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AN ECONOMIC ASSESSMENT OF THE CONTRIBUTIONOF AGRICULTURAL INFORMATION TOFARM PRODUCTIVITYAMONG SMALL HOLDER DAIRY FARMERS IN LARI DISTRICT

BY:

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Declaration

I, **Henry M. Mwololo**, hereby declare that the work contained in this thesis is my own and that other scholars' work referred to in here has been acknowledged. I also declare that the content of this thesis is original and it has not been submitted elsewhere for any academic award

30/11/2012

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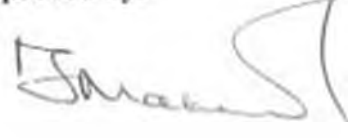

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To all of you, I say thanks and God bless.

Dedication

I dedicate this work to my parents: Patrick Mwololo and Felister Mbenge, my brothers: Alex Makoso and John Kamuti. You were there when I most needed you. We are truly a family.

In memory of:

All my grandparents who never lived to see the fruit of my sweat; **R.I.P**

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Acronyms

ASL:	Above Sea Level
AGDP:	Agricultural Gross Domestic Product
C-D:	Cobb Douglas
EPZA:	Export Processing Zone Authority
ECIS's:	European Conference on Information System's
GDP:	Gross Domestic Product
GOK:	Government of Kenya
ICT's:	Information and Communication Technologies
IT:	Information Technology
KES:	Kenya Shillings
KENVO:	Kijambe Environmental Volunteer Organization
KM:	Kilometre
KG:	Kilogram
KDSP:	Kiambu District Strategic Plan
MOALD:	Ministry of Agriculture and Livestock Development
NAFTA:	North America Free Trade Agreement
PFP:	Partial Factor Productivity
PCA:	Principal Component Analysis
SPSS:	Statistical Package for Social Sciences
TFP:	Total Factor Productivity
URT:	Unit Root Test
USA:	United States of America

Abstract

Dairy farming remains an important activity especially among smallholder farmers in central Kenya owing to the small land holding of approximately1.9 acres. It is a source of income and sustenance. Traditionally land, capital and labour have been considered as the necessary and sufficient factors of production. However, information has recently been identified as a potential factor of production due to its unique characteristics, but its contribution to farm productivity is not well understood. This study sets to assess the contribution of agricultural information to farm productivity among smallholder dairy farmers in Lari district, a leading dairy producing district in Kiambu County, Kenya

The purpose of the study was to assess the contribution of information to dairy productivity. The objectives of the study were to characterize small holder dairy farmers in Lari district along their information endowment attributes and also assess the contribution of information to farm productivity among small holder dairy farmers in Lari district, Kiambu County.

Information Index was calculated using Principal Component Analysis and the index used to categorize farmers into two groups along their information characteristics. The groups were not significantly different.

A Cobb Douglas (CD) production function was estimated to assess the contribution of land, labour, capital and information to farm productivity among smallholder dairy farmers in Lari district. The results showed that land influenced productivity positively significant at the 5

percent level. Labour, capital and information also have positive and significant influence on productivity at 1 percent level

Based on the above findings, the policy implications are that to improve and maintain high productivity in the dairy sub-sector in Lari district, the government of Kenya through the ministries of agriculture and cooperatives should formulate policies which would act as incentives to retain the dairy farmers in the enterprise. With time as the farmers accumulate information and hands on skills, they would improve milk output Such incentives could include price premiums for quality of milk as well as supporting small holder dairy farmers to bulk their milk and take advantage of collective action

CHAPTER 1

INTRODUCTION

1.1 Background information

Information has been defined in diverse ways by different individuals depending on their backgrounds and their objectives. For instance, Losee (1998) an engineer defined information as the characteristics of the output of a process, these being informative about the process and the inputs.

According to Davenport and Prusak, (1998) information refers to data that has been analyzed to a certain degree. On its part, data analysis can mean data being contextualized, categorized, calculated, corrected, or condensed These are all aspects of data analysis. However, these definitions have common features which can be compared irrespective of the discipline defining information. One such feature includes information being a derivative of data (input) (Davenport and Prusak, 1998)

When data is contextualized, it is assigned a purpose for which it was gathered. Categorizing explains the units of measurement used to collect and codify the data. Calculating analyzes raw data mathematically or statistically in order to reach a conclusion. Correcting removes errors and condensing summarizes the data (Davenport and Prusak, 1998). If data analysis is done with an aim of meeting a given agricultural objective, for instance, increased productivity in agriculture then it becomes agricultural information.

Information is more often confused with knowledge. According to Blair (2002), Knowledge is a fluid mix of framed experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of those who have it. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices and norms.

Information has taken the centre stage in the world of business. It is increasingly being recognized as one of the firm's most valuable assets Unfortunately, its value is largely thought of more than seen with information management consumes vast and ever increasing quantities of organizational resources in its capture, storage and processing (Moody and Walsh, 1999

According to the then Ministry of Agriculture and Livestock Development (MoALD, 1998), information is recognized as a potential factor of production in addition to the traditionally known factors of production namely land, labour and capital. However, the available information is scattered and thus its contribution to dairy production in the country remains largely unexplored

Traditionally, economists have classified factors of production into three broad categories namely; land, labor and capital (Cleveland, 1982). These factors have been viewed as the main inputs to the production process. Land has been used to represent the natural raw material, labor to represent the human effort both physical and mental, while capital is the contribution of money among other non monetary facility into the production process (Cleveland, 1982). The three factors of production obey the law of diminishing returns. For instance, even if labor was

free, additional units of labor will translate into increased productivity up to a given limit *ceteris paribus*. Managers have extended the list of the factors of production to acknowledge the important contribution of management into the production process. As a result, they have included management talent and entrepreneurial ability as a fourth factor of production (Austin *et al.* 2006)

Valuation of information is an issue which has not been fully explored with several efforts to quantify the contribution of information being underway by different researchers. The results of the many studies being undertaken could have huge implications for the IT industry in the future. Thus, information has recently been considered as a potential factor of production. Information consumes huge but unreported amounts of resources in the economy and hence its impact on the firm should be clearly known.

The percentage of an organization's resources devoted to information handling is growing inform of software development, hardware stocks as well as personnel. As organizations invest more in information and IT, there is need to quantify its role. Quantification of information will make it possible to improve it and give it more attention in its management. Through quantifying information, organizations will be able to justify investment in its generation, processing and storage (Moody and Walsh, 1999).

Information valuation provides a better approach to measuring IT effectiveness because it measures the value of the product (information) rather than the production equipment (systems and technology). It directly measures the information bottom line i.e. the value created by IT in

terms of information delivered to users. This should be used as the primary basis for developing IT strategies and evaluating proposed II initiatives (Glazer, 1993).

Information has very unique characteristics which differ greatly with the characteristics of the traditional factors. Information is expansible with use. More information and of better quality is generated with use. It exhibits increasing returns to use. All other factors of production are viewed as scarce as opposed to information that is viewed as a factor of potential glut. Information is compressible and substitutable. Large chunks of information can be reduced into small amounts of meaningful information and knowledge. This makes information management a practical science. Appropriate information application can result to an efficient way of using the other scarce factors like land (Walter *et al*, 1990; Glazer, 1993).

Information is transportable. Advancements in information and communication technologies (ICT) have overcome most of the barriers associated with information transfer e.g. geographical barriers. This characteristic makes information a strategic tool in agriculture because the right information can be availed to the right people and in the right time at the right place. Most of the other factors of production are relatively mobile like labor and capital with land being immobile. Information is diffusible. It is difficult to own information as a private good and hence it tends to portray the characteristics of a public good.

Information is sharable (Glazer, 1993). A piece of information given does not diminish the source. This makes it easy to share for no one loses in the process as opposed to a scarce resource where on giving out some, the stock diminishes. In summary, information is not faced

with the challenge of scarcity and does not diminish with use as opposed to the other factors of production (Walter and Walter, 1990). Due to these characteristics, Walter and Richard argued that information should be adopted as a factor of production.

Dairy is an important subsector in Kenya's economy alongside others like tea. In the year 2008, dairy contributed 14 percent of agricultural GDP (AGDP) and about 3.5 percent of the total GDP (GoK, 2008). Currently, dairy contribute 30 percent of livestock GDP and 3 percent of Kenya's GDP (Bennet and Kurwijila, 2011) compared to livestock in general which contributes 10 percent of total GDP (FAO, 2011). The contribution of dairy compares well with the tea sub-sector which contributes 4 percent to Kenya's total GDP (TRI K, 2011).It is a source of income to approximately 800,000 smallholders (Kiptarus, 2005). For instance, in the year 2008, milk production was estimated at about 5.1 billion litres valued at Kenya Shillings (KES) 100 billion (GOK, ASDS, 2010). Kenya's dairy sector is dominated by small scale farmers who produce up-to 80 per cent of the milk (GOK, ASDS, 2010).

The subsector is robust in the Kenyan highlands. With an altitude of up to 2,400 metres above sea level and a rainfall of up to 1,400 mm per year, Lari district is a suitable production zone. Owing to the small land holding per household in the district of approximately 1.9 acres, zero grazing remains the dominant dairy production system in the district. Despite the district's dairy production characteristics and the associated returns from the enterprise, most households remain poor with a poverty incidence of about 32 percent (KDSP, 2005).

A study carried out by Kijabe Environmental Volunteers (KENVO, 2007) reported lack of information and technical skills to improve dairy enterprise as some of the challenges resulting to inefficient use of land among other resources. Low milk productivity of 2035 Kg/Cow/Year in Kiambu County part of which is Lari is as a result of high fragmentation of land among other reasons which call for an intensive approach to dairy production (Mwangi, 2010, KDSP, 2005-2010 and KENVO, 2007). According to the above studies, the possibility of Lari residents realizing their dream of improved returns from milk production lies with the availability of knowledge on how to utilize the available scarce resources efficiently.

1.2 Problem Statement

Traditionally, land, labour and capital are recognized as the core factors of production. Lately, studies have reported that information has taken the centre stage in the world of business agriculture notwithstanding. Information is increasingly one of the firm's most valuable assets. Studies have suggested that information is a potential factor of production and hence should make it to the list of the core factors.

Dairy farmers in Lari district continue to produce below international productivity. The low productivity is partly attributable to high land fragmentation. However, with the right information and appropriate skills, dairy farmers in Lari can improve their milk productivity.

Despite the recognition of the potential contribution information can make to the production process and productivity, the contribution of information has not been fully explored and hence not well known. As a result, the question of what the contribution of information is to farm productivity has not yet been answered and hence is more thought of than known. Therefore, this study set to address the problem by exploring the influence of information if taken as a factor of production alongside the traditional factors to farm milk productivity in Lari district, Kiambu County, Kenya.

1.3 Purpose and objectives of the study

The purpose of this study was to assess the contribution of agricultural information to farm productivity among smallholder dairy farmers in Lari district, Kiambu County, Kenya.

The specific objectives of the study are:

- To group dairy farmers in Lari district along their information endowment characteristics.

- To assess the contribution of agricultural information to milk productivity among smallholder dairy farmers in Lari district.

1.4 Hypotheses to be tested

The hypotheses to be tested are that:

There are no differences in agricultural information endowment across small holder dairy farmers in Lari district.

Access to agricultural information does not contribute to farm productivity among smallholder dairy farmers in Lari district

1.5 Justification

Several studies have suggested that information is a potential factor of production which could help increase productivity in different sectors. This would be so because information helps increase the efficiency with which the other factors of production are utilized (Walter and Richard, 1990; Weill, 1992; Moody and Walsh, 1999). For the Kenyan dairy sub-sector, information has been identified as one of the potential factors to improving dairy productivity (MoALD, 1998). The above mentioned studies only give an insight into the possibility that information has potential as a factor of production but do not explore the actual contribution of information to farm productivity among smallholder dairy farmers. This study therefore attempts to contribute towards filling in this knowledge gap.

Agriculture remains the main stay of Kenya's economy. The dairy subsector remains an important sub-sectors in Kenya's economy (Muriuki et al. 2004) contributing approximately 3 percent to total GDP (TGDP) (GoK, 2008; Omiti, 2006; Nganga, 2010; FAO, 2011). As a result, this study focused on dairy because of the impact it would have on Kenya's economy and consequently the residents of Lari district.

The focus in Lari is justifiable because, owing to the small land holding per household of approximately 1.9 acres, small-scale dairy production remains one of the viable enterprises. Despite the district's dairy production characteristics and the associated returns from the enterprise, most households remain poor with a poverty incidence of about 32 percent (KDSP, 2005).

The productivity of the smallholder dairy farmers in Lari district, Kiambu county is as low as 2,035.7 kilograms per cow per year compared to an average of 2,500 kilograms per cow per year in South Africa, 3,500 kilograms per cow per year in Argentina while the USA was producing 9,000 kilograms of milk per cow year in the year 2007 (Technoserve, 2008). As a result, this study focused on the smallholder dairy farmers who are the majority of the producers in Lari district to find out what role information can play in improving milk productivity especially with the increasing population.

The results of this study would be important in improving the productivity of the dairy enterprise in Lari. It would also be easy to adopt the results in other dairy producing areas in Kenya. Policy makers would also use such findings to put in place interventions to improve the enterprise.

1.6 Chapter Summary

To summarize the chapter, Dogan's pillars of knowledge (institutions, information, innovations and ICT) were adopted and modified to explain the objectives of this study. At the household level, the household is the decision making unit hence treated as the institution. Several enterprises exist within the household's environment

The first step in enterprise selection would involve household seeking information with respect to the available enterprises. The information includes but not limited to: margins from the different enterprises, inputs required and market dynamics. After the household gathers adequate information, the next step involves matching the different enterprises with the available resources mostly land, labour and capital. Through mental processes, households choose the

most appropriate enterprise to optimize the available resources. Through innovativeness which is a product of information, households optimize their yields from the selected enterprise. Throughout the thinking process, information flows in all directions as constant feedback is sought and given to source. The household also improves the information available

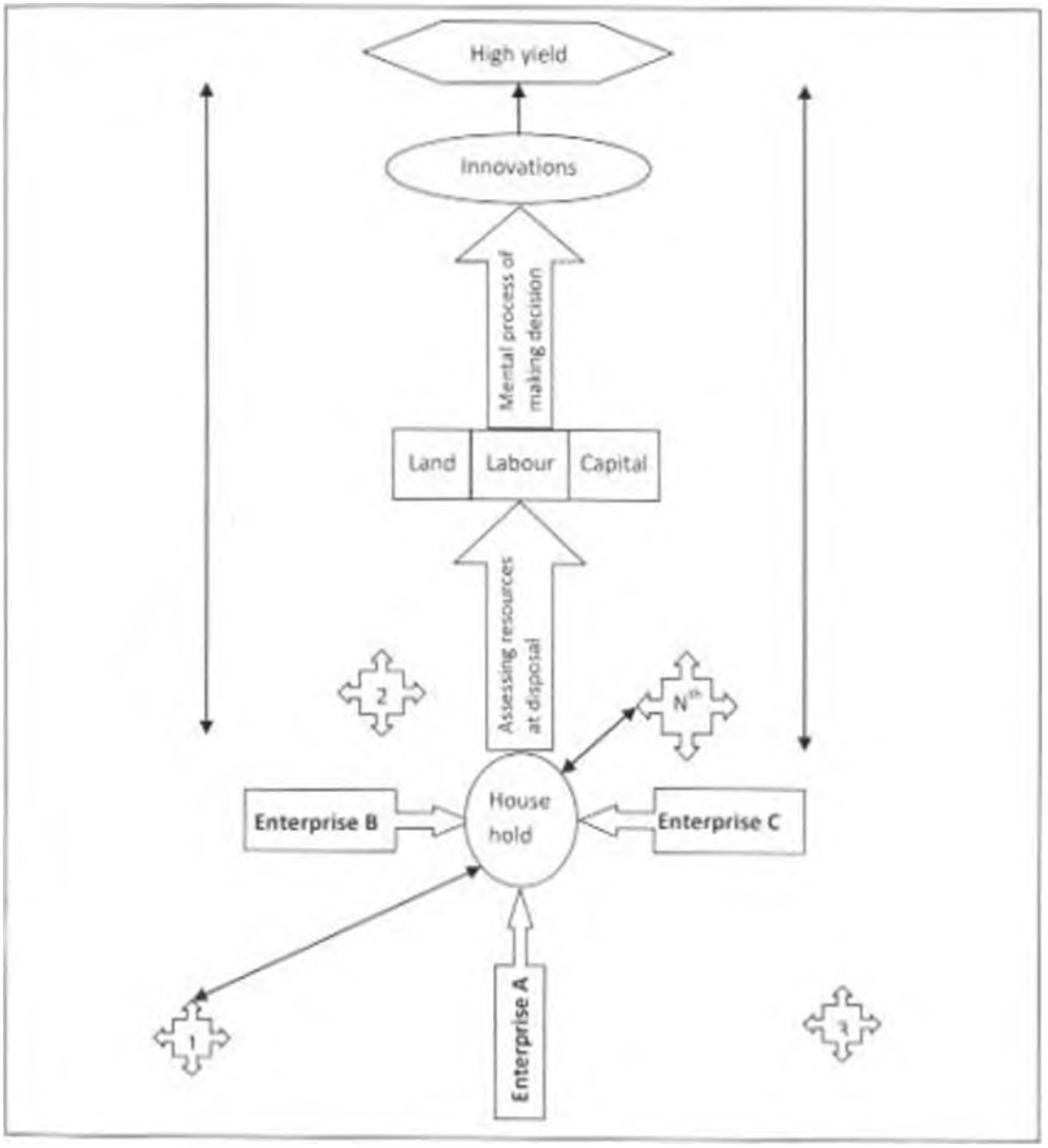

Figure 1: The process of transforming information into decisions (Adopted and modified from Dogan's pillars of knowledge, 2007)

Key:

Symbol	Meaning
	Enterprises e.g. dairy, Irish potato, tea
	Processes
	Institution (household)
	Innovations
	Information e.g. education, training
	Results
	Factors of production
	Information and Communication Technologies

CHAPTER 2

LITERATURE REVIEW

This chapter reviews studies that have suggested information as a potential factor of production. This is followed by a theoretical review of approaches used to measure agricultural productivity. The chapter closes by reviewing empirical studies that have looked at information as a potential factor of production and those that have measured productivity by estimating a C-D production function.

2.1Theoretical review

Production refers to the amount of output obtained from given levels of inputs in a sector (Yeboah *et al*. 2011). A derivative of production is productivity which is a measure of agricultural output from a production process, per unit of input used (Gawamadzi, 2010). Two measures of productivity have been widely used: the partial factor productivity (PFP) and the total factor productivity (TFP) (Nyangito and Odhiambo, 2003). PFP compares output to one of the different types of inputs such as labour, capital, land and other relevant inputs *ceteris paribus*. PFP can be expressed as;

$$PFP = Y/X \qquad (1)$$

Where; Y is the output and *X* is aninput. Although commonly used, the partial productivity measure has a weakness in that it does not control for the level of other inputs employed (Nyangito and Odhiambo, 2003). When one considers productivity through time, an additional source of productivity growth, called technical change, is possible. When we observe that a farm

has increased its productivity from one year to the next, this may not be solely attributed to use of a specific input but could be due to technological change even with no change in input use. Technical change is the portion of output not explained by the amount of inputs used in a production. As such, its level is determined by how efficiently and intensely the inputs are utilized in production (Gawamadzi, 2010). It measures output per unit of total factor productivity (Nyangito and Odhiambo, 2003).

Measuring agricultural productivity is important because it implies efficient utilization of scarce resources while agricultural production gives the overall status of the sector with respect to demand. Increases in agricultural productivity lead also to agricultural growth and can help to alleviate poverty in developing countries, where agriculture often employs the greatest portion of the population, (World Bank 2008). As farm productivity and production increases, wages earned by those who work in agriculture increase, food prices decrease and food supplies become more stable. The end result is a food secure society.

This study adopted the PI P to assess the contribution of land, labour, capital and information to farm productivity among smallholder dairy farmers in I ari because the study used primary data.

2.2 Empirical Review

Dogan, (2007) studied the role of knowledge which is a derivative of information as a new factor of production in the economic growth of Turkey by use of time series data and applying the Unit Root Test (URT) on the four pillars of knowledge namely; institutions, education, innovations and ICT's. The study found out that a unit increases in any of the four pillars led to a 1.03 percent increase in GDP *Ceteris Paribus*

The implication that can be drawn from this finding is that the transition to a knowledge economy leads to increase in the total factor productivity and hence economic growth. The study concluded that, knowledge can be the engine of economic growth if the four pillars are taken as prerequisites. The current study undertakes a similar analysis as Dogan's but uses a production function approach to bring out the influence of information to production along with the contributions of the traditional factors of production. The other difference is in the types of data used by the two studies. Dogan used time series data whereas the current study used cross sectional data. Also the current study is different from Dogan's in that the geographical areas are different as well as some of the regressors e.g training on dairy.

Weill in (1992) used descriptive comparative analysis to compare the incomes of two groups of manufacturing firms in the United States of America (USA). One group had invested in IT while the second group invested in information and used IT as a means of disseminating that information. The study found out that firms which invested in information performed better than those which invested in IT. However, the author did not perform any statistical analysis to determine whether the difference in margins was as a result of the information or otherwise. The

recommendation from the author was that it is information that gives firms an advantage edge against their competitors and not the technology in place and hence any rational firm should ensure that IT complements content.

The current study is similar to that of Weill (1992) in that it also assesses contribution of information to farm production. However, the two studies are different in the sense that Weill looked at manufacturing industry whereas the current study focuses on dairy production which is an agricultural industry. Also Weill used descriptive analysis only whereas the current study uses quantitative statistics in order to assess the contribution of information to farm productivity among smallholder dairy farmers. The regressors are also different with the current study including land, labour and capital in the model in addition to information.

Walter and Richard (1990) used descriptive analysis to describe the unique characteristics of information. This was not a strong basis to build a case for information to be treated as a factor of production. The study concluded that the unique characteristics included information being expansible, increasing with use, portable and varying both in the short and long runs. These characteristics lacked in the traditional factors of production. However, the authors did not undertake any quantitative analysis to assess information as a potential factor of production. The study by Walter and Richard is similar to the current study in that the two try to qualify information as a potential factor of production. The two studies differ in that the current study takes a quantitative approach as opposed to the descriptive approach undertaken by Walter and Richard. Also the current study estimates a production function and augments the traditional factors of production with information.

Mwakalobo (2000) undertook a study to assess resource productivity and efficiency among smallholder coffee farmers in Rungwe district, Tanzania. The author applied the Cobb Douglas (C-D) approach. The findings showed that the farmers were inefficient in their resource allocation. The study recommended that farmers could form groups in-order to improve their bargaining power. The current study estimates a production function borrowing from the C-D approach hence is similar to Mwakalobo's but augmenting the traditional factors of production with information to assess its contribution as a 'factor of production' to farm productivity make the two studies different. Mwakalobo focused on the coffee subsector while the current study focuses on the dairy subsector. The study by Mwakalobo did not include information as part of its regressors.

Nyangito, *et al* (2004) undertook a study to identify and estimate the sources of agricultural growth and productivity in Kenya. By use of secondary data, they estimated a C-D function as well as a Translog production function. The study found out that agricultural growth can be attributed to factor inputs – Land, labour and capital with labour accounting for 48 percent of agricultural growth. The current study takes a similar approach to estimate C-D function using regression analysis. However, the two studies differ in that, Nyangito *et al* (2004) focused on the agricultural sector at the macro level whereas Mwololo focuses on agriculture at the micro level of; case of dairy production. Also the current study augments the C-D production function with information in addition to the traditional factors of production making it different from Nyagito's study which did not consider information as a factor of production.

Karienych (2007) used the Cobb Douglas function to assess the effect of land ownership by women to productivity of maize in Machakos district. Different status of land tenure were assessed which included ownership by the women, land owned by their husbands and lastly land owned by relatives. The outcome of the study was that those women who owned land had more autonomy in using it. They could even use the title deeds as collateral to access credit. As a result, they were more productive than those who farmed on land owned by their husbands and the least productive group wasthat of women who operated on land owned by relatives.

The study by Karienych (2007) is similar to the current study because they borrow from the C-D approach and use regression analysis to assess productivity. However, the current study focuses on dairy productivity whereas Karienych focused on maize productivity. The geographical areas are also different with Machakos being in the Arid and Semi Arid region of Kenya whereas Lari is located in the Kenyan highlands. Gender was the main exogenous variable in the study by karienyeh as opposed to information in the current study.

A study by Njuguna *et al (2007)* examined the sources used by farmers in such of agricultural information on striga and/or stemborers control technologies and factors that influence acquisition of such information in Western Kenya region. Njuguna and *et al* (2007) used principle component analysis (PCA) to derive few latent variables that encapsulate maximum variance in the pathways. The study extracted two components (latent variables) proxying for 'agricultural knowledge'. Type I-knowledge (first component) loaded heavily with sources that had 'group' information searching. Type II-knowledge (second component) loaded heavily with sources requiring individual farmer search. Both types of knowledge positively and significantly

influenced the likelihood of households using improved technology to control stemborer, while only Type-II knowledge and social economic factors were important in influencing the farmers' likelihood of using an improved technology to control striga. This study concluded that information is an important factor in the households' likelihood of using improved technologies in the control of striga and stem-borer.

2.3 Chapter summary

Literature reviewed on information as a factor of production showed that information is gaining momentum and that information and knowledge have the potential to not only improve productivity at farm level but they can also transform economies with Turkey being a case study.

On the empirical review of approaches used to measure agricultural productivity, the main drivers of productivity that most researchers have studied and found to have significance contribution to agricultural productivity include; land, capital, labour, education, extension services among others. Most of these studies have used translog, C-D production function as well as multiple regression analysis. Amongst these estimation methods, it is C-D which is popular and has been frequently used in studies related to production as is with this study. The next chapter presents the methodology applied in this study.

CHAPTER 3

METHODOLOGY

This chapter introduces the theoretical framework upon which this study is based. This is followed by a presentation of the models and approaches to be used in the estimation of the C-D function as well as the specification to calculating an information index. The area of study as well as the approach used to determine the sample size is discussed together with the sampling procedure. The chapter ends by presenting the study area.

The methodology aimed at categorizing farmers in Lari into groups of information. This was achieved by using the principal component analysis approach to calculate an information index and a student s t to test whether the groups were significantly different were applied. The second objective was to assess the contribution of information to farm productivity. This objective was achieved by estimating a C -D production function.

3.1 Theoretical framework

This study is based on the theory of the firm. Firms are described by fixed and exogenously given technologies that allow them to convert inputs (land, labor, capital and raw materials) into outputs (products). Competitive producers take both input and output prices as given, and choose a production plan (input combining technology) to maximize profits. The relationship between the inputs and the resulting output(s) can be expressed inform of a production function (Levin and Milgrom, 2004; Ciawamadzi, 2010).

Several approaches have been used to estimate production functions. Most studies on productivity have typically used the constant return to scale type of technology with two factors of production — capital and labour which is commonly known as a Cobb-Douglas (C-D) production. Following Gujarati, (2003), the C-D production function can be specified as:

$$Y = A\,K^{\alpha}L^{\beta} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (2)$$

Where: Y, K and L indicate the output, capital and labour. *A*, α and β are the elasticities to be estimated. Most productivity studies use the C-D approach which assumes constant returns to scale which is rarely the case. Also the C-D model assumes production entail only two factors of production. These two weaknesses are overcome by transforming the exponential generic C-D function into a linear function by taking natural logarithms on both sides of the function (Nyangito *et al* 2004).

On transforming the generic C-D function, it becomes a linear function and hence can accommodate more than the two traditional factors of production. The generic C-D function is transformed into a linear function by taking the natural logarithms on both sides of equation (2) and specified as shown in equation (3). This study adopts the Cobb Douglas (C-D) production function because it has been widely used in studies of productivity. The C-D function is also flexible and can be augmented with information as a factor of production. The C-D function is also less complicated.

$$Ln\,Y = Ln\,A + \alpha\,Ln\,K + \beta\,Ln\,L \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (3)$$

Where: LnY, LnK and LnL indicate the natural logarithms of Output, Capital and Labour. A is a constant whereas α and β are the elasticities to be estimated.

3.2 Empirical models

3.2.1 Principal Component Analysis (PCA)

Most studies used Principal components analysis (PCA) to calculate wealth index. However, the concept was adopted and adapted for this study. The aim of PCA is to extract from a set of k variables, a reduced set of m factors that account for most of the variance in the p variables. The objective is to reduce a set of v variables to a set of m underlying super ordinate dimensions. Each factor is estimated as a weighted sum of the p variables. The i-th factor is thus (Tangyintuo and Mungoma, 2008);

$$F_i = w_{i1}x_1 + w_{i2}x_2 + w_{ik}x_k \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (4)$$

Where: w are the weights and x are the variables. Consider N households each owning a nonnegative vector of information $a = (a_1, \dots, a_K)$. The procedure of PCA begins with a set of K-variables. $(a_1^1, \dots, a_K^1)$ representing the ownership of K-assets by the i-th household. This is represented by binary scale: (1 if true and 0 otherwise) for dummy variables or continuously. Each variable, a_k^1, is specified by its mean and standard deviation. That is,

$$\frac{a_1^1 - a_{m1}^1}{s^1} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5)$$

Where: a^1_{mi} is the mean of a^1_i across all N households and s^1_i is the standard deviation. The selected variables are linked with latent components (factors) for each of the i-th household through the equation:

$$a^1_i = v_{11}A_{1i} + v_{12}A_{2i} + \ldots + v_{1K}A_{1K} \qquad \forall\ i = 1, \ldots, N \quad (\textbf{households})$$

$$a^1_i = v_{N1}A_{1i} + v_{N2}A_{2i} + \ldots + v_{KK}A_{Ki} \qquad \forall\ k = 1, \ldots, K \quad (\textbf{information proxies}) \quad (6)$$

Where: the A_i are the components and the v_i are coefficients on each component for each variable and these are constant across all households. Note that it is only the left hand-side which is observed, making the solution to the problem indeterminate.

The PCA solves this by determining specific linear combinations of the variables with maximum variance accounted for in the first principal component A_{1i}. The procedure is repeated for each successive component accounting for the maximum of variance remaining. Technically the procedure solves the equations $(A - \lambda I)X_n = 0$ for λ_n and x_n, where A is the matrix of correlations between the scaled variables (the a_i) and x_n is an unknown column vector of coefficients on the n-th component for each variable. Solving the equation yields the Eigen values (or characteristic roots) of A, λn and their associated eigenvectors, x_n (Johnston, 1984). The final set of estimates is produced by scaling the x_ns so the sum of their squares sums to the total variance.

Reversing equation *(4)* yields factor loading ("scoring factors") from the model that are estimates for each of the K-principal components:

$$A_{1i} = f_{11}a_i^1 + f_{12}a_i^2 + \ldots + f_{1K}a_i^K \qquad \forall\ i = 1, \ldots, N \quad \ldots\ldots\ldots\ldots\ldots (7)$$
$$A_{Ki} = f_{K1}a_i^1 + f_{K2}a_i^2 + \ldots + f_{KK}a_i^N$$

Where: A_{1i} is the first principal component, a_i^1 is the normalized variable, f_{1i} is the factor score coefficient (weight) by which the normalized variable is multiplied to obtain a factor score in the linear combination. Thus, the information index for each household is based on the expression

$$A_{1i} = f_{11}\frac{a_i^1 - a_m^1}{s^1} + \ldots + f_{1N}\frac{a_i^N - a_m^N}{s^N} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

The assigned weights are then used to construct an overall 'wealth index', applying the following formula:

$$I_i = \sum_{j=1}^{K}\frac{[b_i(a_{ji} - x_i)]}{s_i} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

Where: w_i is a standardized wealth index for the i-th household; b_i represents the weights (scores) assigned to the (k) variables on the first principal component; a_{ji} is the value of each household on each of the k variables; x_i is the mean of each of the k variables; and s_i the standard deviations. A negative index ($-w_i$) means that, relative to the communities' measure of wealth,

the household is poorly endowed and hence worse-off while a positive figure (w_i) signifies that the household is well-off. A zero value, which is also the sample mean index, implies the household is neither well-off nor worse-off (Langyintuo and Mungoma, 2008; Filmer and Pritchett, 2001).

3.2.2 Cobb Douglas (C-D) production function

To assess the contribution of information to dairy productivity among smallholder dairy farmers in Lari District, a C-D production function was estimated. The variables included in the model were; milk output in kilograms as the depended variable and Land, capital, labour and information as the independent variables. Education, training on dairy, access to ICT, Experience and subscription to social groups were used as proxies to measure information and augment the generic C-D production function. The model was specified as shown in equation (4)

$$lnY = lnA + \alpha_1 lnN + \alpha_2 lnK + \alpha_3 lnL + \alpha_4 LI + \alpha_5 NI + \alpha_6 Edu + \alpha_7 Exp + \alpha_8 Tr + \alpha_9 ICT + \alpha_{10} Subgrps \quad (10)$$

Where: Y is the amount of milk in kilograms per cow per month, A is a constant, N is the size of land in acres, L is the total labour employed per month in man hours, K is capital captured as number of dairy cows per household, Edu is the number of years spend in schools, Exp is the number of years in the dairy business, Tr is training on dairy, ICT is access to Information and Communication Technologies and $Subgrps$ is subscription to social groups while $\alpha_1 - \alpha_i$ are the elasticities to be estimated.

Education

Household members who have been educated are assumed to be able to interpret agricultural technology better and hence are more efficient in utilizing available resources. Given the same resources, education is hypothesized to influence production positively. The study used the number of years the household head has spent in school as a measure of education.

Experience

As a household engages in dairy business over time, it learns from its mistakes and mistakes of other farmers. As a result, experience is expected to have a positive relationship with productivity as the household improves on dairy management skills. Experience was measured as the number of years a household has been in the dairy business

Training on dairy

Training on dairy is expected to improve on efficiency of the dairy farmers in the way they allocate their resources especially managing the enterprises. Experience is expected to have a positive influence on productivity. It was measured as a dummy variable (trained = 1 and untrained = 2).

Access to ICT

Proper use of ICT can reduce the cost of running dairy business and consequently increasing production. This could be demonstrated by when a farmer calls a veterinary officer as opposed to spending time to go look for them. Access to ICT for purposes of the dairy business was captured as dummy variable (Access to ICT = 1 and in-access to ICT = 0).

Subscription to social groups

Social groups are source of information for many aspects of life by them being social gatherings and dairy is not an exception. Membership to such groups was hypothesized to have a positive relationship with productivity. The variable was measured as dummy (subscribe = 1 and don't subscribe = 0).

In addition to information, the following traditional factors of production were measured.

Land

The study hypothesized that production for those households who have set aside a relatively larger acreage of land for the dairy business will be high. This would be associated with the number of dairy cattle a household can keep as well producing its own feed which could be relatively affordable. The opportunity cost would also be low with large acreage going to dairy production. Land measured in acres and a positive relationship is expected

Labour

Labour hypothesized to influence returns from milk positively. Studies by Nyangito *et al (2004)* and Gawamadzi (2010) showed that labour contributed significantly to productivity. In this study labour was measured as the number of man-hours dedicated to the business per month.

Capital

Capital is hypothesized to influence production from the dairy business positively. The number of dairy cows a household keeps was seen to be the most important form of capital hence used to

measure the variable. Number of dairy cattle was hypothesized to influence productivity positively.

In summary, the variables measures, there units of measure and the expected direction of influence to productivity are presented in table 1 below.

Table 1: Description of variables used on the empirical model

Variable	Unit of measurement	A priori sign
Land	Acres	Positive
Labour	Man hours per month	Positive
Capital	Number of dairy cows	Positive
Education (Proxy to information)	Years in school	Positive
Experience	Years in dairy business	Positive
Training on dairy	Dummy (1=Yes, 2=No)	Positive
Access to ICT	Dummy (1=Yes, 2=No)	Positive
Subscription to social groups	Dummy (1=Yes, 2=No)	Positive

3.3 Data sources

3.3.1 Study Area

Lari District of Kiambu County in central Kenya is approximately 44.1 km^2 with an estimated population of 111,302 hence a population density of 252.3 Persons/Km^2 (Kiambu District strategic Plan 2005-2010). It borders Limuru district to the south, Githunguri to the east, Nyandarua County to the north and Nakuru County to the west.

Lari District is located between 0°50" and 1°40" S and 36°35" and 36°43" E. The climate is largely cool and wet, however the landscape is divided into two agro- ecological zones, the lower and the upper highland zones, with altitude varying from 1760m above sea level (a.s.l) in the lower zone to 2610m above sea level in the upper zone respectively. Rainfall varies depending

on the altitude, ranging from 700mm per year in the low altitude zone to 1400mm per year in the upper zone. Rainfall is bimodal with the long rain occurring in the months of March to May followed by a cold season during July and august and culminating in the short rain in October and November. The land is purely an agriculture zone and the agricultural practices are rain dependent (KDSP, 2005-2010).

Kiriita cooperative society was selected because it is the largest cooperative society in the district dealing in milk marketing. Other small societies exist though they act as collection centres for the milk which is then delivered to Kiriita With a total membership of six thousand farmers two thousand of which are active, Kiriita was assumed to be a good representative of the districts dairy farming business

This study utilizes primary cross sectional data collected systematically from a survey involving 120 farmers in Lari district. A structured questionnaire (appendix 2) was used to interview farmers in Lari. The sample size for the research was calculated using Mugenda and Mugenda, (1999) approach (7)

$$n = \frac{Z^2\ pq}{d^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (11)$$

Where; n is the desired sample size for N>10,000, Z is a constant associated with the required confidence level (James, *2001*), p is the proportion of the population expected to possess the target characteristics, q is 1-p and d is the significance level The sample size was calculated to be 99.66 households. However, the target population was 2,000 farmers which is less than

10,000 (N< 10,000) and hence the sample size was adjusted following (Mugenda and Mugenda, 1999).

$$nf = \frac{n}{1+\left(\frac{n}{N}\right)} \qquad (12)$$

Where: **nf** is the adjusted sample size (N<10,000), **n** is sample size when N>10,000 and **N** is the population size. The resulting sample size was marked up by 20 percent to take care of non response among other data collection irregularities. This gave a sample size estimate of 119.6 households which was rounded off to the nearest whole number ($n \approx 120$).

3.3.2 Sampling procedure

Systematic random sampling technique was applied to select the sample size. Kiriita cooperative society had a total of 6,000 members according to their first register but the active ones were 2,000 according to their second register. The 2,000 active members formed the sampling frame for the study. The sampling interval (k) was determined as shown in formula (9).

$$k = \frac{N}{n} \qquad (13)$$

The sampling interval k was 17, **N** is the population size and **n** is the sample size. The society identifies each member with a unique identification number during registration. By use of a table of random numbers and utilizing the last two digits of the numbers, the first member to be included in the study was randomly selected. By use of the formula, $K = n + k$, where **K** is the

next household to be included in the sample. n is the previous member included and k is the sampling interval (Mugenda and Mugenda 1999), the K-th household was determined and the process was repeated until a sample size of 120 was achieved. Each member of the society included in the sample was assumed to represent a household because the members were the actual owners of the dairy business.

3.3.3 Data analysis

The collected data was analyzed using the statistical package for social sciences (SPSS 16.0) and excel. The results were divided into two categories; descriptive and quantitative statistics. The descriptive analysis used Principle Component Analysis to categorize farmers, measures of variability, tables and graphs to highlight of any observable trends. On the other hand, the quantitative analysis used the student's t statistic and linear regressions analyses to make conclusions and inferences.

3.4 Chapter Summary

In summary, Lari district was selected because dairy farming is common enterprise due to its conducive climatic conditions which favor the enterprise. Kiriita cooperative society was selected because it is the biggest dairy society in the district with a membership of six thousand farmers.

Out of the 2000 active dairy farmers, 120 were selected systematically and participated in the survey. Data was analyzed by use of SPSS 16.0 and excel and results presented in chapter four.

3.5 Limitation in the estimation

The study used PCA to calculate information index which was then estimated alongside land, labour and capital. This approach forms part of the limitation of this study in that, the study utilized primary data which is not very appropriate to measuring impact.

Other limitation include inadequate funds to undertake the within the expected period of time. This affected the sample size which had to be down sixed without compromising the quality of results. However, this meant that, the study did not take advantage of large sample size which gives results more representative to the actual population.

CHAPTER 4

RESULTS AND DISCUSSION

This chapter presents the results of the study in two subsections. The first subsection presents the descriptive statistics results whereas the second subsection presents the quantitative results. The descriptive results have been organized into household, farm, technology and information characteristics whereasthe quantitative findings present the C-D production function regression estimates. The response rate was 78 percent with data from 94 households being analyzed.

4.1 Descriptive results

Table 2 presents the results of household characteristics among the dairy farmers in Lari district.

4.1.1 Household characteristics

Men in Lari district are mostly the heads of the households with only 25 percent of household being headed by women (figure 2).

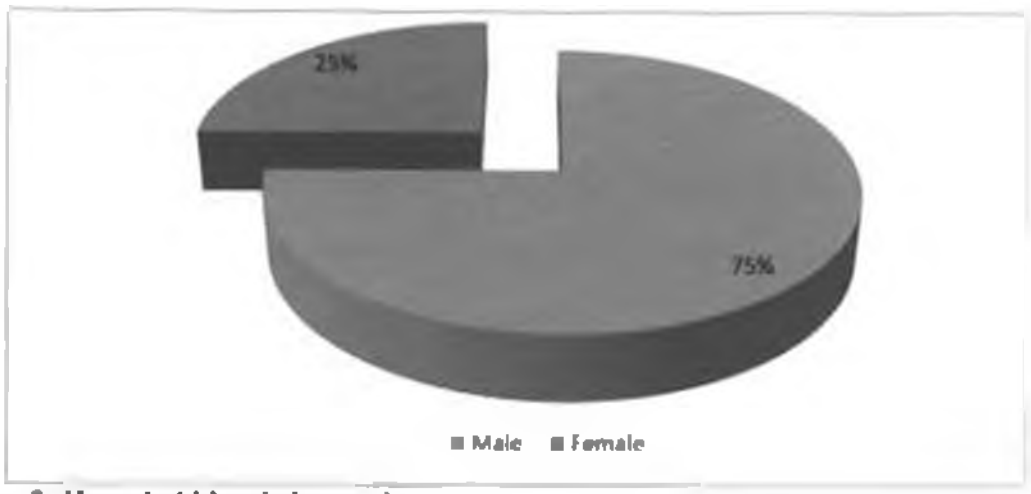

Figure 2: Household heads by gender

Age

The average age of household heads in Lari district is 50years with the oldest dairy farmer being 85 years and the youngest is 26 years of age. A standard deviation of 10 years implies that 68 percent of the population household heads are within the age of 40 and 60 years (Table 2).

Education

The average number of years spend in school by the farmers in the district is approximately 10 years (Table 2). Sixteen years is the maximum number of years spent in school. The least learned farmer has not finished primary school Households are the decision making units in agriculture and hence the education of the most learned member of the household was considered. On average, other members of the households had spend 11 years in school with some having spent a maximum of 16 years in school and a minimum of 3 years having been spend in school (Table 2).

Household Size

Households in Lari district have an average of 5members with the largest household having 15 members and the least having only one member living in the household The results of the household characteristics are summarized in Table 2.

Table 2: Household characteristics

N = 94	Mean	Std. Deviation	Min	Max
Age of household head (Years)	50.3	10.5	26	85
Education of household head (Years in school)	10.5	2.7	4	16
Education of most learned member of the HH (Years in school)	11.9	2.6	3	16
Number of members in the household	5.0	2.6	1	15

4.1.2 Farm characteristics

Small holder dairy farmers in Lari take the enterprise as a business as shown by the 99 percent of respondents who reported that dairy is a business to them. One percent of farmers undertake dairy as a cultural enterprise (figure 3).

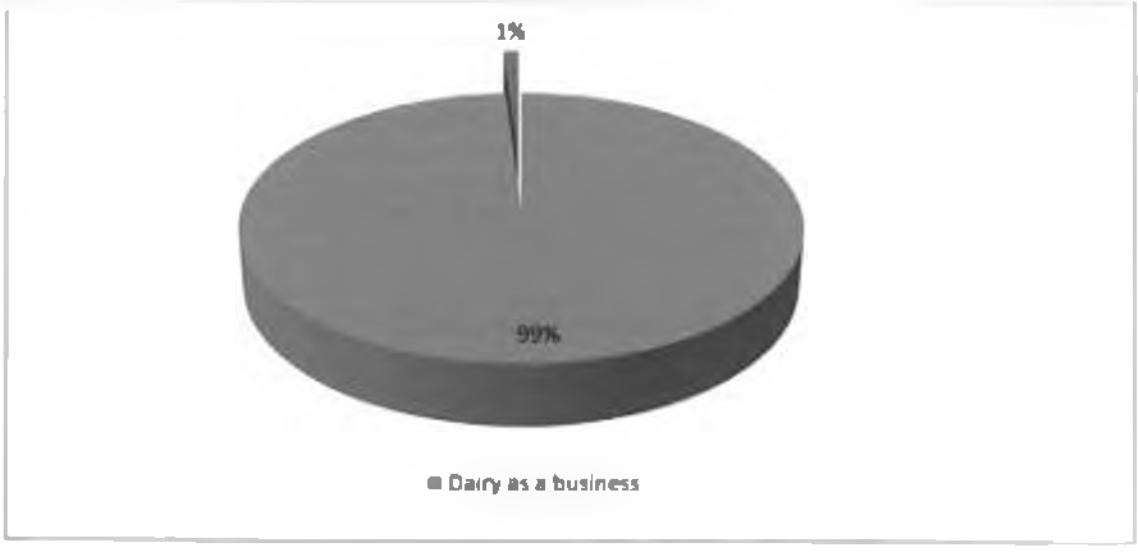

Figure 3: Proportion of dairy farmers undertaking the enterprise as a business

Experience

Farmers in Lari district have been in the dairy business for 15 years on average. The most experienced farmer has been in the business for 35 years whereas the least experienced farmer has been keeping dairy cows for 3 years. With a standard deviation of 8 years, 68 percent of the farmers have been in the business for between 6 and 22 years (Table 3).

Capital

Dairy cows are probably the most important investment in the dairy business. On average, dairy farmers in Lari district keep 2 dairy cows with the maximum number of dairy cows kept being 1 and a minimum of 1 cow. This finding confirms the categorization of smallholder dairy farmers by Export Processing Zone Authority (EPZA, 2005) as those who keep between 2 – 3 dairy cows (Table 3).

Milk Production

The average milk productivity is 581kilograms of milk per cow per month with the most productive farmer producing 974 kilograms of milk per cow per month. With a standard deviation of 156, 68 percent of the farmers produce between 425 and 737 kilograms of milk per cow per month. This finding imply productivity has increased since the year 2010 when Kenya's dairy productivity was reported to be 112 kilograms of milk per cow per month (Wambugu *et al.* 2010). However, productivity of farmers in Lari district and perhaps Kenya in general remain far below international yields for instance, in the year 2008, milk productivity in the USA was 750 kilograms per cow per month (Technoserve, 2008) (Table 3).

Land Size

As presented in table 3, land continues to be highly fragmented in Lari district. This is associated with the high population density of 252 Persons/Km^2 (Kiambu District strategic Plan 2005-2010). On average, households in Lari are keeping the dairy cows on 1.8 acres of land. This confirms the findings by Mwangi (2010) who reported an average of 1.9 acres land holding in the district. The minimum land ownership is 1 acre with only one farmer owning 30 acres of land.

Labour Availability

Two types of labour are available in Lari district; family labour and hired labour. Family labour is common with 219 of the total 379 man-hours per month employed in dairy production being supplied by family members. Some households do not have any family labour at all making the minimum family man-hours zero. The maximum amount of family labour employed is 720 man-hours. Only 97 man-hours are hired on average with a minimum of zero and a maximum of 600 man-hours being hired. A total of 379 man-hours are employed in Lari district on average with a minimum of 30 man-hours and a maximum of 1,000 man-hours being employed per month (Table 3).

Gross margins

The average gross margin from milk sales in Lari is KES 15,401 per cow per month with some farmers making upto KES 55,650 per cow per month. Considering a standard deviation of 10,831, 68 percent of the farmers make gross margins of between KES 4,570 and KES 26,232 per cow per month (Table 3).

Table 3: Farm characteristics

N = 94	Mean	Std. Deviation	Min	Max
Years in the business	14.7	8.2	4	60
No. of dairy cows	2.2	1.0	1	4
Quantity of milk produced per month	581	408	60	974
Size of land for the business	1.8	3.1	1	30
Family labour (Man-hours per month)	218.6	160.4	0	720
Hired labour (Man-hours per month)	96.9	112.4	0	600
Total labour (Man-hours per month)	378.6	222.4	30	1000
Gross Margins per cow per month	15401.0	10831.1	1590	55650

4.1.3 Technology characteristics

Figure 1 below presents information on the level of access of ICTs by the households. A household either accesses ICT for purposes of dairy production (Dummy = 1) or not (Dummy = 0).

Mobile Phone

Mobile phone is the most accessed ICT and it is mostly used for contacting the veterinary officers whenever a cow falls sick or is on heat with 93 percent of the farmers accessing mobile phone by either owning or borrowing (figure 4).

Radio and TV

Radio is also a common ICT with 87 percent of the dairy farmers listening to radio programs which educate farmers on agriculture and dairy in particular. Though a rural area, television (TV) ranked high as source of good information for dairy keepers with most of the information being run inform advertisements of chemicals by private companies (figure 4).

Newspapers and Internet

Newspapers and the internet are not common as sources of important information. This could be so because of the recurrent cost associated with the two. For internet, knowledge on how to mine relevant information is an associated barrier to its use (Figure 4).

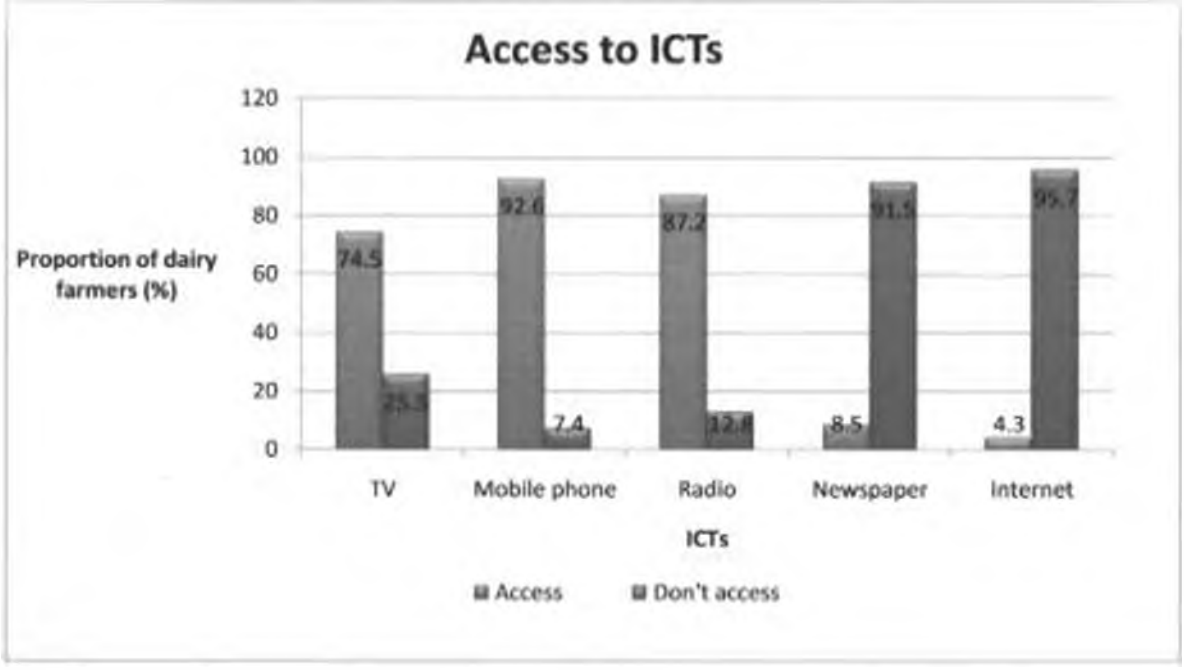

Figure 4: Proportion of dairy farmers accessing ICTs

4.1.4 Categorization of dairy farmers in Lari along their information characteristics

The first objective of this study was to categorize farmers in the district along their information characteristics. The characteristics were; education, training on dairy, access to ICTs, experience and subscription to social groups. This was achieved by using the above attributes to compute an information index.

By use of the Principal Component Analysis (PCA) as explained in chapter 3, smallholder dairy farmers in Lari district can be put into two distinct information categories (Figure 5). The two categories are; those households well endowed with information and those that are not. Of the dairy population in Lari, 45 percent is well endowed with information with the remaining 55 percent lacking information.

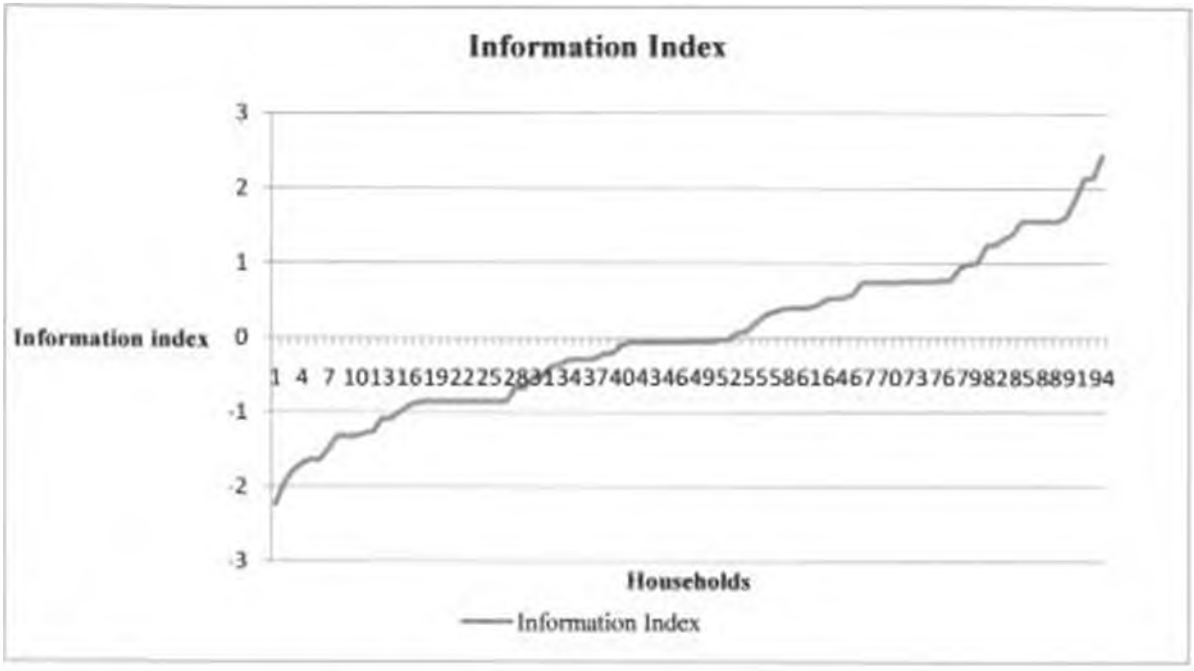

Figure 5: Farmer categories along information characteristics

To determine whether the two groups were significantly different, a student's t statistic was used to compare the means of the two groups. The groups already identified were treated to be independent of each other. The t statistic was calculated using the formula below;

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_{x_1}^2}{n_1 - 1} + \frac{S_{x_2}^2}{n_2 - 1}}}$$, $df = (X_1 - 1) + (X_2 - 1)$, $\alpha = 0.01$ ..... (14)

Where, t is the statistic, X_1 and X_2 are the means of the two groups, S^2_1 and S^2_2 are the standard deviations of the two groups, df are the degrees freedom and α is the margin of error. With a $t_{cal} = 1.829$ and a $t_{crit} = 2.6303$, the study failed to reject the null hypothesis that the two groups of farmers are not significantly different with respect to their information endowment and concluded that there exists no significantly different groups of dairy farmers in Lari district and any strategy to address their information needs should address the whole population of dairy farmers.

4.2 Contribution of information to farm productivity

To assess the contribution of information to farm productivity among smallholder dairy farmers in Lari district, a C-D production function was estimated. The regression analysis was preceded by a partial correlation coefficient analysis (appendix 1) which showed that artificial variables land * information and capital * information were highly correlated ($r^2 = 0.9$). The interaction variable capital * information was dropped because it was assumed information would have more effect on labour than capital. The regression results are presented in Table 3. Three of the four estimated variables were significant at different levels with a goodness of fit ratio (R^2) of 0.63 meaning that over 63percent of the variation in productivity of dairy is explained by the independent variables included in the model.

Table 4: C-D Production function regression results

Regressors	Beta	P values
(Constant)		0.023
$\alpha_1 Land$	0.24	0.014**
$\alpha_2 Labour$	0.26	0.007*
$\alpha_3 Capital$	0.35	0.001*
$\alpha_4 Labour * Information$	-0.04	0.785
$\alpha_5 Land * Information$	0.24	0.007*
$\alpha_6 Education$	0.10	0.230
$\alpha_7 Experience$	0.25	0.002*
$\alpha_8 Training\ on\ dairy$	0.04	0.657
$\alpha_9 ICT$	0.03	0.658
$\alpha_{10} Subscription\ to\ groups$	-0.05	0.591
Adj. R^2	**0.63**	
N	**94**	

*** and ** denote statistically significant at 1%, 5% levels respectively**

Land

Land had the correct sign as hypothesized and was also significant at the 5 percent level ($p< 0.05$) with an elasticity of $\alpha_1 = 0.24$. A 10 percent increase in acres of land dedicated to dairy would result to a 2 percent increase in milk productivity. This finding seems to contradict finding by Nyangito *et al.* 2004 which found out that land was not significant at 5 percent as a source agricultural productivity. However, a study by Gawamadzi, 2010 on the sources of growth in Malawi found out that land was significant though at 1 percent level.

The implication of the result to the dairy farmers in Lari district is that, they can actually increase milk productivity by allocating more land to the enterprise. More land would enable the farmers to keep more animals and also produce their own feed which is a costly input.

Labour

Labour (α_2) has a positive sign as hypothesized and an elasticity of 0.26 significant at the 1 percent level ($p<0.01$) (Table 4). A 10 percent increase in man-hours per month dedicated to the enterprise would result to 2.6 percent increase in milk productivity. This is so because dairy cows are sensitive to management practices e.g. watering, feeding, treatment and even time of milking. A slight delay in any of those management practices can reduce productivity significantly.

This finding is in agreement with Odhiambo *et al.* (2004) who found out that the elasticity of labour to productivity in Kenya was significant at the 5 percent level. The implication to dairy farmers in Lari is that, they can increase productivity by dedicating more man power to manage the enterprise.

Capital

The results show that capital has a positive impact on dairy productivity and is significant at the 1 percent level ($\alpha_1 = 0.35$; $p<0.01$) (Table 4). This finding is in agreement with the earlier hypothesis on the direction of influence. The number of dairy cows has been used as a proxy to measure capital; one percent increase in the number of dairy cows would translate into more milk and consequently increase the production from the enterprise by 0.35 percent.

Capital inform of dairy cows can be increased for as long other resources like land and labour are adequate and this would translate into higher production.

Information

Information was measured in form of proxies. The proxies used were selected on the basis of whether they would provide a farmer with information to use directly or indirectly for improving the enterprise. The proxies were: education, access to ICT, number of years in the dairy business, subscription to social groups as well as training on dairy. Only experience was significant as discussed below.

Experience

Taken as a proxy to measure information, experience has a positive influence on productivity ($\alpha_7 = 0.25$) significant at the 1 percent level ($p<0.01$). The assumption is, as farmers spent time on the enterprise, they gain expertise over time. Farmers would also learn from their mistakes and improve as time goes. As a result, the number of years a dairy farmer spend producing milk has a positive impact on productivity. For instance, a farmer producing the highest amount of milk in Lari of 2,100 Kg/Cow/Month has been in the business for 20 years as opposed to another who has been keeping dairy cows for only 6 years and even does not take the enterprise as a business ending up with only 60 Kg/Cow/Month.

The study sought to find out the effect of information when used together with land and labour. Interestingly, when information complements land, the influence on productivity is positive ($\alpha_5 = 0.24$) significant at the 1 percent level ($p<0.01$). However, the elasticity of complementing land with information is not different form when land is used alone. The implication though is that, dairy farmers in Lari can improve their milk output by utilizing information on modern technologies as well as appropriate dairy management practices without necessarily increasing

the size of land under dairy. This is a finding which could easily be adopted to transform the enterprise.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to categorize farmers in Lari along their information characteristics in addition to assessing the influence of information to farm productivity among smallholder dairy farmers in Lari district, Kiambu County. The analysis started with a descriptive approach which addressed household, farm, technology and information characteristics in that order. The PCA approach was also used to categorize farmers as well as calculating the information index. This was then followed by a C-D production function estimation using regression analysis to determine the influence of each of the individual factors of production to productivity from the enterprise. Following is the summary and the policy implications.

5.1 Summary

Household characteristics were defined by the age of the household head; the number of years spent in school, gender of the head as well the household size. In Lari, 75% of households are headed by a male with the household head having spent 11 years in school. On average, families in Lari have 5 members. The age of the household head is 50 years on average.

The household farms were characterized by number of dairy cows, size of land under dairy, amount of milk produced per month as well as the gross margins. Dairy farmers in Lari keep 2 dairy cows on average on 1.8 acres of land. Milk production is 581 Kg/Cow/Month on average. The enterprise is still profitable with farmers making 15,400 Ksh/Month as gross margins. Labour supplies 379 man-hours/month 219 man-hours of which are family labour.

Information remains at the centre of business in the current era. However, its contribution to the production process is not well known. This study set out to find what the contribution of information is to productivity, a case of small holder dairy farmers in Lari district, Kiambu County. Dairy farmers in Lari are exposed to different types of information and different channels. Access to mobile phones is by 91% of the dairy farmers followed by radio programs which are accessed by 87% of the farmers. The least accessed source is news papers and the internet which are accessed by less than 10% of the population owing to the cost of purchasing newspapers and the skills required to serve the net.

Dairy farmers in Lari district can be categorized into two distinct groups. One group is well endowed with information while a second group lacks information ($p<0.1$). This categorization was based on the response of the farmers to the different aspects used to measure information including education, access to ICT, subscription to social groups and experience in dairy.

With respect to individual factors, land labour and capital contributed significantly to production from dairy. Information in form of the number of years spent in dairy significantly influence dairy production if taken alongside the traditional factors. Information when used to complement land also contributes significantly to productivity. These results are supported by other studies that have suggested that information is a potential factor of production to complement the traditional factors.

5.2 Conclusion and Policy Recommendations

The analysis from the study has found out that small scale dairy production is still common in Lari district. In addition, milk production has increased since 2008 but still the current production trails below international yields and hence farmers have not been able to realize their full dream of sufficient margins from the enterprise.

To be able to address the challenge low dairy productivity in Lari district, the study recommends the following:

1) From the finding that, over time in the business, farmers acquire more information on dairy management as well as adopting new technologies in the market and this has a positive significant influence on productivity, there is need for the government through the ministry of agriculture and ministry of cooperatives to formulate policies that will act as incentives to retain dairy farmers in the business. Such incentive policies would include premium prices for quality of milk. This would mean over time, dairy farmers would benefit from the information they acquire over time.

2) From the finding that information when used to complement land also results to positive and significant dairy productivity calls for a policy intervention to discourage further land fragmentation. Such a policy could be designing capacity building programs targeting those with a specified minimum size of land. Using the program, it could be possible to encourage household to consolidate their small pieces of land in-order to the minimum size with an aim of benefiting from the program.

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APPENDICES

Appendix 1: Partial correlation coefficient matrix

	Training on dairy	Subscription to social groups	Experience on dairy farming	Land	Labour	Capital	Capital * Information	Labour * Information	Land * Information	Education	Access to ICT for dairy production
Training on dairy	1.00										
Subscription to social groups	0.14	1.00									
Experience on dairy farming	-0.05	0.10	1.00								
Land	-0.11	-0.17	0.10	1.00							
Labour	-0.01	-0.10	0.08	0.33	1.00						
Capital	-0.49	-0.03	-0.04	0.18	0.28	1.00					
Capital * Information	0.48	0.63	0.05	-0.40	-0.11	-0.26	1.00				
Labour * Information	0.47	0.57	0.06	-0.34	-0.07	-0.24	0.91	1.00			
Land * Information	0.17	0.24	-0.08	-0.52	-0.25	-0.21	0.55	0.54	1.00		
Education	-0.28	-0.16	-0.23	0.17	-0.05	0.11	-0.58	-0.53	-0.28	1.00	
Access to ICT for dairy production	0.15	0.04	0.09	0.04	-0.09	-0.04	0.29	0.30	0.04	-0.12	1.00

Source: Author's analysis, 2012

Appendix 2: Questionnaire

AN ASSESSMENT OF THE INFLUENCE OF AGRICULTURAL INFORMATION TO FARM PRODUCTION AMONG SMALL HOLDER DAIRY FARMERS IN LARI DISTRICT

BY:

HENRY M. MWOLOLO

A56/77480/2009

NOTE: information collected by use of this questionnaire is strictly for academic purposes and shall be accorded confidentiality of the highest order.

HHN: _____

Date: _____ _____

Enumerator: _____

PART 1: HOUSEHOLD INFORMATION

Q1. What is the gender of the household head?

a) Male

b) Female

Q2. What is the relationship between the responded and the household head?

a) Head

b) Wife

c) Daughter/Son

d) Relative

Q3. What is the age of the household head? .....years

Q4. What is the highest level of education attained by the household head? ..... years

Q5. Does the household head have any training on dairy farming?

a. Yes

b. No

Q6. How many members of the household stay in the household?

Q7. What is the highest level of education did the most learned member of the household reach?

.....years

Q8. Does the household have access to any working ICT's? If yes, l ist below

a.

b.

c.

d.

Q9. Does the household access any other type of IC'I apart from the listed ones? If Yes list them and state from where

Q10. For what purposes doe the household members access the ICT's?

Q11 Does the household access any extension services? If Yes from where?

Q13. Does any member of the household subscribe to any social grouping? If yes does the group members discuss any matters to do with dairy?

Codes;

YES=1

NO=0

PART 2: FARM CHARACTERISTICS

Q14. Is dairy farming a business to the household or otherwise? If Yes go to Q18.

Q15. For how many years has the household done the business?

Q16. How many dairy cows does the household possess?

Q17. How much milk (kgs) does the household produce per day?

Q18 What size of land has the household set aside for the business?

Code: YES=1, NO=0

PART 3: LABOUR INFORMATION

Q19. How many laborers dedicate their efforts towards the business?

TYPE	QUALITY		
	NON SKILLED	SEMI SKILLED	SKILLED
FAMILY			
HIRED			

Q20. How many hours does each laborer work per day?

Q21. What are the total man hours per day which go to the business? (Laborers/day * Hrs/ Laborer/Day)

Q22. What is the hourly rate per unit man hour?

PART 4: MARKET INFORMATION

Q23. Where do you sell your milk?

Q24. What is the milk collecting centre?

Q25. What is the cost of transport to the centre?

Q26. How much does a kg of milk cost in KES?

Q27. Are there other milk selling outlets apart from Q23?

If Yes how much does a kg of milk go for in KES?

PART 5: CAPITAL INFORMATION

Q28. How much did it cost to build the animal shelter?

Q29. Where do you get your feeds from? a. Buy b. Produce own

Q30. If the answer to Q29. Is (a) for how does a tonne cost?

Q31. If the answer to Q29. Is (b) how much would you sell a tonne if you were to sell?

Q32. How much feed (in tonnes) does a cow take per day?

Q33. How much does it cost to access health services per month i.e. chemicals?

Q34. How much are the extension services per visit?

Q35. How many litres of water does an animal take per day?

Q36. How much does a litre of water cost?