0
KTDA to inform farmers on the required tea quality and expected sales	20	26.7
Reduction of workers at the buying centres to enable better payment of farmers	4	5.3
More factories to be contracted	6	8.0
Provide computerized weighting that every farmer can afford	1	1.3
Improvement of high grade tea for farmers to have good bonus	1	1.3

**3.8.7.3 Payment to Farmers**

Nearly all the respondents (99.1%) would really like their payments increased or at least reviewed every two years. About 28.9% of the respondents feel that the management needs to embrace technology especially in informing farmers when to collect their dues. Moreover, computers can be used to process salaries. Furthermore, 19.3% of the respondents suggest the adoption of the banking system when dealing with payments. Farmers can be advised to open accounts through which their payments can be made.

**Table 15- 3.15: Payment to farmers**

Response	Frequency	Percent
Increase payment/review payment at least after two years	113	99.1
Embrace technology in informing farmers when to collect their dues	33	28.9
Improved management	4	3.5
Adopt the banking system when dealing with payments	22	19.3
Farmers are the major stakeholders in tea farming and should be given the largest share at whatever cost	2	1.8
Reduce the price of fertilizers	2	1.8
Improve security at pay points	2	1.8

**3.8.8 Analysis for Factory Management questionnaire****3.8.8.1 General Information****Table 16- 3.16: Factory name**

Name of factory	Frequency	Valid Percent
Kebirigo	3	23.1
Kionyo	2	15.4
Tombe	3	23.1
Nyansiongo	3	23.1
Imenti	2	15.4
Total	13	100

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The findings of the study show that Kebirigo, Tombe and Nyansiongo factories were represented by approximately 23.1% of the respondents. In addition, about 15.4% of the respondents were affiliated with Kionyo and Imenti factories.

**Table 17- 3.17: Number of farmers**

Number of farmers	Frequency	Valid Percent
5000-8000	4	9.1
9000-12000	4	18.2
Above 12,000	3	27.3
Total	11	100

Table 3.17 highlights the total number of farmers in the factories. It emerged that in 27.3% of the respondents, the total number of farmers was above 12,000. Similarly, in 18.2% of the cases, the entire number of farmers was in the range of 9,000 -12000 farmers. Conversely, 9.1% of the respondents indicated that their factories hold approximately 5,000 -8,000 farmers in totality. Therefore, this means that in the majority of factories, the total number of farmers appears very high.

**Table 18- 3.18: Geographical area of operation**

Area in square kilometers	Frequency	Valid Percent
116	2	22.2
120	2	22.2
600	1	11.1
1200	1	11.1
1260	1	11.1
1600	1	11.1
1700	1	11.1
Total	9	100

The respondents were asked to indicate their geographical area of operation in square kilometres and 22.2% of the respondents said their geographical operational area was 116 and 120 square kilometres respectively. Similarly, according to 11.1% of the respondents, their physical area of operation was between 600 and 1700 square kilometres.

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**Table 19- 3.19: Control of tea buying Centres**

	Frequency	Valid Percent
42	2	18.2
48	2	18.2
54	3	27.3
67	2	18.2
68	1	9.1
80	1	9.1
Total	11	100

The distribution of tea buying centres controlled by the factories is presented in table 3.19. Apparently, 27.3% of the respondents control up to 54 of the tea buying centres whereas 18.2% of the respondents are in control of 42, 48 and 67 of the tea buying centres respectively. Approximately 68 and 80 of the tea buying centres are controlled by 9.1% of the respondents.

**Table 20- 3.20: Average numbers of members per tea buying centre**

	Frequency	Valid Percent
100 -399	7	70
400 – 699	3	30
Total	10	100

The percentage distribution of the average number of members per tea buying centre is given in table 3.20 above. On average, seven in every 10 of the respondents (70.0%) have between 100 and 399 members. Additionally, one third of the respondents illustrated that the average number of members for every tea buying centre lies in the range of 400 to 699 members.

**Table 21- 3.21: Level of updating farmers on factory performance**

	Frequency	Valid Percent
Once a year	4	28.6
Twice a year	2	14.3
Quarterly	1	7.1
Monthly	8	57.1
Weekly	2	14.3
Not defined	1	7.1

Table 3.21 presents the percentage distribution of how often factories update farmers on factory performance. Slightly above half of the respondents (57.1%) update their farmers on

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factory performance on a monthly basis. In 28.6% of the cases, this information is presented annually. Notably, 14.3% of the respondents keep their farmers posted on factory performance on either a weekly basis or semi-annually respectively.

**Table 22- 3.22: Mode of communication**

Mode of communication	Frequency	Valid Percent
Radio	2	14.3
Print media	7	50.0
Posters	9	64.3
Mobile	3	21.4
Word of mouth	4	28.6
Meetings (Barazas)	10	71.4

The different channels of communication applied by the various factories are given in table 3.21. Generally, half of the respondents (50.0%) utilize the print media. Approximately 64.3% of the respondents find posters effective while 28.6% of them apply word of mouth in disseminating information. Slightly above 20.0% of the respondents employ mobiles in communication as 14.3% of them make use of the radio.

**Table 23- 3.23: Grievances to the factory management**

	Frequency	Valid Percent
Through delegates	6	40.0
Posters	4	26.7
Print media	5	33.3
Radio	2	13.3
Mobile	3	20.0
Meetings	15	100.0

All the farmers (100.0%) agree that they do present their grievances to the factory management and the response is mainly given through meetings. About 40.0% of the respondents use delegates to respond to farmers' complaints while 33.3% of them utilize the media on the same. Posters, mobiles and the radio are used as response channels by 26.7%, 20.0% and 13.3% of the respondents respectively.

**3.8.8 .2 Receiving of Tea from Farmers**

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**Table 24- 3.24: Daily recording of tea received from each Buying center**

	Frequency	Valid Percent
Recorded manually	2	13.3
Recorded manually and immediately entered in computer	15	100.0

The percentage distribution of how daily recording of tea received from each buying centre is done is presented in table 3.23. Notably, in all the factories (100.0%) recording is done manually and immediately entered in the computer. Alternatively, in 13.3% of the cases, daily tea received from each buying centre is recorded manually. However, no record is entered in computer at source.

**Table 25- 3.25: Factory verse Buying Center weights Comparison**

	Frequency	Valid Percent
0.5 -10	5	71.5
Above 10	2	28.6
Total	7	100

All the respondents (100.0%) acknowledge that they certainly compare with the total weights as recorded by the tea buying clerk against factory records. Further, three – quarters of the respondents (71.5%) pointed out that the average difference in weight varied between 0.5 and 10 kilograms. Conversely, in 28.6% of the cases, the average variation in weight exceeded 10 kilograms. Remarkably, there was no negative disparity in weight.

**Table 26- 3.26: Handling of the excess/deficit daily weights**

	Frequency	Valid Percent
Use only factory weight	2	15.4
Use buying center weight	3	23.1
Surcharge tea buying clerk on the deficit difference(if deficit)	9	69.2
Use the end product weight	3	23.1

Table 3.25 provides the distribution of how excess/deficit daily weight is handled when calculating payment. According to 69.2% of the respondents, if there is a deficit, the tea buying clerk is surcharged on the deficit difference. On the other hand, 23.1% of the respondents either use the buying centre weight or the end product weight respectively. However, just about 15.4% of the respondents use only the factory weight.

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**Table 27- 3.27: Buying centre System information availability**

	Frequency	Valid Percent
Yes	9	64.3
No	5	35.7
Total	14	100

All the respondents (100.0%) affirm that a system that checks daily tea collection for every buying centre is indeed present. Additionally, 64.3% of the respondents agree that they have a system in place that can show the amount of tea held in a buying centre at any given time. However 35.7% of the respondents hold a different opinion.

**Table 28- 3.28: Schedule of tea collected from tea Buying centres**

	Frequency	Valid Percent
Assign vehicles to particular buying centres	9	64.3
Assign vehicle according to amount of tea in Buying centres	6	42.9
Other	2	14.2

The schedule of tea collected from tea buying centres is presented in table 4.27 above. Approximately 64.3% of the respondents assign vehicles to particular buying centres while 42.9% of them assign vehicles according to the amount of tea in buying centres. Nevertheless, 14.2% of the respondents utilize other assignments like the route system in addition to assigning vehicles according to the number of available vehicles. Notably, none of the respondents makes use of Ad-hoc assignment.



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**3.8.8.3 Processing of Tea**

**Table 29- 3.29: Weight information in Processing Stages**

	Frequency	Valid Percent
Yes	11	78.6
No	3	21.4
Total	14	100

Approximately 78.6% of the respondents concur that they have a system in place that is responsible for checking the weight of tea leaves in the different stages of processing. On the contrary, 21.4% of the respondents are yet to employ such a system in their operations.

**Table 30- 3.30: Mode of communication about tea quality to farmers**

	Frequency	Valid Percent
Tea Buying clerks	13	92.9
Posters	5	35.7
Meetings	8	57.1
Radio	2	14.3
Mobile phones	1	7.1

Poor quality/low yield is attributed to poor harvest, poor handling or tea overstay at buying centre before it is brought for processing among others. As a result, nine in every ten of the respondents (92.9%) communicate about tea quality to farmers through the tea buying clerks. About 57.1% of the respondents use meetings to convey this message as 35.7% of them make use of posters to inform farmers of the desired tea quality. On the contrary, mobile phones are used as a mode of communication by 7.1% of the respondents.

**Table 31- 3.31: Checking for quality at Tea buying centre**

	Frequency	Valid Percent
Physical inspection at sortation table	5	55.6
The leaf collection clerk will inspect the leaf at the Buying center	4	44.4

Checking for quality of tea at the buying centre is mainly done by physical inspection at the sortation table where samples are taken and leaf count done, as implied by 55.6% of the respondents. On the other hand, 44.4% of the respondents said the leaf collection clerk will inspect the leaf at the buying centre and will only buy two leaves and a bud.

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**Table 32- 3.32: Checking for quality at factory**

	Frequency	Valid Percent
Physical inspection by supervisors/quality control persons	5	55.6
At the off-loading bay	3	33.3
Representative sampling	1	61.1
Leaf count of the selected samples	1	50.0

Apparently, tea quality at the factory is mainly done by representative sampling according to 61.1% of the respondents. Leaf count of the selected samples to check for quality is done by half of the respondents (50.0%) while physical inspection by supervisors/quality control persons to ensure quality is carried out by 55.6% of the respondents. Quality checks at the off-loading bay are approved by 33.3% of the respondents.

*3.8.8.4 Dispatching of processed tea*

**Table 33- 3.33: Relationship between the system and payment system**

	Frequency	Valid Percent
Systems fully integrated	4	28.6
Data downloaded to another system	2	14.3
System produces payment slips	6	42.9
Data is manually transferred	1	7.1
No linkage	3	21.4

Generally, all the respondents (100.0%) have a system recording dispatch of final tea product from the factory. Table 4.32 presents the link between this system and the payment system. According to 42.9% of the respondents, the system is structured in such a way that it produces payment slips whereas 28.6% of the respondents indicated that the systems are fully integrated. About 7.1% of the respondents said data is manually transferred while 14.3% of the respondents download the data to another system. On the contrary, 21.4% of the respondents systems have no linkage to the payment system.

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**Table 34- 3.34: Treatment of operational costs**

	Frequency	Valid Percent
Remove all operational costs before declaring bonus	14	100.0

The study required the respondents to indicate how operational costs are treated before coming up with the final payments and all the respondents (100.0%) unanimously said that all operational costs are removed before declaring bonus. None of the respondents has a standard amount deducted per kilogram and neither do they treat operational costs differently depending on the situation.

*3.8.8.5 Type of ICT Systems on Board*

**Table 35- 3.35: Presence of an automated system in the factory**

	Frequency	Valid Percent
Yes	13	92.9
No	1	7.1
Total	14	100

Table 3.34 presents the availability of any automated system in the factory. Nearly all of the respondents 13(92.9%) have an automated system in the factory. However, such a system does not exist in 1(7.1%) of the cases.

**Table 36- 3.36: Type of front end platform applied in the system**

	Frequency	Valid Percent
Windows	14	93.3
MySQL	1	6.7

The type of front end platform currently operating in the system is given in table 3.35. About 14(93.3%) of the respondents apply windows as 1(6.7%) of them currently employ SQL. Linux, Unix and Solaris are not common among the respondents.

**Table 37- 3.37: Database management system in use**

	Frequency	Valid Percent
Ms SQL	9	69.2

The respondents were asked whether the system in place was a relational database Management (RDMS). About 69.2% of the respondents apply Ms SQL database

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management systems in their operations. Oracle and Informics are not utilized by any of the respondents.

**Table 38- 3.38: Multi-user systems Information**

	Frequency	Valid Percent
12	4	36.4
13	2	18.2
15	4	36.4
20	1	9.1
Total	11	100

The distribution of multiuser systems and the number of clients' machines in the network is given in table 3.37 above. All the respondents (100.0%) affirm that the systems are multiuser with 36.4% of the respondents having approximately 12 and 15 client' machines in the network respectively. On the other hand, 18.2% of the respondents have 13 clients' machines while 9.1% of them have about 20 of the same machines in the network.

**Table 39- 3.39: Systems supported in the factory**

	Frequency	Valid Percent
Transaction processing	12	92.3
Payment processing	12	92.3
Cheque processing	11	84.6
Marketing automations	1	7.7
Payroll processing	13	100.0
Other	1	7.7

Table 3.38 presents the distribution of various systems supported in the factories. Generally, all respondents (100.0%) support payroll processing while marketing automations are supported by 7.7% of the respondents. Transactions processing as well as payment processing are in use in 92.3% of the respondents respectively. Cheque processing on the other hand is supported by 86.4% of the respondents. Moreover, 7.7% of the respondents indicated that they support other systems like the operation system.

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**Table 40- 3.40: Input of data to the systems**

	Frequency	Valid Percent
Manual data capture	13	92.9
Electronic file transfer	6	42.9
Flash disks	5	35.7
Download through internet	4	28.6
Using GSM technology	1	7.1

The percentage distribution of how data is captured to the system is given in table 3.39 above. Nearly 93.0% of the respondents capture data manually whereas 42.9% of them input data to the system through electronic file transfer. Flash disks are used by 35.7% of the respondents even as 28.6% of them download their data through the internet. Notably, 7.1% of the respondents make use of the GSM technology.

**Table 41-3.41: Technologies used to interlink a factory and Head Office**

	Frequency	Valid Percent
VSAT	10	71.4
Wireless technology	5	35.7
GPRS/EDGE(GSM technology)	3	21.4
Optic fibre	1	7.1

Technologies used to interlink a factory and the head offices are shown in table 3.40 Three quarters of the respondents (71.4%) use VSAT as 35.7% of them utilize wireless technology. GPRS/EDGE (GSM technology) is applied by 21.4% of the respondents. Further, the optic fibre technology is used by 7.1% of the respondents.

**Table 42- 3.42: Emerging services implementation**

	Frequency	Valid Percent
SMS	1	7.7
Factory information access through internet	7	53.8
Use of point of sale(POS)	7	53.8

The study required the respondents to indicate what emerging services they have implemented or is in the process of implementation. Slightly above half of the respondents (53.8%) use point of sale (POS) as well as accessing factory information through the internet respectively. However, SMS has been adopted by about 7.7% of the respondents.

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**Table 43- 3.43: Technologies used to connect to the internet**

	Frequency	Valid Percent
VSAT	9	69.2
GPRS/EDGE(GSM technology)	1	7.7
Optic fibre	1	7.7
Wireless	3	23.1

Table 3.42 shows numerous technologies used by the factories to connect to the internet. About 69.2% of the respondents use VSAT whereas 23.1% of them make use of the wireless technology. GPRS/EDGE (GSM technology) and optic fibre are utilized by approximately 7.7% of the respondents respectively.

**Table 44- 3.44: Mobile ownership and information dissemination.**

How information is passed between farmers and Factory Management	Own Mobile phone	
	Yes	No
Through tea buying centres	78.8	80.0
Through posters	55.3	44.0
Through committee members	89.4	84.0
Members to visit factory management	25.0	44.0
Radio	6.1	4.0
Cell phones	11.4	8.0
Word of mouth	30.3	36.0
Barazas	27.3	48.0
No defined methods	0.0	4.0

This indicates that farmer communicate to factory management through committee members and Buying Centre clerks. Only 11% of farmer who own phones and 8% of farmers who do not own phones communicate using cell phone.

**Table 45- 3.45: Mobile phone ownership verse payment Information.**

How get information about tea payment schedules	Own Mobile phone	
	Yes	No
Through tea buying clerks	84.5	70.8
Through other farmers	37.2	45.8
Through factory	59.7	70.8
Electronic media	1.6	0.0
Cell phones	10.9	8.3
Word of mouth	27.1	33.3
No specific media	1.6	0.0

Over 70% of Farmers get payment information through Tea Buying Clerks. However only 10% are informed through mobile phones. There is also a big percentage of farmers who get information through Factories. This wastes time for farmers that will otherwise be used effectively.

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**Table 46- 3.46: Calling channel verses preferred communication channels**

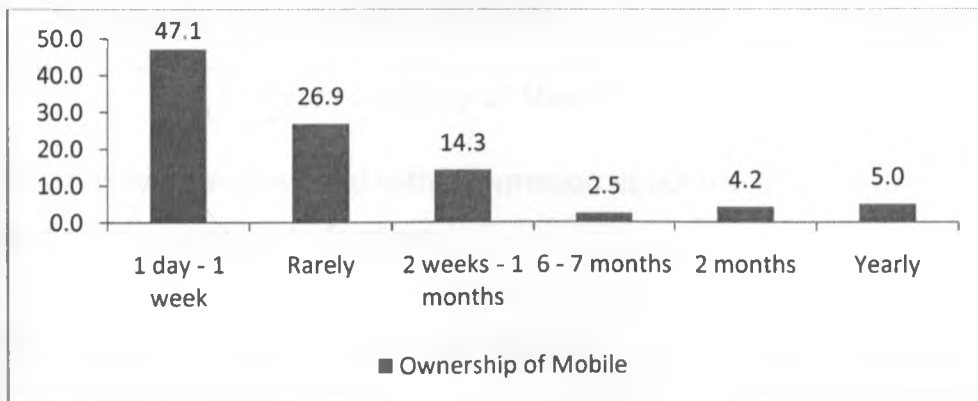
Channel used for calling meetings	Preferred communication channel					
	Radio	Mobiles	TV	Newspaper	Newsletter	Other
Word of mouth	56.9	80.0	20.0	32.3	27.7	1.5
Through tea buying centres	67.2	78.4	19.8	25.9	23.3	3.4
Through posters	77.1	81.9	22.9	25.3	20.5	4.8
Mobiles	36.4	90.9	9.1	18.2	63.6	9.1
Radio	75.0	50.0	50.0	50.0	75.0	50.0
Newsletter	43.8	93.8	12.5	43.8	81.3	6.3

Table shows that a great percentage of farmers using mobile phones prefer Mobiles.

**Table 47- 3.47: Data transmission awareness verse preferred channel**

Preferred channels	Awareness that phone can transmit data	
	Yes	No
Radio	48.7	75.0
Mobile	85.9	85.7
TV	19.2	8.9
Newspaper	25.6	23.2
Newsletter	29.5	8.9
Other	5.1	1.8

**Figure 21 Ownership of mobile phone and response time**



Above graph shows that 47% respondents with mobiles gets response within a week.

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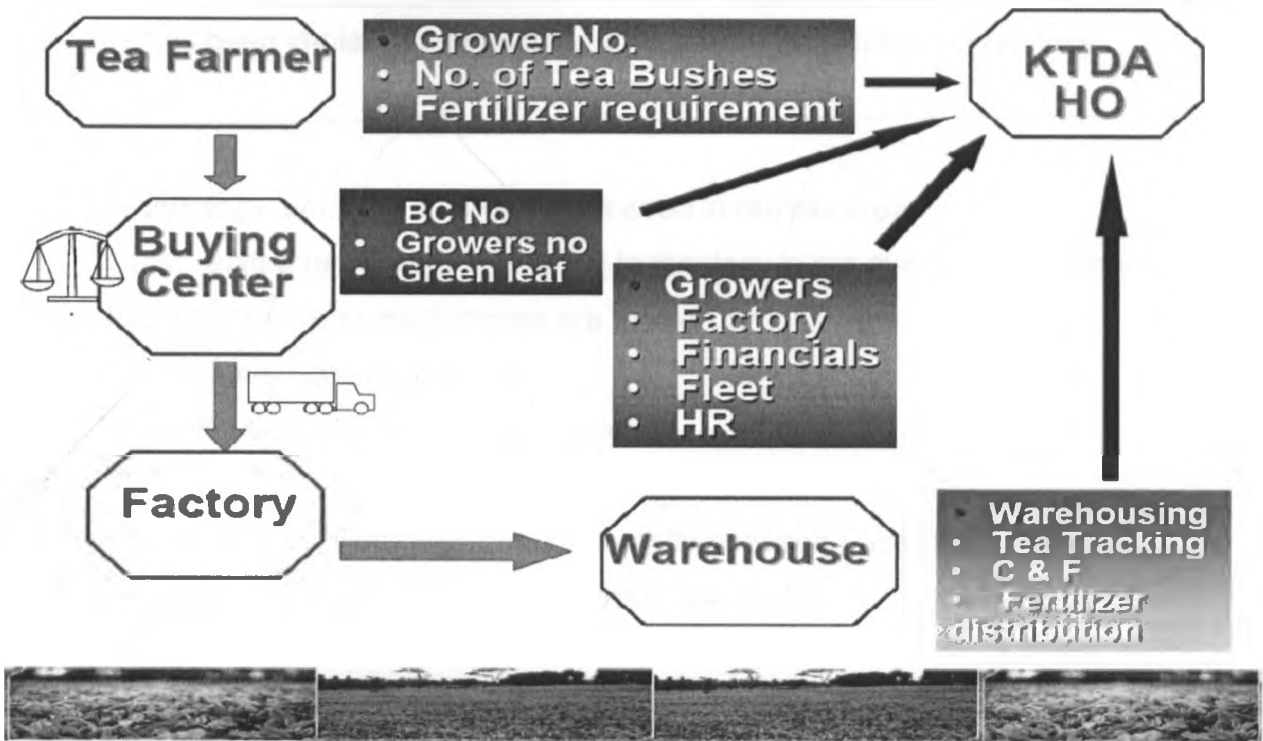
**3.8.9 Current Information Flow:**

Information flow in KTDA organizations is centered to One Direction however the ideal information requires to be bidirectional.

The diagram below indicates the information flow:

**Figure 22 Information Flow in KTDA**

**1.3- Information Systems**



*Diagram courtesy of Mwende Gatabaki GM-ICT KTDA*

KTDA Headquarters if fed with information about the farmer, processing warehousing and does payments to farmers.

The current information flow is as follows:

- i. Tea Farmer to Buying Centre: the Process is Manual and the major media is verbal.
- ii. Buying Center to Factory: Green leaves transported, and Manual Data for each farmer's daily proceed is manually captured in system.



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- iii. Factory to Warehousing: Processed Tea is transported and manual records provided.
- iv. Farmers to KTDA HQ: returns done through manual and electronic Media

### 3.8.10 Network infrastructure in place

Provision of integrated communication services and better Management of information, all KTDA factories and functional areas requires to be interlinked, VSAT technologies has been implemented as the preferred communication technology because:

- i. Technology available all over Kenya even in remote areas.
- ii. Other related technology e.g. wired technology is not available in remote locations where some factories are located.
- iii. Able to have higher bandwidth.
- iv. Reliability and availability is guaranteed.

The diagram below illustrates the connectivity between Factories, KTDA Headquarters, warehouse and to the rest of the world.

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Figure 23 WAN Connectivity in KTDA

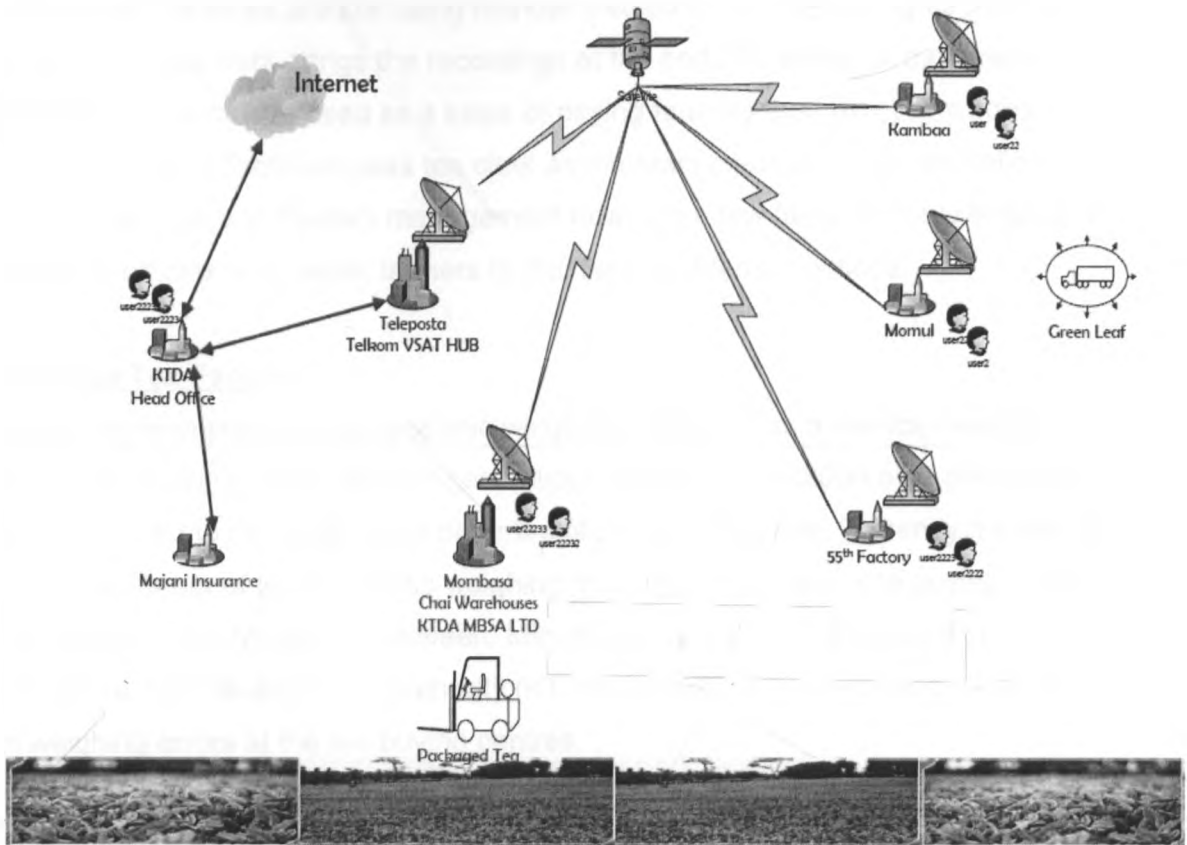


Diagram courtesy of Mwende Gatabaki GM-ICT KTDA

3.8.11 Research Observations

ICT offices

All factories have established ICT offices headed by System Administrators. Other infrastructural requirements are as follows:

- i. Run Client server environment.
- ii. Mid range server IBM e Series servers
- iii. Have established LAN
- iv. Connect to Head quarters using VSAT technology.

Factories do not have established DRS systems on site. Data is replicated to HQ servers after an interval of one hour.

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### Nyansiongo, Kiamokama, Tombe, Kebirigo, Ogembo, imenti and Kionyo Tea Factories

These seven factories are still using manual method in recording weights from tea farmers. The tea clerk brings the recordings at the end of the day for data capture at the factory. This data is used as a basis of paying farmers their monthly wages and bonus. The entire factories uses tea clerk as the main means of communication between farmers and Factory management however a few factories have employed extension officers who assist farmers to maintain best farm practices.

### Nyankoba Tea Factory

The factory is implementing electronic weighing machines as a service delivery channel in buying centres. This project rollout started in April 2009 on a pilot basis and is required to be rolled out to other tea factories in Nyanza. Currently the factory is using eight out of ten electronic weighing machines in its forty nine buying centres. The project is a joint venture between, Ministry of Agriculture, Tea Board of Kenya and Kenya Tea Development Authority (KTDA) to sort out issues raised by farmers on weighing errors at the tea buying centres.

### Advantages of Electronic Weighing Machine.

- i. It is digital, therefore easy to read and provides accuracy of nearest 100g.
- ii. Once the weight is taken, it is permanently stored in weighing internal memory; tea clerk cannot erase the data.
- iii. Produces receipts showing the farmer's details current weight and monthly cumulative weight.

### Issues Raised by the use of Electronic Calculators

- i. There is a likelihood of losing data especially in transit before uploading. This happened ones therefore having difficulty in reconstructing the data.
- ii. The weighing of tea is done only when there is availability of the tea collection truck. Therefore farmers cannot utilise their time properly.
- iii. The data is uploaded to the Factory systems when the truck delivers tea. Therefore the factory management cannot know how much tea is at buying centres at any given time.

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- iv. Available backup Power does not sustain the electronic calculators for a day; therefore recharging now and then therefore slows or disrupts business.

### 3.8.12 Processing of Tea

Tea is weighed immediately it is delivered to the factory by the delivery truck, the tea is weighed at stages indicate below. The final weight is inputted to the system before releasing it to the warehouse. The average weight reduction between green leaves and final product is at a ratio of 3:1.

Processing of tea undergoes the following process:

#### **a) Withering**

This first stage of tea processing and its main purpose is to bring down the internal moisture of the leaf. It also initiates chemical reactions in the leaf cell necessary for quality tea production.

#### **b) Leave Maceration**

The process involves cutting and macerating the leaf to produce a fine mash, or "dhool." Its purpose is to expose the cell contents to atmospheric oxygen for further development through the action of enzymes during fermentation.

#### **c) Fermentation**

This stage is an oxidation process. Fermentation or oxidization is the most important stage in the manufacture of black tea and this process differentiates the types of teas produced. It makes black tea uniquely different from all other teas.

#### **d) Drying**

This is process stops fermentation and introduces a stable product of low moisture content between 3.0 to 3.3%. It involves the physical removal of moisture and it's a crucial process as it seals in all the flavour, aroma and character created during manufacture that is released by brewing. This leads t the final product.

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### e) Tasting

Testing process evaluates the tea for quality and manufacturing faults. The taster assesses the flavour, smell, colour etc of the infused leaf and the uniformity of size, fiber content and trueness of grade for the dry leaves.

#### 3.8.13 Identified Gaps.

The following gaps were identified as a major source of farmer's dissatisfaction and required to be addressed:

1. A number of errors caused during weighing of green leaves at tea buying centres.
2. Lack of proper communication channels between the farmer and Factory management.
3. Lack of collection of Tea proceeds from tea Buying Centres.

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### CHAPTER 4      FRAMEWORK DESIGN

#### 4.1 Introduction

The design of the proposed systems is meant to solve issues relating to the communication breakdown in the delivery, processing and selling of tea products. This encompasses the farmer, Factory management, Factory processes and warehouse. Farmers will be able to gather information about the performance of their factory, sales and marketing trend.

This chapter discussed on the proposed framework design. It is divided into three sections, Section one discusses on how the framework solve farmer's problems, section two discusses proposed framework Buying centre - factory connection, and Section three discusses on the proposed prototype.

#### 4.2 Solutions provided by the proposed Framework

##### 4.2.1 Farmers Cards

All Farmers will be issued with Magnetic stripe / Smart cards that will be used for:

- i. Farmer Identification.
- ii. Recording of farmer's details and produce at Buying Centre.  
Card will be used to record the tea delivery at tea Buying centre therefore reducing errors of omission or commission especially on farmers' details.
- iii. Gathering farmers Tea transaction history and cumulative weight information at the Buying centre.

##### 4.2.2 Recording tea proceeds in tea Buying Centres.

Point of Sell (POS) terminals will be assigned to each Tea buying Clerk. The terminal will be used to transmit the farmer and tea weight information from Tea buying centers. The terminals will use GPRS (Cellular) technology in transmitting data to the factory servers on online and real-time basis and the farmer will receive a receipt after each transaction is

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completed indicating the total weight for the day, cumulative weight for the month and annual cumulative weight. At the end of the day, the Tea Buying Clerk will be able to get all required summaries. This equipment will achieve the following:

- i. Elimination of the cumbersome manual recording at buying centre and at the Factory level.
- ii. Reduction of recording errors that have been identified in the current manual system.
- iii. Confirmation of farmer's daily, monthly and yearly cumulative weight per each receipt.
- iv. Faster in inquiry on daily collections from different technologies e.g. phone.
- v. Better transport management especially from tea collection from Centers.
- vi. Can be used to eliminate farmer's restrictions to only one buying centre.
- vii. Transparency in recording of farmers proceeds. Farmers will be able to get the current status at any given time.

### 4.2.3 Connectivity from Tea Buying Centres to Factory.

Connectivity through cellular technology (GPRS) has been fast growing, easier to use, cheap comparing other service technologies, does not require expensive equipments to implement and its availability in remote areas. This makes the technology preferred over other technologies (Wired and Wireless).

### 4.2.4 Adequate information flow between farmers and KTDA.

Most Farmers currently do not appear to understand and appreciate the costs of the services they receive from KTDA and how much the same services would cost if supplied from other providers. This is solved through the interconnectivity done to all stake holders. Factories and warehouse are interconnected to the head office through VSAT as depicted below. Farmers will be allowed to access reports that relate to the overall performance of tea industry, auction at warehouse, and expenditure

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through their mobile phones hence increasing farmers' confidence. The same will be availed by the use of internet.

### 4.2.5 Provision of services to farmers especially in payments, and tea collection.

Linking of Tea Buying Centers to Factories, and Factories to KTDA HQs and warehouse will ensure provision of all information required from tea collection to Tea auctioning.

The major complaints over tea payments are due to lack of transparency on the part of the KTDA on the determinants of payments to farmers.

Farmers will also be updated though the use of SMS. This is a functionality of the switch software.



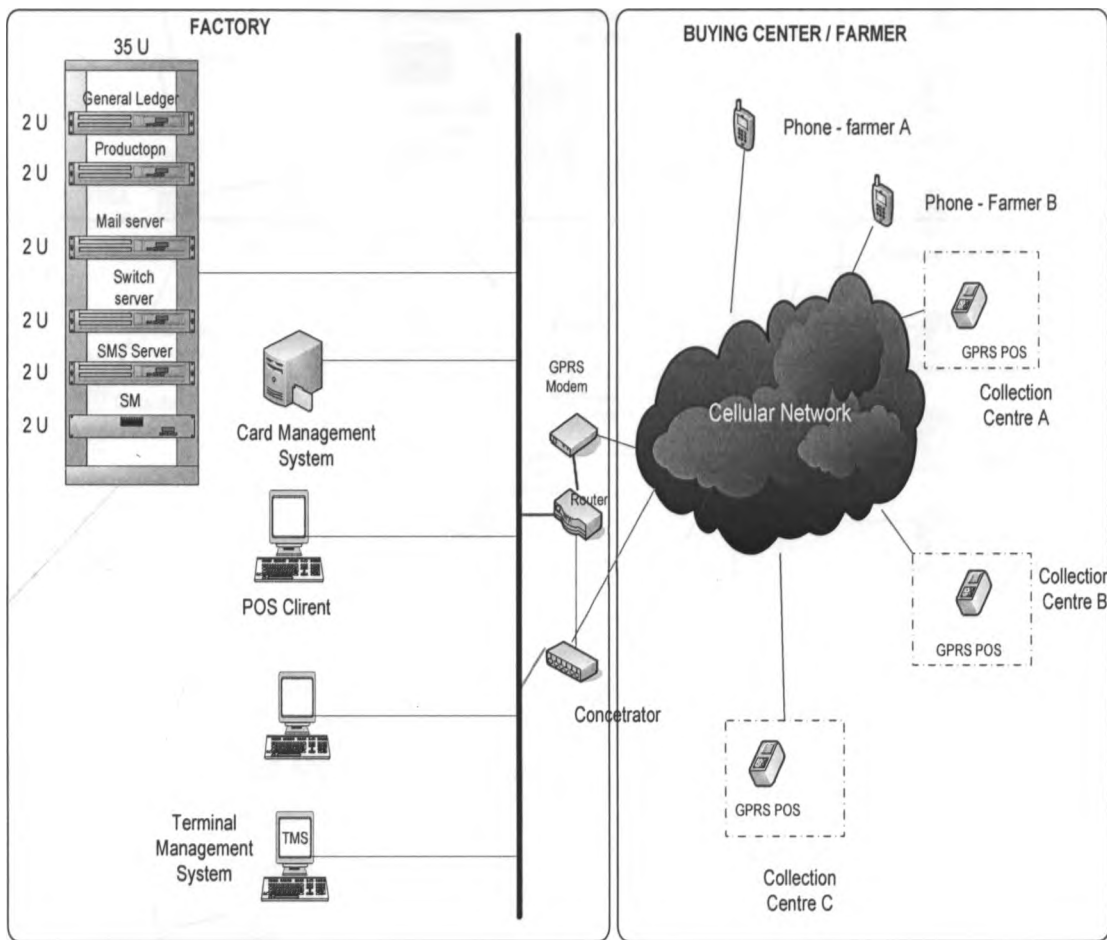
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4.3 Buying Centre – Factory Design

Diagram below depicts the technological changes to be employed:

Figure 24 Schematic Diagram of Factory and Farmers / Tea Buying Centre

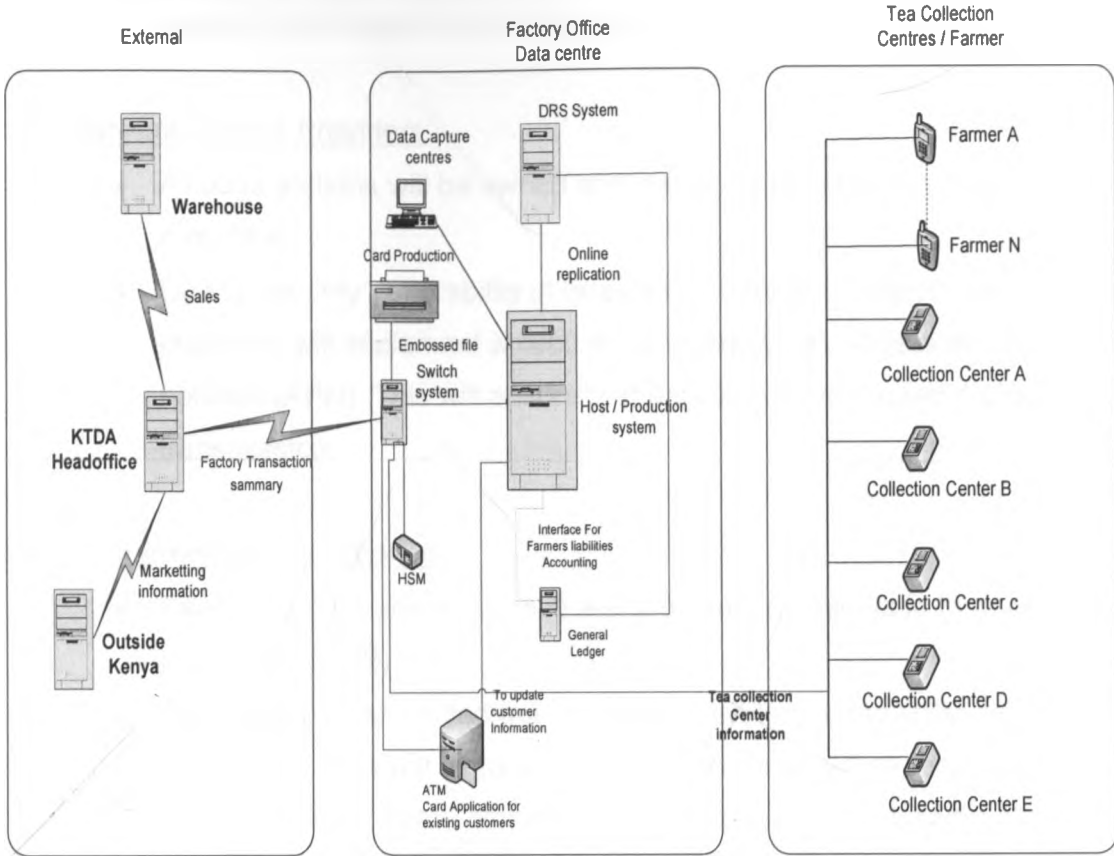
SCHEMATIC DIAGRAM OF FACTORY AND FARMERS / TEA BUYING CENTRE.



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Figure 25 Proposed Tea Processing Schematic Diagram

PROPOSED TEA PROCESING INFRASTRUCTURE



Description Proposed Model is as follows:

4.3.1 External to Factory

i. POS terminals

Features of the POS terminal will be as follows:

- Has GPRS Functionality.
- POS with dual SIM card slots, SIM cards from different service providers will be installed for the purpose of failover. POS will automatically detect and transmit packets using the service provider with stronger signal.

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- Many Tea Buying centers do not have electrical power source. Therefore, POS should be fitted with a rechargeable battery that can power it for at least full day. A spare battery is highly recommended.

### ii. Network Service Providers

- All base stations will be owned and managed by network service providers.
- Due to security vulnerability in wireless technology, Network service providers will implement a secure tunnel known as Access private network (APN). This will ensure that data is not intercepted during transmission.

### iii. Farmers Mobile Phones

- Farmers will be able to receive alerts on various events in form of short messages (SMS).
- SMSs will be transmitted from the switch system to the GSM technology. This will ensure information required will be received by farmers at appropriate time and also reducing errors caused by misreporting.
- Farmers will be able use the mobile phone for enquiry purpose, receive alerts when payment is due and will be able to forward their suggestions to the factory management faster.

## 4.3.2 Networking equipments

### I. LAN

Local Area network should be implemented in areas are such as, receiving of leaf, withering section, tasting, drying fermentation and dispatch section for inputting data in various stages of tea processing.

The network topology will be determined by the spread of the factory and the amount of traffic in the network. This should conform to IEEE standards.

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### II. Network Concentrator

The Concentrator receives all signals from POS terminals and routes the packets to the Switch therefore providing single connection to the switch software. This avoids opening many sessions in the switch software that will otherwise have impact on system performance and licensing.

#### i. Routers

One core router will be required for connection of two or more Local Area Networks (LAN) or connection to Wide Area Network (WAN). Routers work in layer 3 in OSI model and their main task is routing and forwarding of information.

Each factory will be connected to Headquarters via a router.

### 4.3.3 Software Applications

#### i. Core application Software

The core software should be able to process farmers data on delivery, processing dispatch and also payment processing. Features of the system will be:

- Implemented on open platform.
- Accept multiuser environment.
- Integrate with other systems.
- Able to produce required reports.
- Support Short Message Systems (SMS)

#### ii. Switch Software

Switch software receives inputs from various input devices and directs the packets to the right application for this instance it receives packets from POS and relays them in the appropriate format to the appropriate application. The features required are:

- Must be able to handle all factory transaction volumes
- Support appropriate number of Cards

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- Capable of supporting appropriate hardware
- Able to connect to the Host
- Running on appropriate Database Management Software.
- Able to transmit data in the required message format
- Support card production and management
- Secure transfer of data. e.g. Data encryption
- Able to provide appropriate reports.

### iii. Card Management software

Farmers magnetic / Smart cards require customization so as to be accepted by the system. Card Management software will be used for Production and Management of these magnetic strip / chip cards.

### iv. Terminal Management Software

Terminal management software will be used to configure POS terminals.

### v. Mail

This will be used for communication between factories, HQ and warehouse.

### 4.3.4 Hardware Requirements

Current hardware for the main (Core) system will be retained if the core system will not be changed. The following hardware will be purchased.

- i. Switch hardware, for switching the transactions
- ii. Router provide access to inside and outside of the Local Area Network
- iii. Concentrator to work as a concentrator of traffic to the host
- iv. POS to be used for transaction processing at Tea buying center

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### 4.4 Disaster Recovery site

Disaster recovery Site is part of business continuity planning.

The DRS suggested should be online real-time with replication. Thus the DRS servers should be at par with the production sever. This will eliminate any downtime wherever the server malfunctions. DRS server should be on a different site from the production environment.

### 4.5 Security

#### Security Module

Security Module is required to Protect and control access to critical information, able to scale, manage, and secure encryption processes. It therefore provides:

- i. Secure generation,
- ii. Secure storage,
- iii. Use of cryptographic and sensitive data material.

Security Module will provide both logical and physical protection of these materials from non-authorized use and potential adversaries.

This will provide key exchange for the protection of high-value cryptographic keys

### 4.6 Prototype

A prototype will have the following setups:

#### Factory Setup

- i. Switch software: Postillion comprising the modules such as, Hypercom node, Card Management software ( Hypercom Postcard), POS Management Software (Hypercom terminal management software).
- ii. Hardware: Any mid-range server as a Switch Hardware server with the following specifications:
  - Processor capacity Intel Xeon 3.6 GHz

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- Number of Processors : Two
  - Hard Disk Capacity : 500GB
  - Number of Hard disks : Minimum 4
- iii. Core Router Cisco 2800 series
- iv. Network switch Hardware Cisco manageable switch
- v. Concentrator Hypercom NAC IEN 2500 with let 61 downlink and another let 61 Uplink cards.



### Setup at Buying Center

- i. POS terminal: Hypercom T4230 POS terminal (GPRS enabled terminal) connected to a battery pack.



- ii. SIM Cards: Zain, Safaricom, YU, and Telkom cards whichever has higher signal strength. The service provider must be able to provide an APN for secure data transmission.
- iii. Weighing Machine: Electronic weighing Machine



- iv. Circuit between POS and factory should be point to point. Configurations should be done to provide Access private Network (APN) tunnel.

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**CHAPTER 5 – DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS****5.1 Introduction**

This chapter gives the conclusions and recommendations arising from the study to establish the information framework for small scale tea farmers using cellular technology. The focus of this study was based on farmers and factory management of tea growing area in Kenya.

The major finding in the study was that majority of factories have good communication infrastructure between the factories, KTDA Headquarters and warehouse however this has not been implemented between factory and farmers. Therefore there is lack of adequate communication between factory management and farmers.

**5.2 Challenges & Limitation**

The main challenges in the study were;

1. Reluctance of Factory Management respondents to respond to the questionnaire.
2. Factory management group were not able to finalize completion of the questionnaire, resulting to more visits for follow-ups.
3. Gathering of information a challenge given the spread of factories and Tea buying centres.

The main limitation in the study was being unable to implement the designed Communication framework to measure its effectiveness due to cost, resources and time required however the factories are implementing this in phases.



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### 5.3 Conclusions

185 out of 192 questionnaires administered to the respondents were returned and ended up being useful for the study. The response was therefore 96%. This report is based on the analysis and interpretation of results of the 185 questionnaires.

The proposed framework therefore was designed based on the problem definition, questionnaire, interviews and document review. This will therefore be able to solve communication problem between farmers and factory management and also greatly improve service delivery. This will embrace the current technology and provide encouragement and transparency to farmers.

Emerging services to be implemented will enable farmers to access their data through Point of Sale (POS), Phone and internet. Ideally most factories use VSAT and wireless technologies to connect to their head office.

### 5.3 Recommendations and further studies

It is recommended that the researchers do further studies on the following two areas;

1. Research on the impact the system will bring after the implementation of the framework.
2. Research on how the use of technology can assist factories to be able to sell their products directly without using middlemen.

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### CHAPTER 6 - APPENDIX

7.1 Reference

7.2 Farmers Questionnaire

7.3 Factory management Questionnaire

7.4 Farmers' cards

7.5 Letter of introduction from University

## APPENDIX 1

### 7.1 References

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## APPENDIX 2

### 7.2 FARMERS SELF ADMINISTERED QUESTIONNAIRE

#### INSTRUCTIONS

- i. Please complete this questionnaire considering each question thoughtfully.
- ii. Your response will be strictly confidential and data from this research will be reported only in the aggregate.
- iii. Kindly maintain honest and objective feedback so as to meet the intended purpose.
- iv. All information will be used only for the purpose of this study.

#### A. Farmer Information

Name \_\_\_\_\_ Optional

Name of your tea Buying centre: \_\_\_\_\_

Name of Factory : \_\_\_\_\_

1. How many Acres have you planted tea? \_\_\_\_\_ (Please Specify in acres)
2. How many times do you harvest your tea in a month? \_\_\_\_\_ (Please Specify)
3. What is the average weight of your harvested tea per month? \_\_\_\_\_ Kilograms (Please Specify)
4. Which month is the tea yield highest in a year? \_\_\_\_\_ ( Please indicate month)
5. Which month is the tea yield lowest in a year? \_\_\_\_\_ ( Please indicate month)

#### B. Record Keeping

6. How is the tea collection records kept? ( Please tick all that apply)
  - Manually recorded in farmer's card only.
  - Manually recorded in card and also on tea Buying clerk record book.
  - In electronic format and downloaded to KTDA systems.
  - Electronic format on real time reflected to factory servers immediately as the tea clerk captures from tea Buying centre.
  - No definite method.

7. Do you get your monthly Summary either from Tea Buying clerk of the Factory? (Please tick as appropriate)
- Yes
  - No
8. How do you cross check your monthly delivery weights verse the paid up weight? (Please tick as appropriate)
- Only through Tea Buying clerk.
  - Through the factory records.
  - I have my own manual recording through documentation from Tea Buying clerk.
  - It is not possible to confirm.
9. How do you keep your monthly cumulative weights? (Please tick as appropriate)
- Manually using cards.
  - Manually using payment slips.
  - Use Tea Buying clerk records.
  - Use Factory records.
  - I do not keep the records.

**C. Tea Buying Centre Information**

10. How far is the tea Buying centre from your farm? \_\_\_\_\_ Kms. (Please Specify in Kilometres)
11. Who owns your tea Buying centre? (Please tick as appropriate)
- Individual member
  - Farmers who are members to the tea Buying centre.
  - Kenya Tea Development Authority (KTDA).
  - Other Specify \_\_\_\_\_
12. How is the tea Buying centre managed? (Please tick as appropriate)
- Through nominated members done by Farmers.
  - Through nomination done by KTDA
  - Fully employed manager by farmers
  - No defined management
  - Other Specify: \_\_\_\_\_
13. How many days is the Buying centre open per week? \_\_\_\_\_ Days. (Please Specify Number of Days)

14. What time is the tea Buying centre is open? \_\_\_\_\_ . (Please indicate time)

15. What time is the tea Buying centre closed? \_\_\_\_\_ . (Please indicate time)

16. When tea is left at the tea Buying centre for long, it loses its quality? If this is true, what is the longest period of uncollected tea have you ever observed? (Please tick as appropriate)

- Overnight
- 1 day
- Two days
- Over two days
- Not applicable.

17. What are the major causes in 16 above? ( Please tick all that apply)

- Tea not acceptable quality.
- Buying delays at Buying centre due to unavailability of Tea clerk.
- Collection delays at Buying centre due to Lack of transport.
- More tea available than what the Factory can take.
- Collection delay due to Bad weather.
- No known reasons.

18. Approximately how many times is tea not collected in time per Month? \_\_\_\_\_  
(Please Specify)

19. Are you allowed to deliver your tea to another Buying centre other than the one you are a regular member? (Please tick as appropriate)

- Yes
- No

If it is a No please provide your explanation?

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20. How can you rate the type of services that are offered at your tea buying stations? (Please indicate percentage between 0% and 100%)

- a. Time to taken to deliver \_\_\_\_\_
- b. Communication to farmers \_\_\_\_\_
- c. Average tea collection from centres. \_\_\_\_\_
- d. Accuracy in Record keeping. \_\_\_\_\_

**D. Communications**

21. How is the information passed between farmers and the Factory management? ( Please tick all that apply)

- Through Tea Buying clerk
- Through Posters
- Through committee members
- Members to visit factory management
- Radio
- Cell phones (Mobile phones)
- Word of mouth.
- Baraza
- No defined method.

22. How do you channel your compliments / complains to the management especially from your tea Buying centre? ( Please tick all that apply)

- Tea Buying clerk
- Posters
- Through committee members
- Members to visit factory management
- Through scheduled meetings
- No defined method.

23. How often do you communicate to KTDA management on Tea collection issues? (Please tick as appropriate)

- When Issue arises,
- Discuss with tea buying clerk at tea Buying centre.
- When holding meetings
- No need to call

24. How long does the management take to respond to your complains? \_\_\_\_\_(Please Specify duration)

25. How many times do you hold meetings in your tea Buying centre? \_\_\_\_\_  
(Please Specify )

26. What is the main communication channel used for calling meetings. ( Please tick all that apply)

- Word of mouth
- Through tea Buying centre.

- Through Posters
- Mobiles
- Radio
- Newsletter

**E. Communication channels available**

27. Do you own a mobile phone? (Please tick as appropriate)

- Yes
- No

28. If yes then what service provider / providers have you subscribed to? ( Please tick all that apply)

- Safaricom
- Zain
- Telkom/Orange
- YU
- Any other (Please specify) \_\_\_\_\_

29. Please provide the make and model of your Mobile phone. \_\_\_\_\_  
(Please indicate e.g. Nokia 1202)

30. What services do you use your phone for? ( Please tick all that apply)

- Voice
- SMS
- Data

31. Are you aware that your phone can be used to transmit data(Please tick as appropriate)

- Yes
- No

32. What is your preferred communication channel : ( Please tick all that apply)

- Radio
- Mobile phones
- Television
- Newspapers
- Newsletters.
- Others Please specify: \_\_\_\_\_

33. How will you like information regarding to tea delivery, dispatch, processing and payments to be passed to you? ( Please tick all that apply)



- Through Posters
- Through Radio
- Word of mouth
- Through Short messages SMS to your Mobile Phone.
- It does not matter how I will be informed.

**F. Payment systems**

34. How do you get information about tea payment schedules? ( **Please tick all that apply**)

- Through tea Buying clerk
- Through other farmers
- Through factory
- Through electronic media
- Through Mobile phone
- Word of Mouth
- No specific media

35. How are your tea payment scheduled? (Please tick as appropriate)

- Particular date of the month
- End of month
- Monthly schedule sent to farmers
- Indicated in the payment slips
- No specific schedule

36. If not how do you know the exact payment date? ( **Please tick all that apply**)

- Through Visiting the Factory
- Through Tea Buying clerk
- Indicated in the payment slips
- Through Newsletter
- Through Mobile
- Not specific

37. How are you informed on bonus payment rates: ( **Please tick all that apply**)

- Through annual meetings.
- Through factory newsletters.
- Through buying clerks.
- Through Mobiles.
- No definite way of communication.

38. What level of satisfaction can you suggest on the delivery and payment of tea?  
\_\_\_\_\_ % (Please indicate in percentage 0% totally dissatisfied while 100% Fully satisfied )

G. **Recommendations**

39. What other service improvements will you recommend to be implemented on the following:

a. Delivery of tea to Buying centres:

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b. Processing of tea at factory.

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c. Payment to farmers.

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## **APPENDIX 3**

### **7.3 FACTORY MANAGEMENT INFORMATION QUESTIONNAIRE**

#### **INSTRUCTIONS**

- i. Please complete this questionnaire considering each question thoughtfully.
- ii. Your response will be strictly confidential and data from this research will be reported only in the aggregate.
- iii. Kindly maintain honest and objective feedback so as to meet the intended purpose.
- iv. All information will be used only for the purpose of this study.

#### **a. General information.**

Name of Officer: Optional: \_\_\_\_\_

Officer title: Optional : \_\_\_\_\_

Factory Name: : \_\_\_\_\_

1. What is the total number of Farmers in your factory? \_\_\_\_\_ (Please Specify Number)
2. What is your geographical are of operation in square Kilometers? \_\_\_\_\_ (Please Specify)
3. How many tea buying centers do you control? \_\_\_\_\_ (Please Specify)
4. What is the average number of members per tea Buying center? \_\_\_\_\_ (Please Specify)
5. How often do you update your farmers on factory performance? (Please tick as appropriate)
  - Once a year,
  - Twice a year
  - Quarterly
  - Monthly
  - weekly
  - Not defined.
6. What mode of communication do you apply? (Please tick all that apply)
  - Radio
  - Print Media

- Posters
  - Mobile
  - Word of Mouth
  - Meetings (Barazas)
  - Not defined.
7. Do farmers present any grievances to the factory management?
- Yes
  - No
8. How do you respond to farmers' grievances? (Please tick all that apply)
- Through delegates
  - Posters
  - Print Media
  - Radio
  - Mobile
  - Meetings
  - Do not handle.
- b. Receiving of Tea from Farmers**
9. How do you record daily tea received from each Buying center? (Please tick all that apply)
- Recorded Manually.
  - Recorded manually and immediately entered in computer
  - Entered in computer at source
  - Other recording Please indicate: \_\_\_\_\_
10. Do you compare with the total weights as recorded by the tea Buying clerk against factory records? (Please tick as appropriate)
- Yes
  - No
11. If there are any differences, what is the average difference? \_\_\_\_\_ (Please specify weight in Kilograms negative to indicate deficit positive to indicate gain)
12. How do you handle the excess / deficit daily weight when calculating payment? (Please tick all that apply)
- Use only Factory weight
  - Use Buying center weight.
  - Surcharge tea Buying clerk on the deficit difference (if deficit).
  - Use the end product weight

13. Do you have a system to check daily tea collection per each Buying center? **(Please tick as appropriate)**

- Yes
- No

14. Do you have a system in place that can show the amount of tea held in a Tea Buying centre at any given time? **(Please tick as appropriate)**

- Yes
- No

15. How do you schedule tea collection from tea Buying centers? **(Please tick as appropriate)**

- Assign vehicles to particular Buying centers
- Assign vehicle according to amount of tea in Buying centers
- Ad-hoc assignment
- Other Assignment Please indicate: \_\_\_\_\_

**c. Processing of Tea**

16. Do you have a system in place that checks the weight of tea leaves in different stages of processing? **(Please tick as appropriate)**

- Yes
- No

17. Having poor quality / low yield is attributed to either, poor harvest, poor handling or tea overstaying at buying center before it is brought for processing among others. How do you Communicate about Tea quality to farmers: **(Please tick all that apply)**

- Tea Buying clerks
- Posters
- Meetings
- Radio
- Mobile phones
- Put on Payslip
- No defined method

18. How do you check for quality at:

a. Tea Buying centre? **( Please indicate)**

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b. The Factory.

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**Dispatching of processed Tea**

19. Do you have a system recording dispatch of final tea product from the factory? (Please tick as appropriate)

- Yes
- No

20. If yes, how is the system linked to payment system? (Please tick all that apply)

- Systems fully integrated.
- Data downloaded to another system.
- System produces payment slips.
- Data is manually transferred.
- No linkage
- Other State: \_\_\_\_\_

21. How do you treat the operational costs before coming up with the final payments (Especially for Bonus payments)? (Please tick as appropriate)

- Remove all operational costs before declaring Bonus.
- Have a standard amount deducted per Kilogram.
- Treated differently as per situation
- No specific method used.

**d. Type of ICT Systems on board**

22. Do you have any automated system in the Factory? (Please tick as appropriate)

- Yes
- No

23. If yes, what type of front end platform is the system running on? (Please tick all that apply)

- Windows
- Linux
- Unix
- Solaris
- mySQL

Other: Please specify \_\_\_\_\_

24. Is the system a relational database Management (RDMS)? \_\_\_\_\_ If so, What Database management systems are you using? **(Please tick all that apply)**

- Ms SQL
- Oracle
- Informics
- Any other State \_\_\_\_\_

25. Is the system single or multiuser? \_\_\_\_\_. If multiuser how many clients' machines are in the network? \_\_\_\_\_ **(Please Specify number)**

26. What systems are supported in your factory: **(Please tick all that apply)**

- Transaction processing
- Payment processing
- Cheque processing
- Marketing automations
- SMS banking
- Internet banking capabilities
- Payroll processing
- Others: Please State \_\_\_\_\_

27. How do you input data to the systems? **(Please tick all that apply)**

- Manual Data Capture
- Electronic file transfer
- Flash disks
- Download through internet
- Using GSM technology

28. Which technologies are used to interlink your factory and Head Office? **(Please tick all that apply)**

- Digital leased lines
- Analogue Leased lines
- VSAT
- Wireless Technology
- GPRS/EDGE (GSM technology)
- Optic Fiber
- Branches not interconnected
  
- Others: State \_\_\_\_\_

29. What emerging services have you implemented or in the process of implementing **(Please tick all that apply)**

- SMS

- Factory information access through Internet.
- Use of Point of Sale (POS)
- Others -----(State)

30. Which technologies does your factory use to connect to the internet? (Please tick all that apply)

- No internet connection
- leased lines
- VSAT
- Dial up
- GPRS/EDGE (GSM technology)
- Optic Fibre
- Wireless

e. **Recommendations**

31. What other service improvements will you recommend to be implemented in your factory?

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## APPENDIX 4

### 7.4.2. CURRENT TYPE

KTDA LEAF COLLECTION SYSTEM

Transaction No: NS07-3378-C302145503

Leaf Collection Clerk: Everline Mogere

Timestamp: 02-03-2010 14:55hrs

Factory: NYANSIONGO TEA FACTORY CO. LTD

Centre: NS014 MATONGO NS014

Grower: 49 BONARERI OMWOYO

Tare Weight (Kg): 2.0000

Net Weight (Kg): 30.80000

Day's Net Weight (Kg): 45.600000

Monthly Todate (Kg) as at 17 FEB 2010 00:00: 60.4000

Cummulative Excluding today's net weight

**APPENDIX 5**  
**7.5 LETTER OF ONTRODUCTION**



**UNIVERSITY OF NAIROBI**  
**SCHOOL OF COMPUTING AND INFORMATICS**

Telephone: 4447870/4444919/4446544  
Telegrams: "Varsity" Nairobi  
Telefax: 254-020-4447870

P. O. Box 30197  
Nairobi  
Kenya

Ref: SCI/MSCIS/2006

22 May 2009

**TO WHOM IT MAY CONCERN**

**DATA COLLECTION FOR 2<sup>nd</sup> YEAR PROJECT OMWOYO JAIRO MAOSA**  
**P/56/P/7388/2006**

This is to confirm that the above named is a bonafide student at School of Computing & Informatics, Chiromo Campus, University of Nairobi pursuing an M.Sc degree course in Information Systems.

He is currently undertaking his research project titled "**Information framework for small-scale tea farmers using cellular technology**".

Kindly allow him to collect data within your organization and the data gathered will be used for academic purposes only.

Your assistance in terms of granting approval to collect the data will be highly appreciated.

A handwritten signature in cursive script, appearing to read 'A. B. M. Olimba'.

School of Computing & Informatics  
University of NAIROBI  
P. O. Box 30197  
NAIROBI

**MRS. A. B. M. OLIMBA**  
**FOR: DIRECTOR**  
**SCHOOL OF COMPUTING AND INFORMATICS**