ANALYSIS OF SOCIO-ECONOMIC FACTORS AFFECTING THE
YIELDS OF SMALLHOLDER COFFEE FARMERS
IN KIRINYAGA COUNTY, KENYA.

BY

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OCTOBER 2014
DECLARATION

“This Thesis is my original work and has not been presented for a degree in any other University”.

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Date

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DEDICATION

I dedicate this work to my family. My loving wife, Justa Kagendo, my dear children; Joel, Joanne and John for their great support and understanding during the period of my studies.
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**ABBREVIATIONS AND ACRONYMS**

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<tr>
<td>AEZ</td>
<td>Agro Ecological Zone</td>
</tr>
<tr>
<td>CBK</td>
<td>Coffee Board of Kenya</td>
</tr>
<tr>
<td>CDF</td>
<td>Coffee Development Fund</td>
</tr>
<tr>
<td>CRF</td>
<td>Coffee Research Foundation</td>
</tr>
<tr>
<td>GAP</td>
<td>Good Agricultural Practices</td>
</tr>
<tr>
<td>GNP</td>
<td>Gross National Product</td>
</tr>
<tr>
<td>GPP</td>
<td>Good Processing Practices</td>
</tr>
<tr>
<td>ICO</td>
<td>International Coffee Organization</td>
</tr>
<tr>
<td>HA</td>
<td>Hectare</td>
</tr>
<tr>
<td>KG</td>
<td>Kilogram</td>
</tr>
<tr>
<td>KSH</td>
<td>Kenya shillings</td>
</tr>
<tr>
<td>OLS</td>
<td>Ordinary Least Squares</td>
</tr>
<tr>
<td>UM₁</td>
<td>Upper midland one</td>
</tr>
<tr>
<td>UM₂</td>
<td>Upper midland two</td>
</tr>
<tr>
<td>UM₃</td>
<td>Upper midland three</td>
</tr>
<tr>
<td>USD</td>
<td>United States Dollars</td>
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ABSTRACT

Coffee is one of the key agricultural export commodities in the Kenyan economy. Prior to 1998, coffee was Kenya’s top foreign exchange earner and currently ranks fourth after tea, tourism and horticultural sub-sectors. Despite coffee prices displaying a stable trend increase since 2002, yields in Kirinyaga County have remained low. This has negatively impacted on the farmers earnings from the coffee enterprise thus affecting their economic wellbeing due to the loss of income. This study aimed at determining the socio-economic factors influencing yields as well as assessing the influence of coffee prices on re-investment and yields within the small holder sector of Kirinyaga County. A total of 251 farmers were selected from the study area using the stratified random technique and a semi-structured questionnaire used to collect the data. The selection of farmers was done by first dividing the entire population into several sub-populations referred to as strata. The three agro-ecological zones that are suitable for coffee growing in Kirinyaga County represented the strata. Due to logistical limitations, three co-operative societies cutting across the three zones were randomly selected and fourteen wet mills representing the various AEZs further selected to represent each stratum. Finally, farm households were randomly selected from each of the selected factories using the random number tables. The data was analyzed using descriptive statistics, regression (log – linear model) and correlation analysis using Stata (version11). The results indicated that the mean age of the respondents was 52.95 years. This suggests that the small holder coffee farming community is skewed towards the aging which could negatively affect productivity in the farms. Out of the 76.52% of the farmers who needed credit, only 36.8% had access to adequate credit. This lack of adequate credit limits productivity. The study revealed that only 35.4% of farmers were aware of the Coffee Development Fund despite the existence of institution since 2006. The multiple regression analysis showed an R² of 0.5217 for all variables investigated which means that 52.17% of the variation in yields can be explained by these variables. The explanatory variables which were statistically significant were access to adequate credit, having some source of cash from other enterprises or employment and consulting extension agents. It was also found that there was a strong positive relationship between price and the level of re-investment (Pearson’s r =0.814). This indicates that higher prices encourage reinvestment in coffee. However, the correlation analysis between price and yields showed a Pearson’s correlation coefficient of 0.154 which was statistically insignificant. This implies that although price influenced yields positively, it did not necessarily lead to significantly higher yields. Higher prices need to be supported by the three significant variables in order to increase yields significantly. Agricultural policy effort on small holder coffee farming should thus focus on ensuring farmers get access to adequate credit, diversification of farm income base, and training.
CHAPTER ONE: INTRODUCTION

1.1 Background information

Coffee was introduced in Kenya at the Coast Province by the French Holy Ghost missionaries in 1893. At independence in 1963, coffee production stood at 43,778 tons from a total hectareage of 45,538. The industry experienced phenomenal expansion after independence, through Government and donor-supported programmes to an estimated 170,000 ha in the 1989 (C.B.K, 2010). Coffee is produced under two distinct production systems namely small-scale holdings and plantations, currently estimated to be 700,000 and 4,000 respectively. The small-scale growers are organized into over 500 coffee co-operatives.

The smallholder plantings started in early 1930s in Meru and Kisii areas following the recommendations by the Devonshire White Paper report of 1923. The report was a policy paper issued by the Protectorate’s colonial secretary who indicated that African interests in the colony had to be paramount. This gave rise to the emergence of the smallholder sector operating under the auspices of marketing co-operative societies. The Swynnerton plan (1954) spurred an increase in small coffee farming across the country and in 1966, the smallholder production overtook that of estates.

1The Swynnerton Plan was a colonial agricultural policy that appeared as a government report in 1954 in Kenya. The aim was to intensify the development of agricultural practice in the Kenya Colony. The plan aimed at expanding the native Kenyan’s cash-crop production through improved markets and infrastructure, the distribution of appropriate inputs, and the gradual consolidation and enclosure of land holdings (Anderson, 2005).
Currently the ratio of estates to smallholder production stands at 40:60 (Karanja, 2002). However, although the small scale farmers produce about 60% of the national coffee output, they also account for 76% of the national acreage.

In the last two and a half decades, production has been on a steady decline from an all-time high of about 130,000 metric tons in 1987/1988 to a low of about 50,000 tons in the 2011/12 as shown by Figure 1.1. This decline has mainly been associated with the low coffee prices in the early 90s as a result of the breaking of the International coffee agreement in 1989 (G.o.K, 2010).

![National Coffee Production Trends](image)

Source: Coffee Board of Kenya (CBK, 2012)

**Figure 1.1: National Coffee production trends**

As illustrated by Figure 1.2 below, coffee yields have also been quite low. Nevertheless, Kenya is still renowned for producing some of the worlds' top grade
Arabica coffee beans. The coffee is highly valued due to its mildly acidic nature and is normally used in small quantities by international roasters to moderate and improve their standards blends (Mercy et al., 2010).

![Yields in Kgs of clean coffee per ha](image)

Source: Coffee Board of Kenya (CBK, 2012)

**Figure 1.2 : National Coffee yields trend**

The coffee prices have however exhibited a continuous improvement in the last 10 years as shown in Figure 1.3.
To revive the industry and reverse the trend shown in Figure 1.1, the government introduced a phased liberalization process from 1992. It introduced the payment of coffee in US Dollars in 1992 and liberalized coffee milling in 1994. In 2001, the Coffee Act number 9 was enacted following the repeal of Coffee Act Cap 333 (CBK, 2012). This de-linked the marketing and regulatory functions undertaken then by the Coffee Board of Kenya. The marketing function was privatized in the year 2002. The Board’s role was therefore redefined as regulatory, overall development and promotion of the industry (CBK, 2012). Other measures included inter-alia: Establishment of the Coffee Development Fund in 2006 to offer credit to coffee farmers, debt waiver to growers amounting Ksh 3.2 billion in 2006 and a further waiver of about Ksh 2 billion in 2012 to enable farmers get a regular income instead of servicing debts. An analysis of coffee farming in the small holder sector indicates
that currently, the coffee enterprise is a profitable business as shown in table 1.1 below. One would have therefore expected that farmers would enhance their yields given the level of return on investment.

The study was carried out in Kirinyaga County. It is the third largest county in Central Kenya after Nyandarua and Nyeri. The others are Muranga and Kiambu. The county was chosen because it is a major coffee growing area with all the agro-ecological zones where coffee can grow, is centrally placed within the major coffee growing region and was thus a good representative of other counties.

Table 1.1: Cost of production and returns for various yield levels in the smallholder sector

<table>
<thead>
<tr>
<th></th>
<th>Most farmers (over &gt;80%)</th>
<th>SL variety at 5kgs/tree</th>
<th>SL variety at 10kgs/tree</th>
<th>Batian and Ruiru II at 10kgs/tree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Produce 0 – 2kg/tree</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>from SL variety</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production kg clean coffee/acre</td>
<td>0 – 150kg</td>
<td>378kg</td>
<td>760kg</td>
<td>1400kg</td>
</tr>
<tr>
<td>Cost/acre (Sh.)</td>
<td>26,500</td>
<td>45,645</td>
<td>75,180</td>
<td>100,000</td>
</tr>
<tr>
<td>Cost/kg cherry (Sh.)</td>
<td>25.00</td>
<td>17.00</td>
<td>14.00</td>
<td>10.00</td>
</tr>
<tr>
<td>Net revenue per acre at Sh.40/kg cherry</td>
<td>16,110</td>
<td>61,755</td>
<td>139,620</td>
<td>300,000</td>
</tr>
<tr>
<td>% return</td>
<td>60%</td>
<td>135%</td>
<td>186%</td>
<td>300%</td>
</tr>
</tbody>
</table>

Source: Coffee Research Foundation (2012)
1.2 Problem statement

Despite coffee prices displaying a stable trend increase since 2002, yields in Kirinyaga County have remained low. For instance, in 2010/11 Nairobi Coffee Auction posted an average of 329.12 US dollars per 50 kilogram bag – a 293% increase in price from 83.73 US dollars posted in 2003/04 as shown by Figure 1.3 above, but there has not been a corresponding increase in yields as shown by Figure 1.4 below. Since coffee farming is an important activity in Kirinyaga County with many smallholder farmers depending on its proceeds for their livelihoods, low yields have affected the coffee farmers’ economic wellbeing due to the loss of income. There was therefore need to study the socio-economic factors influencing the low yields and assess the influence of the improved coffee prices on the small holder production in the county.

![Figure 1.4: Kirinyaga county coffee yields trends versus coffee auction prices](image)

Source: Coffee Board of Kenya (CBK, 2012) and Ministry of Agriculture reports (2012)

**Figure 1.4**: Kirinyaga county coffee yields trends versus coffee auction prices
1.3 Research Objectives

1.3.1 Main Objective

The main objective of this study was to analyze the causes of the low coffee yields in Kirinyaga County.

1.3.2 Specific objectives

The specific objectives of the study were;

i. To determine the socio-economic factors causing low coffee yields in the small holder sector of Kirinyaga County.

ii. To assess the influence of coffee prices on the level of reinvestment in coffee farming

iii. To assess the influence of coffee prices on yields in Kirinyaga County.

1.4 Research Hypotheses

i. $H_0$: Socio- economic factors, such as access to credit, amount of income other than credit, farm size, education level of household head; extension consultations and gender of household head do not influence the level of yields in the smallholder sector.

$H_1$: Socio- economic factors influence the level of yields in the smallholder sector.
11. \( H_0 \): Improvement in coffee prices does not lead to an increased reinvestment in coffee farming.

\( H_1 \): Improvement in coffee prices lead to an increased reinvestment in coffee farming.

111. \( H_0 \): Improvement in coffee prices does not have an impact on yields.

\( H_1 \): Improvement in coffee prices has an impact on yields

1.5 Significance of the Study

Low coffee yields is a major concern for coffee traders, researchers and policy makers. To the coffee traders, it's a loss of business opportunity; to the researchers it remains a challenging issue, while to the policy makers, it is an urgent issue that needs to be sorted out since the improvement of coffee farming is one of the flagship projects under the economic pillar of the vision 2030. The findings of this study guides the various stakeholders on the necessary actions to be taken so as to enhance the sectors' ability to contribute towards to the country's GDP and alleviate poverty in the country.

To the policy makers, this research gives insights for formulating appropriate government policies especially on aspects that touch on coffee yields as a way of alleviating poverty for small coffee producers in Kenya. The work thus contributes to the fulfillment of the economic pillar of the vision 2030, the country's development programme covering the period 2008 to 2030. To the coffee stakeholders, it creates awareness and useful insights to coffee dealers, marketers, millers and inputs
suppliers. This will enable them make better decisions on what areas the farmers need support. Consequently, it will lead to improved yields and hence higher incomes and thus reduced poverty.

The researchers will benefit from the information derived from this work since it will help explain the trend of low coffee yields in Kenya despite improved prices in the last 10 years and make proposals on areas that require further research. The work also sheds light on the degree of underlying issues such as the percentage of farmers who accesses extension services. This will assist researchers to determine the reason behind the various levels of adoption of technologies.

1.6 Limitations and assumptions of the study

The study set to investigate the factors causing low coffee yields in the small holder sector of Kirinyaga County and assess the influence of coffee prices on yields in that County. Generalizations to other coffee growing areas in Kenya should be done with caution since not all areas face similar circumstances. The variation in coffee growing areas therefore limits the extent of generalization of the results to the whole coffee sector. In addition, requesting for information which is considered secret and personal could have encouraged incorrect answers. I thus endeavored to explain to the respondents that this information will be treated with confidentiality.

Further, the cost of carrying out a comprehensive study in all the coffee regions was outside the reach of the researcher. This would have entailed facilitating numerous research assistants and widened the scope of the study. However, it is
hoped that the selected co-operative societies provided sufficient insights applicable to the whole sector.

The key assumptions made were that all coffee co-operative societies had records on farmers' production and that small holder farmers had knowledge on the number of trees they keep and were willing to give full disclosure of information regarding their age, credit sources and alternative sources of income. The time planned for the study was presumed to be adequate and the necessary resources were to be available for the planned study.

1.7 Theoretical framework

The study approached the problem from two theoretical perspectives; the price theory and the supply theory. It then built on other aspects that affect yields and as a result, supply. Given the fact that farmers in a particular situation face similar circumstances, price alone cannot explain the differences in farmers' yields. The framework thus looked at possible reasons for the differences in yields.

1.7.1 Price theory

In economic theory, the law of supply and demand is considered one of the fundamental principles governing an economy. It is described as the state where as supply increases, the price will tend to drop or vice versa, and as demand increases the price will tend to increase or vice versa. This is a basic principle regarding the relationship of goods and services against the demand for those goods and services (Friedman, 1990). Price is determined by the interaction between supply and
demand. An exchange of goods or services will occur whenever buyers and sellers agree on price and quantity. When an exchange occurs, the price agreed upon is called the "equilibrium price", or a "market clearing price" (Friedman, 1990). This can be graphically illustrated as shown in Figure 5 below.

Source: Friedman (1990)

**Figure 1.5: Equilibrium price**

In Figure 1.5 above, both buyers and sellers are willing to exchange the quantity "Q" at the price "P". At this point supply and demand are in balance or "equilibrium". At any price below P, the quantity demanded is greater than the quantity supplied. In this situation, the consumers would be anxious to acquire that quantity the producer is unwilling to supply resulting in a product shortage. In order to rationalize the shortage, consumers would have to pay a higher price in order to get the product they want; while producers would demand a higher price in order to bring more products in to the market. The end result is a rise in prices to the point P, where supply and demand are once again in balance. Conversely, if prices were to
rise above P, the market would be in surplus - too much supply relative to the demand. Producers would have to lower their prices in order to clear the market off excess supplies. Consumers would be induced by the lower prices to increase their purchases. Prices will fall until supply and demand are again in equilibrium at point P (Friedman, 1990).

1.7.2 Supply theory

Supply is defined as the quantity of a product that a producer is willing and able to offer the market at a given price in a given time period (Lipsey, 1986). The basic law of supply is that as the price of a commodity rises, so producers expand their supply onto the market. A supply curve for a commodity thus shows the relationship between its price and the quantity producer wish to sell in a certain period (Lipsey, 1986).

![Supply curve](source: Lipsey (1986))

**Figure 1.6: Supply curve**
A supply curve is drawn assuming ceteris paribus - i.e. that all factors influencing supply are being held constant except price. If the price of the good varies, we move along a supply curve. In the diagram above, as the price rises from P1 to P2 there is an expansion of supply. If the market price falls from P1 to P3 there would be a contraction of supply in the market. Businesses respond to price signals when making their output decisions. There are four hypotheses about what determines the quantity of a commodity that will be supplied by all the firms in a particular market (Lipsey, 1986). These are:

The price of the commodity: Ceteris paribus, the higher the price of any commodity, the more profitable will it be to make it. Higher prices send signals to firms that they can increase their profits by satisfying demand in the market (Lipsey, 1986).

The goals of firms: If producers of some commodity want to sell as much as possible, even if it costs some profits to do so, more will be offered for sale than if they wanted to make maximum profits. If producers are unwilling to take risks, we would expect smaller production of any good whose production is risky (Lipsey, 1986).

Changes in production technology: Production technologies can change quickly and in industries where technological change is rapid, we can see increases in supply. Changes in any one of the factors other than price can cause a shift in the supply curve as shown in the Figure 1.7 below. A shift in supply curve to the left indicate that amount the producers are willing to offer for sale at every price will be less.
However, it is important to note all these factors tend to affect all the farmers in a particular locality in a similar way. For instance, the price of coffee applies to all the farmers in a particular co-operative society since all farmers are paid the same per kilogram of cherry delivered. Therefore, there must be other reasons that influence yields. This was the primary concern in this research.

1.8 Conceptual framework

Social economic factors that affect farmers’ circumstances are likely affect yields. These include: financial factors such as access to credit, amount of other income other than credit; demographic factors such as education level of house hold head and age of coffee farmers as well as cultural issues such as gender of house hold heads. Figure 1.8 therefore shows how these factors (independent variables) jointly
affect yields (dependent variable) hence impacting on the household incomes and thus the welfare of these families.

Independent Variables

**Financial factors**
- Price
- Access to adequate credit
- Alternative income amount

**Demographic factors**
- Age of coffee farmers
- Years of education
- Consulting extension

**Socio-Cultural factors**
- Gender of household head

Dependent Variables

- Household Incomes
- Living standards
- Household welfare
- Enhanced or reduced re-investment

Source: Adopted from Tina et al. (2009)

**Figure 1.8: Conceptual framework**
CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Most studies on coffee seem to focus on adoption of technologies while others seek to explore the technical efficiencies for various production systems. Such coffee farming systems studies indicate that most research work recommends the utilization of agronomic practices such as proper spacing, clean weeding, use of manure and pruning as a way of increasing yields (Kalyebara, 1999). However, it emerges from studies on other crops that there are many socio-economic factors that influence yields of various agricultural commodities. For instance, while studying the socio-economic factors influencing yields of arable crops in Osun State, Nigeria, Adesoji and Farinde (2006), found out that socio-economic characteristics of small scale farmers such as age, level of education and access to credit influences the yields of arable crops such as maize, cowpeas, yams and cassava. Such studies were important in understanding the socio-economic factors influencing coffee yields in Kirinyaga County. This particular study focused on determining the socio-factors that could be behind the low coffee yields despite the improved prices with the aim of addressing the economic wellbeing of farmers in the coffee growing areas.

2.2 Review of previous studies

2.2.1 Commodity price movements review

Movements in commodity prices are important for the welfare of both developing and developed countries (Daude et al., 2010). Commodity prices tend to exhibit
particular characteristics that differentiate them from other traded goods. This is reflected in short-term volatility, occasional price spikes and the possibility of a relative decline in commodity prices over the long-run. Against the background of relatively low prices over the 1990s and early 2000s, price pressures started to accumulate around 2005–08, leading to the commodity price spike of 2007–08 (Corriston, 2011). By late 2008, the prices for many staple commodities were more than double what they had been only a few years earlier. With the recent forecasts of commodity price developments over the next few years and the world population expected to reach 9 billion by 2050 (FAO, 2009), the pressures on the global agriculture and food sector over the next few years are unlikely to diminish, particularly against the background of prolonged under-investment in agriculture (most notably in developing countries) and the possibility that the agricultural sector will be more susceptible to the vagaries of the environment (Corriston, 2011).

It has been argued that high commodity price volatility can reduce the welfare of the poor – such as the smallholder farmers who have limited price risk management strategies (Karanja, 2002). However, one may also expect farmers to take advantage of improved coffee prices to raise their incomes and thus improve their welfare especially when prices show an upward trend for a number of years. Apparently, this was not the case with coffee yields in Kenya. A study on the reasons underlying factors was thus necessary.
2.2.2 Review of studies on socio-economic factors that influence yields

Available literature does not explain why despite the improvement in coffee prices coffee yields remains low. However, studies conducted some time ago on technology adoption shed some light on the factors at play. It was observed that resource constraints, ignorance, extension influence, off-farm employment, and conditions attached to rural credit were major determinants of adoption of coffee production recommendations (Ngatia and Kabaara, 1976). Further, availability of cash, access to inputs on credit, risk aversion, and availability of manure affect adoption of soil fertility management recommendations (Njagi, 1980). Namwata et al., (2010) found that access to extension and credit services were positively associated with adoption of technologies and hence higher yields are. He explained that regular contact with extension agents makes farmers aware of new technologies and how they can be applied while access to credit enables them to buy inputs required by improved technologies.

In Nigeria, while studying the impact of socio-economic factors on the performance of small-scale enterprises in Osun state, Aworemi et al. (2007) found that age, gender and education level of the respondents has significant contribution to the performance of small scale enterprises, measured in terms of profitability. Similar results were observed by Adesoji and Farinde (2006) while studying the socio-economic factors influencing yields of arable crops in Osun state, Nigeria. They also found that access to credit influences the yields of arable crops such as maize, cowpeas, yams and cassava.
In Cote-de-ivore, it has been observed that producers' level of education and access to credit were some of the factors that affect production (Amadou, 2007). Kebede et al. (1990) also observed farm size, farm income, family size, access to information, and education as having significant effect on adoption of fertilizer, single-ox, and pesticide technologies in Ethiopian crop production systems.

In Ghana, studies on adoption of the cocoa production technologies have indicated that the key determinants for adoption of agricultural technologies include: Farmer's educational level, time of residence in the area, availability and quality of extension, farmer's experience, farm size, cropping systems, profitability of the new technology, off-farm income, adequate provision of inputs, availability of timely credit, transportation, social capital (farmer associations, etc.) and functional marketing channels (Jatoe et al., 2005; Mazuze, 2007). It is believed that these socio-economic factors determine the adoption of technologies and hence yields (Aneani et al., 2012).

Coelli and Battese (1996) analyzed the factors affecting the output of Indian coffee farmers, and found a positive correlation between output and the level of education and age of the farmers. On the other hand, Battese and Coelli (1995) found a negative relationship between output and the producer's age, but a positive relationship between output and the educational level of the producer.

Ajibefun et al. (1996) found positive correlations between the degree of technical inefficiency and the farmer's age, farm size and proportion of hired labor used, and a negative correlation between the degree of inefficiency and the producer's
experience. Seyoum et al. (1998) also observed technical inefficiency of maize farmers’ productivity in Eastern Ethiopia as a decreasing function of the farmers’ educational level and the number of hours of instruction received by those farmers who participated in the extension service’s modern technology project.

While looking at efficiency in resource use on smallholder Irish potato farmers in Kenya, Nyagaka et al. (2010) used the Tobit model and found those farmers with more years of formal education were more efficient than their counterparts. More educated farmers are able to perceive, interpret and respond to new information and adopt improved technologies such as fertilizers, pesticides and planting materials much faster than their counterparts. Educational status can thus be assumed to influence coffee production positively because with higher level of education, the farmer would be in a position to technically and economically access a new technology and thus enhance its adoption (Aneani et al., 2012). Similarly, Abdulai and Eberlin (2001) established that an increase in human capital will augment the productivity of farmers since they will be better able to allocate family-supplied and purchased inputs, select and utilize the appropriate quantities of purchased inputs while applying available and acceptable techniques to achieve the portfolio of household pursuits such as income. From these studies, it can be concluded that the more educated the coffee farmers are, the higher the yields one would expect them to produce. The study therefore explored the extent of the influence of the levels of education on yields.
According to Oniah and Kuye (2012), older farmers are less likely to have contact with extension workers and are equally less inclined to adopt new techniques and modern inputs, whereas younger farmers, by virtue of their greater opportunities for formal education, may be more skillful in the search for information and the application of new techniques. This, in return, will improve their level of technical efficiency. Age of coffee farmers is thus predicted to have a negative impact on yields because as the age increases, physical strength tends to reduce and this is assumed to impact negatively on yields. This was the basis for inclusion of farmers age in the model.

Access to extension has a positive relationship with yields (Nyagaka et al., 2010). This implies that efficiency increases with the number of visits made to the farm household by extension workers. Frequent visits to the farmers by the extension agent would provide the farmer with necessary information about the availability of needed resources, market and prices as well as the profitability status of the new technology to clear any doubts and uncertainties concerning it to increase the probability of its adoption (Nyagaka et al., 2010). While working on Sasakawa-Global 2000 project to assess the productivity of maize producers in eastern Ethiopia, Seyoum et al. (1998) found a 14% difference in technical efficiency between farmers who had access to extension services and those who did not. Extension workers play a central role in informing, motivating and educating farmers about available technology for coffee farmers in Cameroon (Nchare, 2007). In this
study therefore, consultation with extension service was thus explored as one of the variables that influence yields in coffee production.

While undertaking a study on economic efficiency of smallholder Irish potato producers in Nyandarua North District of Kenya, Nyagaka et al. (2009) used a parametric stochastic efficiency decomposition approach to measure the economic efficiency in Irish potato production and found out that access to credit has a positive effect on the level of technical efficiency. This suggests that on average, farmers with access to credit tend to exhibit higher levels of yields. Similar results were obtained by Binam et al. (2006) and Amadou, (2007) while undertaking studies on small scale farmers in Cameroon. Access to credit permits a farmer to enhance efficiency by overcoming liquidity constraints which may affect their ability to apply inputs and implement farm management decisions on time. Use of credit therefore loosens financial constraints, ensures timely acquisition and use of inputs and results in increased economic efficiency. Further, it reduces the financial difficulties farmers face at the beginning of the crop year, thus enabling them to make rational decisions for the season and hence increasing yields. Access to credit in the form of cash is thus predicted to have a positive influence on yields since the farmer receiving credit would have the capability to purchase the necessary resources for the cultivation of coffee.

In a study to determine the factors influencing adoption of improved agricultural technologies for Irish potatoes in Tanzania, increased household income was significantly positively associated with adoption of improved technologies and thus
higher yields (Namwata et al., 2010). Similar findings have been reported in several studies. Franzel (1999) argued that higher income farmers may be less risk averse, have more access to information, have longer-term planning horizon, and have greater capacity to mobilize resources and hence increased likelihood of adopting new technologies. Levels of income from other sources other than coffee was thus included as one of the variables to be investigated in this study.

Being a male or married by a household head were significantly positively associated with adoption of improved technologies (Franzel, 1999) leading to higher yields. This study endeavored to look at the extent to which gender influences yields.

2.3 Overview of coffee yields potential

The economic value of Arabica coffee is determined both by the yield potential and the bean quality (Agwanda et al., 2003). Yields of five tons per hectare and higher have been obtained in some close-spaced and unshaded Arabica coffee blocks e.g. in Brazil, Colombia and Kenya (Sondahl et al., 2005). However, most smallholder Arabica coffee farmers produce less than 300 kg of green coffee beans per hectare per year, while intensively managed plantations at conventional spacing may yield an average of two tons per hectare annually (Van der Vossen, 2005). Field trials at Coffee Research Foundation indicate that Ruiru 11 cultivar can produce between 2.5 and 3.0 tons per hectare per year (Van der Vossen, 2009). This implies that the smallholder farmers have the potential to produce much higher yields than they have been producing. It was therefore important to do this study in order to determine the factors that cause low yields in the smallholder sector.
CHAPTER THREE: RESEARCH METHODOLOGY

3.0 Introduction

A survey design was used to gain insight into the general picture of the situation without analyzing the whole population. A representative sample was taken from the population using the stratified random sampling technique. Both descriptive and inferential analyses of the survey data were employed.

3.1 Study area

The study was carried out in Kirinyaga County. It is made up of four administrative districts: Kirinyaga East, Kirinyaga West, Kirinyaga south and Kirinyaga Central. It occupies an area of 1478 km$^2$ with the coffee zones covering approximately 30% (G.o.K, 2010). It has a moderate population density of 309 persons/km$^2$. Between 1979 and 1999, its population grew from 291,431 to 457,105 an increase of 2.84% per year. It is estimated that the current population is approximately 520,000 people, majority of who derive their livelihoods from agricultural activities (G.o.K, 2006). Seventy percent of the county is arable with a high agricultural potential. The rainfall distribution is bimodal and averages between 900-2100 mm annually. The average farm size is approximately 0.8 hectares. The major agricultural enterprises include dairy, tea, coffee, rice, cotton, maize and beans (intercrop) and bananas. The Agro-Ecological zones range from UH$_1$ (Tea - dairy zone) to LM$_4$ (marginal cotton zone) with the coffee zones covering approximately 30% of the agricultural land (G.o.K, 2006). Generally, farmers do not apply adequate
fertilizers and manure on their farms. Thus, average farm inputs and outputs are very low (G.o.K, 2006).

3.2 Study design

The study was a survey design employing both quantitative and qualitative methods. A survey design is useful in gaining insight into the general picture of the situation without analyzing the whole population. A qualitative approach enables the collection of data in actual context in which the phenomena occurs. Bell (1993), stated that quantitative approach has the advantage of getting responses on the same questions from a large pool of respondents and these can be quantified in order to make appropriate conclusions.

3.3 Population

The target population in this study comprised of the small holder coffee farmers of Kirinyaga county. The target population comprised of 47,610 coffee farmers (G.o.K, 2012). The population was stratified according to the various Agro-ecological zones and further into coffee co-operative societies and factories. At the factory level, random selection of individual farm households was done to avoid bias.

3.4 Sample and sampling technique

3.4.1 Sample size

According to Miaoulis and Michener (1976) and Mugenda and Mugenda (2003), the appropriate sample size in social science research is determined largely by three
factors: The estimated prevalence of the variable of interest — low coffee yields in this instance, the desired level of accuracy (95% confidence level in my research) and the acceptable margin of error or the level of precision (5% in my case).

The sample size required can thus be calculated according to the following formula outlined by Mugenda and Mugenda (2003).

\[ n = \frac{Z^2 \times pq}{d^2} \]

Where:

- \( n = \) required sample size (if the target population is greater than 10,000)
- \( Z = \) the value of the standard normal deviate at the required confidence level (at 95% the standard value is 1.96)
- \( p = \) The proportion of the target population estimated to have the characteristic being measured. In this case, the estimated prevalence of low yields in the area while \( q = 1 - p \)
- \( d = \) the level of statistical significance test i.e. margin of error at 5% (standard value of 0.05)

In the coffee main growing areas, it has been estimated that approximately 80% (0.8) of the small scale farmers get low yields (Coffee Research Foundation, 2010). Using the standard values listed above, the required sample size becomes:

\[ n = \frac{1.96^2 \times 0.8(1-0.8)}{0.05^2} \]
The data was thus collected from 251 farms from the three main coffee agro-ecological zones.

3.4.1 Sampling technique

Farm level data was collected by adopting the stratified random sampling design. The goal of this design was to achieve the desired representation from various subgroups in the population (Mugenda and Mugenda, 2003). According to Kothari (2011), if a population from which a sample is to be drawn does not constitute a homogenous group, stratified sampling is generally used in order to obtain a representative sample. Under this method, the total population was divided into several sub-populations that are more homogenous than the total population. These sub-populations are referred to as strata (Kothari, 2011). In this case, the three agro-ecological zones that are suitable for coffee growing in Kirinyaga represented the strata. These are the coffee – tea zone (upper midland one - UM1), the main coffee zone (upper midland two -UM2) and the marginal coffee zone (upper midland three -UM3). Generally, it is known that 25% of the coffee farmers are in UM1, 50% in UM2 and about 25% in UM3 (G.O.K 2006). Therefore, 62 farmers were sampled from UM1, 126 from UM2 and 62 from UM3. To achieve this, three co-operative societies cutting across the three zones were randomly selected and fourteen wet mills representing the various AEZs further selected to represent each stratum due to logistical limitations. Finally, farm households were randomly selected from each of the selected factories using the random number tables. The study adopted the
Tippets random number tables which are generally used (Kothari, 2011). Farmers' membership numbers were used as the farmers' exclusive identity. The interviewed 251 households from the three main clusters of agro-ecological zones were distributed as shown in Table 3.1.

**Table 3.1 Distribution of respondents in the various agro-ecological zones**

<table>
<thead>
<tr>
<th>AGRO - ECOLOGICAL ZONE</th>
<th>No. OF HOUSEHOLDS IN THE STRATA</th>
<th>No. OF HOUSEHOLDS INTERVIEWED</th>
</tr>
</thead>
<tbody>
<tr>
<td>UM1</td>
<td>11,900</td>
<td>62</td>
</tr>
<tr>
<td>UM2</td>
<td>23,810</td>
<td>127</td>
</tr>
<tr>
<td>UM3</td>
<td>11,900</td>
<td>62</td>
</tr>
<tr>
<td>TOTAL</td>
<td>47,610</td>
<td>251</td>
</tr>
</tbody>
</table>

Source: Author (2013)

To get data for objective three, one more co-operative society was randomly selected in addition to the three selected above because for quantitative analysis a sample size of 30 is needed (Mugenda and Mugenda, 2003). Consequently, 30 wet mills out of the 77 in Kirinyaga County were selected using the stratified technique.

### 3.5 Research instruments

A structured questionnaire was used to collect data from the respondents. Although it is costly, this method was selected because it can lead to fairly reliable results (Kothari, 2011). Both open and closed ended questions were used. Open ended questions helped in collection of more in-depth responses from the respondents while closed ended ones were quicker to administer and analyze.
3.6 Variables

The dependent variable in this study was yields while the independent variables were: access to credit, adequacy of the credit, and amount of income other than credit, education level of household head, gender of household head and age of coffee farmers. These variables were adopted from studies undertaken by Aworemi et al. (2010), Adesoji and Farinde (2006) and by Ayoola et al. (2011).

3.7 Model specification

3.7.1 Mathematical specification

\[ Y = f(CA, IOS, FS, ESC, EHH, GHH, AHH) \]

Where:

\[ Y = \text{Yields} - \text{the dependent variable measured in Kgs per tree} \]

\[ A = \text{Access to adequate credit (dummy variable)} \]

\[ IOS = \text{Income from other sources other than credit - such as employment, tea, dairy etc. (measured in units of Ksh10, 000/-)} \]

\[ FS = \text{Farm size - (acres)} \]

\[ ESC = \text{Extension services consultation – either trainings, demonstrations or other educational contacts (dummy variable)} \]

\[ EHH = \text{Education level of Household Head (Years of education)} \]

\[ GHH = \text{Gender of Household Head (dummy variable)} \]

\[ AHH = \text{Age of Household Head (Number of years)} \]
3.7.1 Econometric model

The econometric model was adopted from a study undertaken by Adesoji and Farinde (2006). Their model looked at the socio-economic factors influencing yields of arable crops in Osun State, Nigeria. The proposed model was:

$$\ln Y_i = \beta_0 + \beta_1 CA + \beta_2 IOS + \beta_3 FS + \beta_4 ESC + \beta_5 EHH + \beta_6 GHH + \beta_7 AHH + \epsilon$$

Where $\beta_0$ is the $Y$ intercept, $\beta_1$ to $\beta_7$ the slope coefficients and $\epsilon$ the error term. In this model, the slope coefficient measures the percentage change in $Y$ for a given absolute change in the value of the regressor (Gujarati, 2007).

3.8 Data collection procedure

Both primary and secondary data were used in this study. The secondary data set was obtained from the existing co-operative society’s members’ cherry delivery reports. The primary data set was obtained by administering a semi-structured questionnaire on 251 farm households selected using the stratified random technique. The researcher visited the selected co-operative societies, the wet mills and the selected individual members and administered the questionnaires with the assistance of trained enumerators. The Data set on production and prices from 30 out of the 77 wet mills in Kirinyaga was also was also collected.

3.9 Data processing and analysis

3.9.1 Data processing

Before carrying out the analysis, the data was first processed. This entailed editing, coding, classification and tabulation of the collected data to make it
amenable for analysis (Kothari, 2011). The editing was done to ensure the data was accurate, consistent with other facts gathered, uniformly entered, complete as possible and arranged to facilitate coding and tabulation. Coding was done to ensure that a specific answer could only be placed in one and only one cell in a given category set (Kothari, 2011).

3.9.2 Data analysis

Descriptive and inferential analyses of the survey data were done. Descriptive statistics such as measures of central tendency (mean, frequency distribution and percentages) and measures of dispersion (variance, standard deviation and range) were used to explore the underlying features of the data. The descriptive statistics covered all response variables and provided the basic features of the data collected on the variables and thus provided the impetus for conducting further analysis on the data (Mugenda and Mugenda, 2003).

Regression analysis using the ordinary least square estimation was employed to determine factors affecting coffee yields in the study area. Correlation analyses were done to determine whether a linear relationship between price and investment and between price and yields existed.

3.9.2.1 Multiple regression analysis: Estimation of the cause of low yields

The multiple log-linear regression model was used to estimate the cause of low yields. According to Gujarati (2007), we obtain the mean value of Y or the mean response of Y for the given values of the regressors. The model whose parameters were determined using the OLS is as described in section 3.7.
To measure the goodness of fit, \( (R^2) \) the multiple coefficient of determination, was used to measure the amount of variation in the dependent variable explained by the independent variables. The closer the \( R^2 \) is to 1, the better the fit of the regression line to the actual data but only if there is no multicollinearity (Gujarati, 2007). In the presence of multicollinearity, the standard errors of the affected coefficients tend to be large. In that case, the test of the hypothesis that the coefficient is equal to zero leads to a failure to reject the null hypothesis.

**Testing of the functional form of the regression**

The Mackinnon, White and Davidson (MWD) test defined by Gujarati (2007), was used to choose between the linear and log-linear regression models where;

- \( H_0: \) Linear model: \( Y \) is a linear function of regressors, the \( X \)'s.
- \( H_1: \) Log-linear Model: \( \ln Y \) is a linear function of regressors, the \( X \)'s.

The procedure has the following steps;

- **Step 1:** Estimating the linear model and obtaining the estimated \( Y \) values i.e. \( Y_f \) (\( Y^\wedge \))
- **Step 2:** Estimating the log-linear model and obtaining the estimated \( \ln Y \) values i.e. \( \ln f(\ln Y^\wedge) \)
- **Step 3:** Creating a variable \( Z_1 = (\ln Y_f - \ln f) \) or simply \( \ln (Y^\wedge) - \text{predicted}(\ln Y^\wedge) \)
- **Step 4:** Regressing \( Y \) on \( X \)'s and \( Z_1 \) obtained in step 3 and rejecting \( H_0 \) if the coefficient of \( Z_1 \) is statistically significant
- **Step 5:** Creating a variable \( Z_2 = (\text{antilog of } \ln f - Y_f) \) or simply \( \text{anti}(\ln Y^\wedge) - Y^\wedge \)
- **Step 6:** Regressing log of \( Y \) on the \( X \)'s and \( Z_2 \) and rejecting \( H_1 \) if the coefficient of \( Z_2 \) is statistically significant. The logic behind this test is that if the linear model is in
fact the correct model, the constructed variables $Z_1$ should not be statistically significant for in that case the estimated $Y$ values from the linear model and those estimated from the log-linear model (after taking their antilog for comparative purposes) should not be different (Gujarati, 2007). The same applies to the alternative hypothesis.

**Heteroscedasticity test**

Heteroscedasticity is a violation of one of the requirements of ordinary least squares (OLS) in which the error variance is not constant (Gujarati, 2007). The consequences of heteroscedasticity are that the estimated coefficients are unbiased but inefficient. The variances are either too small or too large, leading to Type I error where the Null hypothesis is rejected when it is true or Type II error where one fails to reject a false Null hypothesis. Heteroscedasticity is mainly prevalent in cross-sectional data set such as the one used in this study. Some of the main causes are model misspecifications, measurement errors, outliers in the data set and subpopulation differences. Breusch-Pagan / Cook-Weisberg test was used to test for heteroskedasticity in the variables.

**Multicollinearity test**

Multicollinearity is a statistical phenomenon in which two or more predictor variables in a multiple regression model are highly correlated. Multicollinearity does not reduce the predictive power or reliability of the model as a whole, but the standard errors of the affected coefficients tend to be large. In that case, the test of the hypothesis that the coefficient is equal to zero leads to a failure to reject the null
hypothesis (Gujarati, 2007). Therefore, an analyst might falsely conclude that there is no linear relationship between an independent and a dependent variable (Gujarati, 2007). According to Gujarati (2007), either the degree of tolerance or the variance inflation factor (VIF) can be used to test the hypothesis that there is absence of multicollinearity where:

\[
\text{tolerance} = 1 - R_j^2, \quad \text{VIF} = \frac{1}{\text{tolerance}}
\]

And \( R_j^2 \) is the coefficient of determination of a regression of explanator j on all the other explanators. When \( R_j^2 = 1 \) (i.e., perfect collinearity), tolerance = 0 and when \( R^2 = 0 \), (i.e., no collinearity whatsoever), tolerance = 1. A tolerance of less than 0.20 or a VIF of 10 and above indicates a multicollinearity problem (Gujarati, 2007).

**Hypothesis testing in the multiple regression model:**

Several tests were conducted. These are:

Testing hypothesis about the individual partial regression coefficient i.e. \( H_0: \beta_1, \beta_2, ..., = 0 \) and \( H_1: \beta_1, \beta_2, ..., \neq 0 \) using the \( t \) test. The \( t \) value calculated from the sample (\( t_{\text{calc}} \)) served as the test statistic. A large absolute \( t \) value compared with the \( t \) table is evidence against the null hypothesis (Gujarati, 2007).

Where the data did not support the null hypothesis, the \( p \) value was smaller than the level of significance \( \alpha \) since for any given sample, the \( p \) value decreases as the absolute \( t \) increases (Gujarati, 2007).

An F test was carried out in order to test the overall significance of the estimated multiple regression model. i.e. finding out if the all the partial slope coefficients are simultaneously equal.
to zero i.e. \( H_0 : \beta_1 = \beta_2 = \beta_3, \ldots = 0 \) where \( F = \frac{\text{ESS/df}}{\text{RSS/df}} \)

The null hypothesis would be rejected if the p value of the F statistic is greater or equal to 0.05.

3.9.2.2 Test Correlation analysis: Testing of the linear association between price and reinvestment/yields

Karl Pearson’s coefficient of correlation (\( r_{xy} \)) is the most widely used method of measuring the degree of linear relationship (association) between two variables (Kothari, 2011). Correlation analysis was used to explore the relationship between the coffee prices paid to the farmers (Kshs) at the co-operative society and the amount of cash (Kshs) re-invested in coffee farms as well as the relationship between those prices (price \( t-1 \)) and yields (yields \( t \)). The correlation coefficient, ranges from -1 to +1. A value of \( r \) near 0 indicates little correlation between the attributes while a value near +1 or -1 indicates a high level of positive and negative correlation respectively. The \( t \)-test was used to indicate whether the attributes are correlated in the population. A \( t \)-value far from 0 (either positive or negative) is evidence for the alternative hypothesis that there is correlation between the attributes (Gujarati, 2007). A p value for the \( t \)-statistic greater or equal to 0.05 would lead to failure to reject the null hypothesis.
CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter presents the results of the study. The results have been reported under the subheadings; socio-economic characteristics of the farmers, regression, heteroskedasticity and multicollinearity tests results, and the correlation analysis results between price, reinvestments and yields. The results are organized along the research objectives as set out in Chapter 1, but giving the descriptive socio-economic characteristics of the study participants first.

4.2 Socio-economic characteristics of the farmers

4.2.1 Age of the household heads

The findings showed that 15.14% of the respondents had ages between 18-35 years, 16.73% between 36-45 years, 29.48% between 46-55 years, and 17.93% between 56-45 years and 20.7% were over 65 years of age as shown in Figure 4.1.

![Age of Household Heads Chart](image)

Source: Author (2013)

Figure 4.1. Age of household heads
Table 4.1 below summarizes the characteristics of the various variables investigated. The average age of the farmers was 52.95 years with the youngest farmer being 20 years old and the oldest 91 as shown in Table 4.1.

Table 4.1. Summary of the characteristics of various variables

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>MEAN</th>
<th>STD. DEV</th>
<th>MIN</th>
<th>MAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE OF HEAD HOUSEHOLD</td>
<td>52.95</td>
<td>14.73</td>
<td>20</td>
<td>91</td>
</tr>
<tr>
<td>YEARS OF EDUCATION</td>
<td>8.16</td>
<td>3.70</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>FARM SIZE</td>
<td>2.23</td>
<td>2.57</td>
<td>0.25</td>
<td>25</td>
</tr>
<tr>
<td>AREA UNDER COFFEE</td>
<td>0.63</td>
<td>0.80</td>
<td>0.04</td>
<td>8.93</td>
</tr>
<tr>
<td>TOTAL No. OF TREES</td>
<td>348.21</td>
<td>432.82</td>
<td>35</td>
<td>4820</td>
</tr>
<tr>
<td>AVERAGE YIELDS PER TREE (kg)</td>
<td>2.31</td>
<td>2.47</td>
<td>0.1</td>
<td>19.9</td>
</tr>
</tbody>
</table>

Source: Author (2013)

4.2.2 Education of Household heads

The findings revealed that 6.05% of the household heads had no formal education, 51.21% had primary education, 34.68% had secondary education and 8.06% had tertiary education as shown in Table 4.2 below. The mean number of years of education was 8.16 years with a standard deviation of 3.7. This implies that majority - 85.89% had secondary or primary education hence are able to make informed decisions.
Table 4.2 Education status of household heads per age category

<table>
<thead>
<tr>
<th>Age</th>
<th>No</th>
<th>Primary</th>
<th>Secondary</th>
<th>Tertiary</th>
<th>Total</th>
<th>percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-35</td>
<td>1</td>
<td>14</td>
<td>17</td>
<td>6</td>
<td>38</td>
<td>15.14</td>
</tr>
<tr>
<td>36-45</td>
<td>0</td>
<td>19</td>
<td>19</td>
<td>4</td>
<td>42</td>
<td>16.73</td>
</tr>
<tr>
<td>46-55</td>
<td>2</td>
<td>39</td>
<td>31</td>
<td>2</td>
<td>74</td>
<td>29.48</td>
</tr>
<tr>
<td>56-65</td>
<td>4</td>
<td>26</td>
<td>10</td>
<td>5</td>
<td>45</td>
<td>17.93</td>
</tr>
<tr>
<td>Over 65</td>
<td>11</td>
<td>29</td>
<td>9</td>
<td>3</td>
<td>52</td>
<td>20.71</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>127</td>
<td>86</td>
<td>20</td>
<td>251</td>
<td>100</td>
</tr>
</tbody>
</table>

Percentage 6.05 51.21 34.68 8.06 100

Source: Author (2013)

4.2.3 Gender of the household heads and their marital status

The study indicated that 87.65% of the household heads were male while 12.35 % were females as shown in Figure 4.2. Majority, (84.86%) were married, 9.96 % widowed, 3.98% single and only 3.3% were separated as shown in Table 4.3.
% of household heads by gender

- Male 88%
- Female 12%

Source: Author (2013)

**Figure 4.2: Percentage of households lead by gender**

<table>
<thead>
<tr>
<th>Marital status</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Married</td>
<td>213</td>
<td>84.86</td>
</tr>
<tr>
<td>Widowed</td>
<td>25</td>
<td>9.96</td>
</tr>
<tr>
<td>Single</td>
<td>10</td>
<td>3.98</td>
</tr>
<tr>
<td>Divorced</td>
<td>3</td>
<td>1.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>251</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: Author (2013)

**Table 4.3 Marital status of household heads**

4.2.4 **Farm sizes, area under coffee and average number of trees per farmer**

Table 4.4 below reveals that 48.21% of the farmers in the study area had farm sizes of 1 acre or less, 43.83% had farm sizes of between 1.1 and 5 acres and only 7.97% had 5.1 acres or more. This shows that the farmers in the area had small farm
holdings. The average acreage in the area was 2.23 acres with a standard deviation of 2.37 while the minimum and maximum holdings was 0.25 and a maximum of 25 acres respectively as shown in Table 4.1 above. Further, majority of the farmers - over 55%, had 0.5 acres of coffee or less. Only 3% had more than 2 acres of coffee as indicated in Figure 4.3 below. The average area under coffee was 0.63 acres while the minimum and maximum acreage was 0.04 and 8.93 acres respectively. The average number of coffee trees per farmer was 348 with the minimum number and maximum number being 35 and 4820 respectively as shown in Table 4.1 above.

Table 4.4 Farm sizes in the study area

<table>
<thead>
<tr>
<th>Farm size (acres)</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 0.5</td>
<td>44</td>
<td>17.53</td>
</tr>
<tr>
<td>0.51-1.0</td>
<td>77</td>
<td>30.68</td>
</tr>
<tr>
<td>- 2.0</td>
<td>47</td>
<td>18.73</td>
</tr>
<tr>
<td>2.1 - 5.0</td>
<td>63</td>
<td>25.10</td>
</tr>
<tr>
<td>5.1-10.0</td>
<td>15</td>
<td>5.98</td>
</tr>
<tr>
<td>Over 10 acres</td>
<td>5</td>
<td>1.99</td>
</tr>
<tr>
<td>Total</td>
<td>251</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Author (2013)
4.2.5 Consultation with extension staff or attending a coffee training

The percentage of farmers who had consulted extension staff or attended training in the last three years was 72.11% as shown in Figure 4.4. Of these, 94.74% attended field training while only 5.26% went to an office to seek advice as shown by Figure 4.5. Those who did not consult or attend any training were 27.89%.

Source: Author (2013)

Figure 4.4 Percentage of farmers who consulted extension staff or attended a Coffee training
The figure below shows the forums for extension contacts.

![Percentage extension forums](image)

Source: Author (2013)

**Figure 4.5 Types of extension forums**

### 4.2.6 Credit analysis results

Figures 4.6 to 4.9 show that 76.52% of the farmers needed credit while 23.48% did not need credit to farm their coffee. Those who did not need the credit gave varying reasons with 31.48% indicating that they had enough money while 27.78% feared zero net returns if the credit borrowed was deducted. About 81% had access to credit while 18.95% indicated that they had no access. Of those who were able to access credit, 54.98% did not get adequate credit while 45.02% got adequate credit. Most of the credit, 86.6% was sourced from the co-operative societies with only 4.24% being sourced from the banks as indicated in Table 4.5. None of the farmers indicated to have borrowed from the Coffee Development Fund despite the fund being in existence for over seven years. Indeed 63.92% were not even aware of its existence.
Percentage of farmers who need credit

- 23.48% need credit
- 76.52% don't need

Source: Author (2013)

Percentage of farmers who had access to some credit

- 81.04% have access
- 18.96% don't have

Source: Author (2013)

Figure 4.6 Percentage of farmers who needed credit

Percentage of farmers who got adequate credit

- 54.98% adequate
- 45.02% not adequate

Source: Author (2013)

Figure 4.7 Percentage of farmers who had access to some credit

Percentage of farmers aware of CoDF

- 35.44% Aware
- 63.92% Not aware

Source: Author (2013)

Figure 4.8 Percentage of farmers who accessed adequate credit

Figure 4.9 Percentage of farmers aware of the existence of the CoDF
Table 4.5 Sources of credit

<table>
<thead>
<tr>
<th>Credit source</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-operative society</td>
<td>142</td>
<td>86.06</td>
<td>86.6</td>
</tr>
<tr>
<td>Commercial banks</td>
<td>7</td>
<td>4.24</td>
<td>90.3</td>
</tr>
<tr>
<td>SACCOS</td>
<td>16</td>
<td>9.7</td>
<td>100</td>
</tr>
<tr>
<td>Totals</td>
<td>165</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Source: Author (2013)

4.2.7 Farmers yields analysis results

Majority of the farmers, 72.91% were producing 3 kilograms of cherry per tree or less. About 19.52% were producing between 3-5 kilograms, 6.37% between 5.01 and 10 kilograms and only 1.2 percent were producing over 10 kilograms as shown in Table 4.6 below. The mean yield was 2.31 kilograms per tree with a standard deviation of 2.47. The lowest yield was 0.1 and the highest was 19.9 kilograms. This confirmed the secondary data collected before the study as in G.o.K (2006).
Table 4.6 Yield categories in the households of the small holder sub-sector

<table>
<thead>
<tr>
<th>Yields (Kg/tree)</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00 - 1.00</td>
<td>87</td>
<td>34.66</td>
<td>34.66</td>
</tr>
<tr>
<td>1.01 - 2.00</td>
<td>61</td>
<td>24.30</td>
<td>58.96</td>
</tr>
<tr>
<td>2.01 - 3.00</td>
<td>35</td>
<td>13.94</td>
<td>72.91</td>
</tr>
<tr>
<td>3.01 - 5.00</td>
<td>49</td>
<td>19.52</td>
<td>92.43</td>
</tr>
<tr>
<td>5.01 - 10.00</td>
<td>16</td>
<td>6.37</td>
<td>98.80</td>
</tr>
<tr>
<td>Over 10</td>
<td>3</td>
<td>1.2</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Source: Author (2013)

4.3 Results of the regression analysis and tests for heteroskedasticity and multicollinearity

4.3.1 Regression analysis results for socio-economic factors affecting yields

The impact of the socio-economic factors on the yields of small scale coffee enterprises in the study area are shown in Table 4.7 below. Seven variables were used to explain and predict the effects of socio-economic factors on the performance of the enterprise. The multiple coefficient of determination, $R^2$ was 0.5217 which was highly significant. Among the regressors, only access to adequate credit, having income from other sources and consulting extension services were statistically significant at 5% level. Farm size was significant at 10% level. This means that only
access to credit, having income from other sources and undergoing training on coffee farming had significant influence on yields.

### Table 4.7 Summary of regression results

| Variable                      | Coefficient | Std error | t-statistic | p >|t| |
|-------------------------------|-------------|-----------|-------------|-----|
| Access to adequate credit     | 1.249       | .091      | 13.76       | 0.000*** |
| Income from other sources     | 0.015       | 0.005     | 3.00        | 0.003** |
| Farm size                     | -0.036      | 0.019     | -1.94       | 0.053*  |
| Years of education            | 0.014       | 0.014     | 1.02        | 0.310   |
| Extension services            | 0.212       | 0.099     | 2.14        | 0.033** |
| Gender of household head      | -0.076      | 0.140     | -0.54       | 0.587   |
| Age of household head         | -0.003      | 0.004     | -.79        | 0.432   |
| Constant                      | -0.223      | 0.265     | -.084       | 0.402   |

Number of Observations = 251  \( F (7, 243) = 37.87 \)  Prob \( > F \) = 0.0000***

\( R^2 = 0.522 \)  Adjusted \( R^2 = 0.508 \)

***, **, * Signify significant at 1%, 5% and 10% levels respectively

Source: Author (2013)

#### 4.3.2 Results for the tests between the linear and log-linear functional forms

Linear model run with \( Z_1 = \ln(Y^\wedge) - (\ln(Y^\wedge)) \) and

Log-linear model run with \( Z_2 = \text{antilog of } (\ln(Y^\wedge) - Y^\wedge) \)
Table 4.8: Results for the tests between the linear and log-linear functional forms

<table>
<thead>
<tr>
<th>Variable</th>
<th>Linear model run with Z₁</th>
<th>Log-linear model run with Z₂</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R² = 0.377</td>
<td>R² = 0.526</td>
</tr>
<tr>
<td>Gender of HH</td>
<td>0.395 0.352</td>
<td>0.124 0.396</td>
</tr>
<tr>
<td>Age of HH</td>
<td>-0.006 0.569</td>
<td>-0.003 0.349</td>
</tr>
<tr>
<td>Education years</td>
<td>0.036 0.3620</td>
<td>0.013 0.040</td>
</tr>
<tr>
<td>Farm size</td>
<td>-0.035 0.503</td>
<td>-0.038 0.000</td>
</tr>
<tr>
<td>Access to adequate credit</td>
<td>2.687 0.000</td>
<td>1.255 1.076</td>
</tr>
<tr>
<td>Other cash amount</td>
<td>0.040 0.006</td>
<td>0.015 0.004</td>
</tr>
<tr>
<td>Extension consultation</td>
<td>0.208 0.471</td>
<td>0.204 0.040</td>
</tr>
<tr>
<td>Z</td>
<td>0.027 0.966</td>
<td>0.117 0.221</td>
</tr>
<tr>
<td>Constant</td>
<td>0.460 0.589</td>
<td>-0.350 0.346</td>
</tr>
</tbody>
</table>

Source: Author (2013)

According to Table 4.8, we cannot reject either the null or the alternative hypothesis since in both functional forms; the coefficients of Z are statistically insignificant (Gujarati, 2007). Therefore, to choose between the two models, further analysis using the Box Cox test was done.

The geometric mean of the dependent variable was first calculated and a new dependent variable equal to Y₁ / geometric Mean of Y created. Both forms of the model were re-estimated with the new dependent variable and the Residual Sum of Squares compared. According to Table 4.9, the log-linear model was the preferred
functional form since it had the lower RSS value of 112.645 compared with the linear model which had an RSS of 420.730 (Sakia, 1992).

Table 4.9: Regression results from the new dependent variable - Yi / geometric mean

<table>
<thead>
<tr>
<th>Model</th>
<th>$R^2$</th>
<th>SS regression</th>
<th>SS residual</th>
<th>SS total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>0.377</td>
<td>254.980</td>
<td>420.730</td>
<td>675.710</td>
</tr>
<tr>
<td>Log–linear</td>
<td>0.523</td>
<td>123.361</td>
<td>112.645</td>
<td>236.006</td>
</tr>
</tbody>
</table>

Source: Author (2013)

4.3.3 Heteroskedasticity and multicollinearity tests results.

Heteroskedasticity test results

According to Breusch-pagan / Cook-Weisberg tests for heteroskedasticity, the results in Table 4.10 show that there was no heteroskedasticity in the model. This is because to the test the null hypothesis, $H_0$: constant variance, the probability of getting a chi square greater or equal to 12.84 by chance must be less than 0.05 in order to reject the null hypothesis (Gujarati, 2007). According to the table, the p value for the overall model (0.0761) was greater than 0.05 thus the null hypothesis that there is uniform variance was not rejected. Therefore, the estimated coefficients are unbiased and efficient. The results in Table 4.10 also indicate that if gender was the only regressor, the model would have been incorrectly specified as indicated by
the p value (0.0323 is less than 0.05), implying that some important regressors would probably have been missing in the model.

**Table 4.10 Results for Breusch-pagan / Cook-Weisberg tests for heteroskedasticity**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Chi square</th>
<th>Prob &gt; chi square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to adequate credit</td>
<td>0.25</td>
<td>0.616</td>
</tr>
<tr>
<td>Income from other sources</td>
<td>0.65</td>
<td>0.420</td>
</tr>
<tr>
<td>Farm size</td>
<td>0.80</td>
<td>0.371</td>
</tr>
<tr>
<td>Years of education</td>
<td>1.15</td>
<td>0.283</td>
</tr>
<tr>
<td>Extension services consultation</td>
<td>1.15</td>
<td>0.283</td>
</tr>
<tr>
<td>Gender of household head</td>
<td>4.58</td>
<td>0.032</td>
</tr>
<tr>
<td>Age of household head</td>
<td>0.70</td>
<td>0.402</td>
</tr>
<tr>
<td>The entire model</td>
<td>12.84</td>
<td>0.076</td>
</tr>
</tbody>
</table>

Source: Author (2013)

**Multicollinearity tests results**

A tolerance of less than 0.20 or a VIF of 10 and above indicates a multicollinearity problem (Gujarati, 2007). Since all the VIF figures in Table 4.11 were greater than 10 and above, we can conclude that there was no multicollinearity. This means that our t-tests are correct.
Table 4.11 Multicollinearity tests results

<table>
<thead>
<tr>
<th>Variable</th>
<th>VIF</th>
<th>Tolerance = 1/VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to adequate credit</td>
<td>1.47</td>
<td>0.681</td>
</tr>
<tr>
<td>Income from other sources</td>
<td>1.46</td>
<td>0.687</td>
</tr>
<tr>
<td>Farm size</td>
<td>1.22</td>
<td>0.818</td>
</tr>
<tr>
<td>Years of education</td>
<td>1.17</td>
<td>0.853</td>
</tr>
<tr>
<td>Extension services consultation</td>
<td>1.10</td>
<td>0.907</td>
</tr>
<tr>
<td>Gender of house hold head</td>
<td>1.10</td>
<td>0.911</td>
</tr>
<tr>
<td>Age of household head</td>
<td>1.07</td>
<td>0.935</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td><strong>1.23</strong></td>
<td><strong>0.813</strong></td>
</tr>
</tbody>
</table>

Source: Author (2013)

4.4 Results for correlation analysis between price and the level of re-investment

Table 4.12 showed that there was a strong positive relationship (Pearson’s r =0.814) between price and the level of reinvestment. This relationship was also statistically significant at 5%. This means that changes in price were strongly correlated with changes in reinvestment.
Table 4.12 Correlation between price and re-investment

<table>
<thead>
<tr>
<th></th>
<th>Price</th>
<th>Re-investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>1</td>
<td>0.814*</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td></td>
<td>0.048</td>
</tr>
<tr>
<td>Sum of Squares and Cross-products</td>
<td>2944.175</td>
<td>387799.044</td>
</tr>
<tr>
<td>Covariance</td>
<td>588.835</td>
<td>77559.809</td>
</tr>
<tr>
<td>N</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Re-investment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>0.814*</td>
<td>1</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.048</td>
<td></td>
</tr>
<tr>
<td>Sum of Squares and Cross-products</td>
<td>387799.044</td>
<td>7.700E7</td>
</tr>
<tr>
<td>Covariance</td>
<td>77559.809</td>
<td>1.540E7</td>
</tr>
<tr>
<td>N</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

*Correlation is significant at the 0.05 level (2-tailed)

Source: Author (2013)

4.5 Results for correlation analysis between price and yields

Table 4.13 showed that there was a weak relationship (Pearson’s r =0.154) between price and yields. This means that changes in price were not strongly correlated with changes in yields although there was a positive relationship between them. This relationship was also statistically insignificant at 5%.
<table>
<thead>
<tr>
<th></th>
<th>Price</th>
<th>Average yields</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Price</strong></td>
<td>Pearson Correlation</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td></td>
</tr>
<tr>
<td>Sum of Squares and</td>
<td>5017.448</td>
<td>26.476</td>
</tr>
<tr>
<td>Cross-products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Covariance</td>
<td>627.181</td>
<td>3.309</td>
</tr>
<tr>
<td>N - years</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td><strong>Average yields</strong></td>
<td>Pearson Correlation</td>
<td>0.154</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0.693</td>
</tr>
<tr>
<td>Sum of Squares and</td>
<td>26.476</td>
<td>5.929</td>
</tr>
<tr>
<td>Cross-products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Covariance</td>
<td>3.309</td>
<td>0.741</td>
</tr>
<tr>
<td>N</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

Correlation not significant at the 0.05 level (2-tailed)

Source: Author (2013)
5.1 Socio-Economic characteristics of the coffee farmers

The mean age of the respondents was 52.95 years. This suggests that the smallholder coffee farming cluster is skewed towards the ageing. Since most coffee production operations in the farm are manual, this has the potential to limit productivity. This concurs with the findings of Adesoji and Farinde (2006) who found that farmers older than 52 years had a tendency of getting less yields. Majority of the farmers, 57.05% had either primary education or no education at all compared with 8.06% only that had tertiary education. Similar observations were made by Mumba et al. (2011). Generally, the more educated people are, the more efficient producers they become (Battese and Coelli, 1995). Low literacy levels can therefore hamper coffee production. Majority of the farmers (72%) had either consulted an extension staff attended a field day on coffee at least once in the last three years. The forums for training were field based with only 5.26 % farmers seeking information from an office visit. This means that field based trainings would reach out more farmers than waiting for farmers to seek information themselves.

Out of 76.52% of the farmers who needed credit, 81.4% indicated that they had access to some credit. However, of these 81.4% only 45.2% had access to adequate credit which translates to 36.8% accessibility to adequate credit. This inadequacy of credit is primarily because most societies lend depending on the number of kilograms delivered at the factory. Majority of the co-operative societies limit the credit to Ksh 10 per kilograms of cherry delivered. This creates a vicious circle of
low yields since only those who have cash from other sources can afford the fertilizers and pesticides needed for coffee production. As Binam et al. (2006); Okoedo-Okojie and Onemolease (2009) observed, credit enables farmers to adopt new technologies more readily since they are able to plan ahead.

5.2 Regression analysis results on factors influencing yields

The analysis of variance (Table 4.7) for the regression analysis yielded an F-value of 37.87, with a p-value of 0.000, indicating that the model was statistically significant even at the 1% level. The coefficient of determination ($R^2$) was 0.5217, meaning that approximately 52.17% of variability of the dependent variable (yields) was accounted for by the explanatory variables in the model. Thus the regression model was adequate since in determining model adequacy, features such as the $R^2$ and the F-value are observed (Gujarati, 2007). The remaining 47.13% could be due to measurement errors or factors not accounted for in the model such as soil and climatic factors.

Access to adequate credit had a positive coefficient of 1.249 with a p-value of 0.000 which is significant at 1%. This means that all other predictors held constant, having access to adequate credit increases yields by 125%. Similar results were obtained by Binam et al. (2006) and Amadou (2007) while undertaking studies on small scale coffee farmers in Cameroon. They argued that access to adequate credit permits a farmer to enhance efficiency by overcoming liquidity constraints which may affect their ability to apply inputs and implement farm management decisions on time. Use of credit therefore loosens financial constraints, ensures timely
acquisition and use of inputs and results in increased economic efficiency. The results also agree with the findings of Adesoji and Farinde (2006) as well those of Nyagaka et al. (2009) who found that farmers with access to credit tend to exhibit higher levels of yields.

The coefficient for income from other sources was 0.015 with a p-value of 0.003 which was statistically significant at 5%. This means that for every unit increase in cash amount from other sources other than coffee (one unit = Ksh10,000 as defined in chapter 3), yields increase by 1.5%. This is because farmers usually swivel finances from one enterprise to the other in their operations. The results agree with those of Namwata et al. (2010) as well those of Franzel (1999) who argued that higher income farmers may be less risk averse, have more access to information, have longer-term planning horizon, and have greater capacity to mobilize resources and hence increased likelihood of adopting new technologies.

Farm size had a coefficient of -0.036 with a p-value of 0.053. Although this was not statistically significant, the results indicate that farmers with smaller farms are more efficient in resource use. The results agree with the findings of Adesoji and Farinde (2006) who found out that increase in farm size decreases the yields of arable crops. Years of education had a coefficient of 0.014 with a p value of 0.310. Although not significant statistically, the results shows a positive relationship between education and yields. More educated farmers are able to perceive, interpret and respond to new information and adopt improved technologies such as fertilizers and pesticides much faster than their counterparts. This agrees with the findings of
Nyagaka et al. (2010) who used the Tobit model and found out that farmers with more years of formal schooling were more efficient than their counterparts. Aneani et al. (2012) also obtained similar results.

Extension services consultation had a coefficient of 0.2121 with a p value of 0.033 which was statistically significant at 5%. This means that consulting extension agents on what needs to be done increases yields by 21%. Nyagaka et al. (2010) argued that frequent visits to the farmers by extension agents provides the farmer with necessary information about the availability of needed resources, market prices as well as the profitability status. Nchare (2007), further argued that extension workers play a central role in informing, motivating and educating farmers about available technologies. The results also concur with Seyoum et al. (1998) who found a 14% difference in technical efficiency between farmers who had access to extension services and those who did not. The gender of household head had a coefficient of -0.076 with a p-value of 0.587 and thus not significant. This means that being male or female does not significantly affect yields. The results contradict the findings of Aworemi (2010) who found that the male gender had higher yields. The age of household head had a coefficient of -0.0028 with a p-value of 0.432 which was not significant. However, it means that older people are more likely to have less yield than the younger ones perhaps due to the manual nature of coffee operations. The results concur with those of Ayoola et al. (2011) who found out that age negatively affects rice yields.
We can therefore reject the null hypothesis and conclude that socio-economic factors influence the level of yields in the smallholder coffee sub-sector. The study therefore disagrees with the findings of Rondinelli (1983) that socio-economic factors have no significant influence on performance but supports the findings of Aworemi (2010).

5.3 Correlation Analyses between price, the level of re-investment and yields

There was a strong relationship (Pearson’s $r = 0.814$) between price and the level of reinvestment which was statistically significant at 5%. This means that changes in price are strongly correlated with changes in reinvestment. The higher the price (payment per kilogram of cherry) the more the farmers would be motivated to invest in coffee. However as Table 4.13 shows, the relationship between price and yields was weak (Pearson’s $r = 0.154$) and insignificant ($p$ value $= 0.683$). This means that changes in price are not strongly correlated with changes in yields. This implies that a good price alone may not necessarily guarantee higher yields.
CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Socio-economic factors that surround small scale farmers have a great influence on yields. The factors found to have significantly contributed to the dependent variable (yield) are access to adequate credit, having some source of cash from other enterprises or employment and consulting extension agents.

It was also found out that although price has a positive influence on yields, the impact of price on yields is dampened by the socio-economic factors that farmers finds themselves in. This implies that although good prices encourage farmers to invest in coffee, there is need for an enabling environment in terms of adequate credit, extension services provision and diversification of farmers’ incomes in order to increase coffee yields significantly.

The results showed that only 35.4% of farmers were aware of the Coffee Development Fund and none of the farmers who had borrowed from the various institutions had done so from CODEF despite the institution having been formed in 2006 to offer credit to coffee farmers. This points to some weakness in information dissemination about credit from the institution.

These results implies that the reason why yields have not improved significantly in the country despite the stable price trend increase from 2002/2003 to 2011/2012, is because underlying socio-economic factors have not been addressed. Efforts to improve yields in the country must thus address these factors.
6.2 Recommendations

To enlarge the income base and the sources of cash, farmers should be encouraged to diversify by having other enterprises such as dairy, bananas and macadamia as income generating enterprises. The government should also endeavor to have at least one coffee extension officer per sub-county to enhance provision of coffee extension services.

The government needs to streamline provision of credit to make it accessible. It should be provided in amounts that are adequate to meet the cost of inputs and labour. There is therefore need to create awareness on the existence of the Coffee Development Fund and carry out further research on the challenges in loan application, processing and repayments. Given the level of average yields in the sub-sector, initial capital can be given out to the farmers to jumpstart production followed by provision of adequate credit. There is also need to undertake a study similar to look at factors affecting some counties – like Murang’a that were formerly large coffee producers.
REFERENCES


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District Agricultural Office (DAO). (2011). *District Annual Reports*. Ministry of
Agriculture, Kirinyaga District.


## APPENDICES

### APPENDIX 1: WORK PLAN

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## APPENDIX 2: BUDGET

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<td>20,000</td>
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<td><strong>TOTAL</strong></td>
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</table>
APPENDIX 3: SMALL SCALE COFFEE FARMERS QUESTIONNAIRE

This questionnaire is designed to solicit for your responses on factors affecting coffee yields. Your responses will be used for academic purposes only and are highly appreciated.

A: BACKGROUND INFORMATION

Date of interview .................................. Interviewer’s name ......................

District ................ Co-op Society: ................ Factory ..............

A.E.Z................

Farmers name .......................... Membership No ..................

Name of the respondent ........................................

Relationship with Household head ..............................

Gender of the respondent Male=1....... Female =2 ..........

B: DEMOGRAPHIC INFORMATION

1. Head of household 1= Male 2= Female

2. Marital status of the head of the household?

1=married .............. 2= widowed/widower .......... 3=

Single .............. 4= Separated/ Divorced ....... 5. Other

(specify) ................

3. Age of the household head ................ years

4. What is the education level of the household head?
No education = 1 primary education = 2 secondary education = 3 tertiary education = 4 Other (specify) = 5
Total number of years of formal education = ............... years

5. How many years have you been farming coffee farming? ............... years

C. FARM INFORMATION

6. What is the total size of your farm? .................. Acres

7. Area under coffee .................. acres

8. No. of coffee trees .................. (Total number)

9. How many matures coffee trees did you have in
   2009/2010 - Traditional varieties (SL, K7, Blue mt) .... Ruiru II ......
   2010/2011 - Traditional varieties (SL, K7, Blue mt) .... Ruiru II ......
   2011/2012 - Traditional varieties (SL, K7, Blue mt) .... Ruiru II /
          Batian ...

10. What other enterprises do you have in the farm

       ..................................................................................

11. What was your production in kgs of cherry in the last five years?
       .......................... 2010/2011 .................
   2011/2012 .................

12. Payment rates per kg of cherry
13. Given that the potential of coffee is up to 40 kgs of cherry per tree, what do you think of your level of production?

It is okay as it is = 1 ……  It bothers me / I desire to increase =2 ………

14. If it doesn’t bother you or is ok as it is, why

15. Are you aware that coffee prices have been going up?  1. Yes …  2. No ………

16. If yes, why have you not gone back fully to coffee production?  1. Lack of money……  2. Prices not good enough……  3. Fear of price fall / waiting to see if prices will continue rising ……..  4. Other enterprises are better…………

5. No longer interested ………  6. Other (explain)…………………………

17. If you have not noted the price increase, why / how comes ……………

18. If it doesn’t bother you or is ok as it is, why

19. If you are interested in going back to coffee, what are you planning to do?  1. Obtain credit……  2. Use my savings ……  3. Use cattle manure from own boma. ………  4. Other (explain)…………………………

D. CREDIT INFORMATION / SOURCES OF CASH

20. Do you require credit (loan) for buying agricultural inputs and for other farm activities in coffee farming?
Yes=1  .................  No=2  ......................

21. If no, why not .........................................................

22. If yes, do you have access to credit for buying these agricultural inputs and other farm activities whenever you need it? Yes=1  .................  No=2  ......................

23. If yes, what are your sources of credit?

1=Co-operative society ............  2=Commercial Banks ..............
3=Millers’ .................................  4=Marketing agent ...................
5=Coffee development fund ........  6=Other (specify) ......................

24. If you do not have access to credit, what are the impediments?

1= Requires collateral.................  2 = Interest rate too high ..............
3= Don’t know where to get ...........  3 =Process too complicated ..... 
5 = Other reason (specify) ......................

25. Have you ever borrowed to finance coffee production? Yes (1)......  No (2)........

26. If no, why?

1= Credit never available ...............

2 = Interest rate too high ............... 

3 = Don’t know where to get ............

4= Requires collateral ....................... 

5 = Other reason (specify) ......................

27. Did you apply for credit in the following years?
28. Was the credit obtained adequate? Yes = 1 ...... No=2 ........

29. Are you aware of Coffee Development fund? Yes = 1 ....... No=2 ......

30. Do you have another source of cash for coffee farming other than credit?
   1= Yes 2 = No  

31. Other source of cash
   1= Employment  2= Business  3= Dairy  4= Tea  
   Other (specify)

32. Approx. how much do you earn per year from all other activities

E. ACCESS TO EXTENSION

33. Did you make any consultation on coffee with any extension staff last year?
   (a) Yes (b) No

34. If yes, how many times last year? .........................

35. What forum was it? a) field day..b) office visit...
   (c)..................(specify)

36. If no, why........................................

F. RE-INVESTMENT

37. How much do you need to run the coffee farm per year (Kshs)
   2011/2012 ............
38. What income did you get from coffee in the last four years?

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39. How much of the income you got from coffee in the last four years was put back into coffee farming?

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  OR (1). 10% ......... (2). 20% ......... (3). 30% ......... (4). 40% ......... (5). 50% ......... (6). Other .................

40. If you did not re-invest, why did you not?

..................................................................................................................

41. If you reinvested, why did you re-invest that much?

..................................................................................................................
APPENDIX 4: CO-OPERATIVE SOCIETY QUESTIONNAIRE

1. Name of the respondent .................................................................
2. Title of the respondent ...............................................................  
3. Name of the coffee society .......... No. of factories .................
4. Date of Interview .................................................................
5. How many registered members do you have ...................................
   6. Male ............ Female ............ Total ......................
   7. How many of the registered members are active
   8. Male ............ Female ............ Total ......................

9. How has been the production (in Kgs of cherry) for the last 10 years in your society?

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10. How have been the coffee payments to farmers (in KShs per Kg of cherry) for the last 10 years?

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11. How many mature coffee trees have your farmers been having for the last 10 years?

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APPENDIX 5: MAIN COFFEE GROWING AREAS

MAIN COFFEE GROWING AREAS

Source: Coffee Research Foundation, 2012
APPENDIX 6: KIRINYAGA COUNTY ADMINISTRATIVE BOUNDARIES

APPENDIX 7: KIRINYAGA COUNTY AGRO-ECOLOGICAL ZONES

KIRINYAGA District

AGRO-ECOLOGICAL ZONES
and Subzones

Study area

Forest Reserve

Unsuitable steep slopes
(only marked outside Nat. Parks or Forest Res.)

Belt of A.E. Zones

A.E. Zones

Subzones

Climatic data for AEZ formulas see tables I and II

Min. of Agr. and GTZ, R. Jaetzold, GIS-Cartogr. J. Wieczorek

Source: Jaetzold et al. (2007).
### APPENDIX 8: CO-OPERATIVE SOCIETIES AVERAGE PRICES AND YIELDS DATA

<table>
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<tr>
<th>YEAR</th>
<th>AVERAGE PRICE PER KG OF CHERRY (KSH)</th>
<th>AVERAGE YIELDS (KGS PER TREE)</th>
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<tr>
<td>2002-03</td>
<td>11.95</td>
<td>3.94</td>
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<td>2003-04</td>
<td>15.66</td>
<td>3.80</td>
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<td>2004-05</td>
<td>16.96</td>
<td>4.17</td>
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<td>2005-06</td>
<td>23.52</td>
<td>3.87</td>
</tr>
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<td>2006-07</td>
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<td>2007-08</td>
<td>27.40</td>
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<td>2008-09</td>
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<td>2009-10</td>
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<td>3.53</td>
</tr>
<tr>
<td>2010-11</td>
<td>93.61</td>
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</tr>
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<td>2011-12</td>
<td>62.21</td>
<td>3.86</td>
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Source: Author (2013)