INFLUENCE OF SOCIAL NETWORKS ON AGRICULTURAL COMMERCIALIZATION: CASE OF TISSUE CULTURE BANANA IN MURANG'A COUNTY, KENYA

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DECLARATION AND APPROVAL

Declaration

I declare that this work is wholly my original work and to the best of my knowledge has not been presented for the award of any degree in this or any other university.

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Approval

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DEDICATION

To my friends and family.

ABSTRACT

Information asymmetry has been recognized as a major impediment to small holder agricultural commercialization in most parts of sub-Saharan Africa. Theoretical and empirical studies in economics and sociology argue that social networks are the most persuasive source of information about new products and behaviours, but governments in developing countries continue to rely on extension services, usually a set of external agents, to communicate with farmers about new technologies. Mixed modelling has been used in this analysis to describe the role of information sharing among banana farmers in enhancing banana commercialization. Social network analysis (SNA) methodology was used to illustrate the network structure revealed by small holder banana farmers in Murang'a. Double Dekker semi-partialing multiple regression quadratic assignment procedure (MRQAP) was used to determine drivers to networking among the farmers. Ordinary least square approach has been used to determine the extent to which networking influences banana commercialization in the area. The network structure depicted is diversified and heterogeneous in composition. Male and female farmers jointly interact in the sharing of information. In terms of network diversity, alters range from neighbours, banana traders, same organisation members and friends with friendship network dominating the structure. Friendship, gender, group membership and neighbourhood (geographical proximity) were found to have an influence to resource sharing among the farmers. Resources sharing among group members and networking among male and female farmers had an impact on the degree of banana commercialization in the study area.

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LIST OF ACRONYMS AND ABBREVIATIONS

CI	-	Commercialization Index
FAO	-	Food and Agricultural Organisation
GoK	-	Government of Kenya
Ha	-	Hactare
HCDA	-	Horticultural Crop Development Authority
ILRI	-	International Livestock Research Institute
Kg	-	Kilograms
KNBS	-	Kenya National Bureau of Statistics
SAMT	-	Small-scale Agriculture and Mobile Technology
SNA	-	Social Network Analysis

CHAPTER ONE
INTRODUCTION

1.1 Background information

Human societies are comprised of individuals connected to one another by overlapping arrangement of social ties that together constitute a social network. At any point in time, banana farmers in Murang'a don't produce in solitary but rather rely on each other to get new varieties of planting materials and market information for their produces. Information on production reputation of one farmer easily circulates among the farmers within the network.

As an interest in networking has grown, different views have emerged regarding the extent to which networking relations are distinct and separate from other relations. White *et al*. (1996) suggests that networks provides a basis for resource sharing, gathering information and the general survival of actors in the network where there is inefficiencies in transmission of information; be it production, management or marketing of either business or agricultural outputs.

Banana is an important food crop and income earner in the country. In 2011, the government earned 23 billion shillings from banana sold locally while flowers brought in revenue of 40 billion shillings. Compared with other fruits, banana is the number one income earner and second to flowers (GoK, 2012). Banana production in Kenya has increased in the past 15 years. This is mainly due to the improved production practices and introduction of improved banana varieties. The key production areas include Nyanza (30,303 ha), Eastern (15,074 ha), Central (11888 ha) and Western (14,116 ha) regions (HCDA, 2010).

Banana production in Kenya receives little support from the government since it is rarely considered critical to national food security. Consequently, agricultural households face high transactions costs owing to limited access to financial services, information asymmetries and poor market infrastructures hence inhibiting their participation in markets (Nkhori, 2004). The converse concurs with Wanjiru *et al*., (2012) who argue that households with lower transaction costs are more likely to participate in markets or otherwise commercialize since they are more likely to recover their production and marketing costs. Participation therefore depends on ability to overcome cost of participating caused by information asymmetry among the players in banana production and marketing.

A pilot project study by Wambugu *et al.* (2008) found that tissue culture have additional advantages over traditional banana accrued from the superiority of the planting materials in terms of; early maturity (12-16 months compared to 18-24 months for the

traditional banana), bigger bunch weights (at least 20kg compared to 10-15kg for traditional banana), high annual yield per unit of land (up to 50tonnes per hectare compared to 30tonnes for traditional banana), resistance to pests and diseases and coordination for market due to uniformity in maturity.

Since introduction of tissue culture technology in Kenya more than ten years ago, banana has turned from a backyard crop to a commercial crop in the country (Kabunga *et al.,* 2012). However, how this technology is transmitted to farmers is characterized by inadequacy from agricultural extension officers. Although the ratio of extension officers to farmers in Kenya is relatively compelling compared to other East African countries, the situation is still not promising. Statistics show that the ratios of extension officers to farmers are: Kenya; 1:1000 (mFarmer, 2014), Tanzania; 1:1145 (SAMT, 2014) and Uganda; 1:2400 (Laura, 2012). Due to this low ratio, farmers do rely on social interactions among themselves to get crucial information on new varieties of planting materials and market information for their produces.

Social network, an informal institutional arrangement, is one of the interaction form that has an impact on agricultural commercialization. Social network is an important platform within which actors or a set of individuals have connections of some kind to some or all of the other members of the set (Malerba, 2007). Owing to these connections, social networks can therefore ease transmission of information or the flow of new ideas and other resources hence can be a desirable avenue by which farmers can commercialize their production.

Several studies regard social network as a major form of social capital given that it is a resource found in personal relationships maintained by households that can influence production decisions and economic outcomes (Putnam *et al.,* 1994; Narayan and Pritchett, 1999; Grootaert, 2001; Renard and Guo, 2013). Therefore, prevalence of social network particularly in rural areas has prospects to improve the productivity as well as the welfare of households and the overall society.

Actors within social networks can be connected on the basis of similarity (same locality, affiliations, or other similar attributes), social relations (kinship, affective or cognitive relations), interactions and/or resource/information flows (Hartmann *et al.,* 2008; Borgatti *et al.,* 2009); as such one farmer in a network affects other farmers' choices directly without the intermediation of the market. Consequently, these farmers' network conceptualized households as often participating in networks that reduces market barriers and therefore enhancing the probability of banana commercialization.

1.2 Statement of the problem

The ratio of extension officers to farmers in Kenya is far above the desired by FAO (1:1000 instead of 1:400, mFarmer, 2014).Therefore this low ratio leads to inadequate access of information from extension officers by farmers in the country. Nonetheless, farmers rely on fellow farmers to get information on planting material varieties and market information for their products. Although there are farmer to farmer extension services, there was a need to investigate on the structure of these networks and how they influence banana commercialization in the area.

1.3 Objectives

1.3.1 General objective

To contribute towards improvement of small holder banana farmers' welfare by depicting the characteristics of social networks they maintain and the determinants of these networks formation as well as establishing their role in enhancing banana commercialization.

1.3.2 Specific objectives

i. To characterize social networks among smallholder banana farmers in Murang'a County.
ii. To examine the factors leading to dependence on social networks among smallholder banana farmers in Murang'a County.
iii. To evaluate the extent to which social networks influence commercialization of banana by smallholder farmers in Murang'a County.

1.4 Research questions

i. What are the characteristics of social networks maintained by smallholder banana producers in the County?
ii. What are the key factors leading to dependence on social networks by smallholder farmers in Murang'a County?
iii. To what extent do these social networks influence commercialization of banana production?

1.5 Justification

Income generation is a key factor in support of sustainable rural livelihoods. The ability of individuals or groups to develop enterprises depends on opportunities generated by

the market and also the ability to create the links and networks that provide information, credit and other forms of support. The interaction between farmers, farmers and traders, and the nature of the links between them, has rarely been studied in detail.The contributions of this study was to enrich an understanding of how social networks play a role in economic outcomes.

The analysis provides information on how commercialization decisions are embedded in a social context concerning exchange behaviors or practices. These are decisions such as where to get hybrid planting materials, when to harvest, where to sell (given the numerous fragmented markets) and at what price to sell the crop. As such, there was need to investigate on the influence of these social networks particularly in facilitating commercialization of banana production by farmers in Murang'a. This was not only for the purpose of developing strategies to advance smallholder agricultural commercialization but to also add on the limited documentations as well as provide an investigative approach on social processes involved and the impact of social networking.

1.6 Scope and limitation of the study

The study only focused on households producing bananas and information was collected by use of structured questionnaire. The parameters of interest were demographic characteristics, network size, influence and prestige, and diversity in composition and function of networks as they influence and determine agricultural households' production decisions. The study was constrained by inaccurate information due to inaccessibility of records, given that data on banana production is scarce and is sporadically reported in the main publication in the state department of Agriculture in Kenya, and reliance on recall data. This limited how much can be learnt about the dynamics that have brought each household to its current network status.

1.7 Definitions of Terms

A social network is a pattern of friendship, advice, communication, or support which exists among the members of a social system.

Agricultural commercialization involves production not only to meet subsistence needs but also for markets.

An agricultural household is intended in this study as shorthand for that group of families in which agricultural activities represent a meaningful proportion of their total household income.

Extent of commercialization in this study is defined by the percentage of the total output that is sold.

Transaction costs are the costs incurred when exchanging goods and services, which can arise in three broad areas: gaining information on or searching for marketing and trading partners; negotiating contracts; and monitoring and enforcing the implementation of the agreement.

CHAPTER TWO
LITERATURE REVIEW

2.1 History and the role of social network

Studies on social networks were initiated by sociologists over a century ago and by the early 1990s, had developed to be a central field of sociology (Wasserman and Faust, 1994). By then, interests in social networks started developing in computer science, statistical physics and economics (Albert and Barabási, 2002; Newman, 2003). With respect to economics, it is unexpected that interest did not develop sooner given the fact that economic activities are usually significantly embedded in social settings. Studies of networks with economic perspectives, using game-theoretic modelling techniques, have only emerged over the past few years (Goyal, 2007; Jackson, 2007; Vega-Redondo, 2007).

Recent studies recognize that participation in formal social networks like farmer groups can encourage learning processes and the embracing of improved cropping systems (Besley and Case, 1993; Wollni *et al.*, 2010). Social network studies emphasizes on the function of informal social networks and neighborhood effects, showing that farmers with experienced and innovative neighbors are more likely to adopt on these innovations (Langyintuo and Mungoma, 2008; Matuschke and Qaim, 2009; Conley and Udry, 2010). Social networks becomes particularly important where other production assets and formal sources of information are scarce (Wu and Pretty, 2004; Matuschke and Qaim, 2009).

Wanjiru *et al.* (2012) in their study on banana marketing outlet in Murang'a found that the contribution of extension workers focuses exclusively on production frontier rather than marketing. Although agricultural extension workers promote the use of tissue culture technology in the area only few farmers successfully acquire these techniques directly from the extension workers.

2.2 Banana production and marketing

Agricultural marketing in Kenya, just like other developing countries, is characterised by long transaction chains, poor access to appropriate and timely information, high transport and transaction costs. These barriers to market participation act as an inhibiting factor towards small scale agricultural commercialization.

In their study on market decision making on banana in Murang'a, Wanjiru *et al.* (2012) found that one major source of transaction costs in marketing of banana is information asymmetry. They argue that provision of market information can strengthen farmers' negotiating ability during transactions with opportunistic buyers, and consequently prevent

the possible exploitation due to information asymmetry. This can be achieved through informal channels and institutional arrangements such as networks which will enable farmers to access markets and potentially achieve better terms in markets.

2.3 Networking among banana farmers

Wanjiru *et al.* (2012) in their study on making marketing decision of banana in Murang'a established that farmer groups play a key role in reducing transaction costs and taking advantage of collective bargaining power. They concluded that there is need to promote formation of more banana marketing groups and support the few existing ones so that they can perform their role of developing market linkages more effectively. Lamb (2011) found that features of people's social networks – the people they know and the links between them - and the ability to use these networks can make a difference to the way they make decisions, to their access to different inputs and market information.

Households in Murang'a County were characterized by physical proximity. This means that information on a new banana variety or market information easily circulates to a large number of farmers in the network within a very short period. Monge and Contractor (2001) stresses that proximate ties are easier to maintain and more likely to be strong, stable and positive. In this view, the flow of information between the farmers and between farmers and buyers can be very successful through their networking since proximity mediates the ease in which information flows among the actors involved.

There is homophily (interaction with similar others) among banana farmers in the area in terms of the size of their farms and the intensity of their investment in banana farms. Networks cluster around social class, sex, occupation and religion. In their article, 'Birds of the same feathers', McPherson *et al.* (2001), similarity breeds connection. This principle structures network ties whose significance is basically information sharing of any kind or form among the actors in the network.

According to Wanjiru *et al.* (2012), transaction costs especially hours spent looking for market information, cost of acquiring market information, transportation costs, trust in buyer, negotiation time, road conditions and distance to the market are the characteristics of banana marketing in Murang'a which certainly discourage banana commercialization.

Social networks relate to commercialisation by easing in acquisition of high yielding varieties, reduction in transaction costs and the smoothening of market access for the farmers. This could be through providing various banana varieties and helping in overcoming information asymmetries.

There is clear theoretical support for the role played by repeated social interactions in reducing transactions costs, and curbing opportunistic behaviour. Social networks potentially offer a cushion against risk in markets and provide direct assistance in the form of access to transport, storage, information and potentially better terms of trade through relationships with actors in marketing chains (Lamb, 2011).

A descriptive study on the influence of social networks on access to information in rice-farming communities in northern Vietnam, Hoang *et al.* (2006) found that agricultural information runs through informal channels, for example kin networks, neighbours and friends. The research found kinship networks to be vital in accessing information, with network of neighbours playing a key role in disseminating technological innovation.

The major idea associated with the interest in networks is the insight that strong networking activities will assist local economic performance through increased information and knowledge sharing among individual banana farmers and the society at large. The most relevant network definition in the context of this study is that offered by Szarka (1990), who argue that networks can refer to both social relationships among individuals and interactions among them.

This study focused on a view of networks as a subset of social capital. This approach utilise the network to capture how banana farmers in the area take advantage of each other in acquiring high yielding planting materials and the sharing of market information for their produces.

2.4 Empirical studies

Affognon *et al.* (2009) in their study on the impact of social networks on cattle farmers' knowledge of animal trypanosomosis in Bukina Faso, found that Social networks play an important role in helping cattle farmers to access valuable information through their contacts, and to improve their knowledge on animal trypanosomosis and its control. However, the study shows that what is important in the cattle farmer's position in the social network is not the degree of centrality measured as the number of people an individual cattle farmer is linked to in terms of information exchange. Instead, it is the ability of farmers to detect those farmers who are likely to possess exceptional knowledge and know-how. Cattle farmers who establish strategic relationships with these people know more about animal trypanosomosis and its control.

Emerick (2013) in the study on female social networks and learning about new technology in India demonstrate that men and women in the same households have very

different social networks and thus different access to information regarding agricultural technologies. They found that the underlying factors that shape network linkages between male farmers are different from those shaping their wives' social networks.

Relying on social network for diffusion of information is a desirable avenue and an extremely low cost approach in diffusing a new technology. If the allocation achieved by exchange in networks is efficient, then networks could be relied upon as a highly sustainable method of ensuring efficient spread of technologies, particularly in the absence of efficient markets.

Handschuch and Wollni (2013) in their study on finger millet in western Kenya conclude that beside formal extension, farmer-to-farmer networks are found to be an effective trigger for the dissemination of finger millet practices. In rural Kenya, many social groups exist and the majority of farmers participate in at least one group. However, group activities vary widely and can be an influential factor for the diffusion of market information which contributes to a large percentage of transaction cost involved in banana production.

2.5 Theoretical framework

2.5.1Theory of transaction cost

Coase (1937) pioneered the theory of transaction cost in his article "The Nature of the Firm," in which he argued that market exchange is not costless. As a result, imperfect information and agency theory have been used to explain the emergence of key agrarian institutions, which have been analyzed as substitutes for missing credit or insurance markets in an environment of pervasive risk, information asymmetry, and high transaction costs (Binswanger and Rosenzweig 1986).

Transaction costs involved in banana production involves the cost for buying or searching for high yielding varieties of banana crop (Wanjiru *et al.,* 2012). Kenyan agricultural crop markets are characterized by missing markets and opportunistic traders who take advantage of information asymmetry between them and the farmers.

Interlocked transaction is an institutional arrangement meant to reduce transaction costs through tying agricultural credit and input supply to the delivery of product at harvest (Govereh et al.1999). In other words, interlocked transactions ties input transactions with output marketing. Such an arrangement has a double advantage in agricultural commercialization. First, small-scale farmers could get agricultural inputs like planting materials, fertilizer and other chemicals on credit basis, which is in itself, a means to

overcome farm household cash constraints. Secondly, farmers are ensured of the marketability of their produce, sometimes even directly at farm-gate (Jayne et al. 2004).

The existence of transaction cost means that commercialization of banana farming may only be exercised by the few who are able to minimise on transaction costs. This research considered networking among banana farmers as one of the way to mitigate the transaction cost involved during the process of marketing. It therefore visualised social network as a subset of social capital that farmers can exploit in overcoming both production and marketing barriers to enhance their degree of agricultural commercialization.

2.5.2 Social network theory

Harary and Norman (1953) were among the first mathematicians who made the relation between graphs and sociograms and who built mathematical models of social networks based on graph theory. In a graph, the nodes represent the actors and the edges represent relationships. Scott (2000) proposes a historical overview of the first applications of graph theory to social network analysis in the mid of the 20th century.

There are many ways in which a network connection can be defined. A connection can be unidirectional (A claims B as a connection or B claims A as a connection) or bidirectional (A claims B as a friend and B claims A as a connection). Unidirectional measures used in the literature include friend or family (Bandiera and Rasul, 2006; Kremer and Miguel, 2007), information contact or information neighbour (Duflo *et al.*, 2006; Conley and Udry, 2010; McNiven and Gilligan, 2012; Cai, 2013), and geographic neighbour (Duflo *et al.*, 2006).

Because the study centres on mitigating transaction costs, it used farmers to farmers and farmers to buyers' contacts to define social networks. This analysis uses unidirectional links where farmer A claims B as a network contact either for planting materials or market information because information is more likely to flow from the farmer claimed as an agricultural contact to the farmer claiming him/her rather than in the opposite direction. It also encompassed information between farmer's potential buyer links.

Social Network Analysis (SNA) methodology has been used for depicting and interpreting patterns of social interactions. SNA examines social structure from the perspective that relationships between two parties or more are partly influenced by the external ties possessed by each other. These interdependencies accumulated throughout the network and thus generated the underlying social structure.

2.6 Conceptual framework

The conceptual framework below illustrates the interrelationships in the study, the key variables involved and how they are interrelated. Socio-economic characteristics are background factors like (age, education level, gender), institutional factors like (marketing system, information asymmetry, access to extension services) and social capital dimensions like (network influence, network size, homophily) do have an influence on network formation. The combination of these factors has been identified as the antecedents and factors that drivers these farmers to rely on these networks. Networking consequently influences the decisions to commercialize by reducing barriers to market participation by banana farmers. Consequently, the degree of agrarian commercialization contributes to the change in farmers income and therefore an overhaul transformation in the farmers wellbeing.

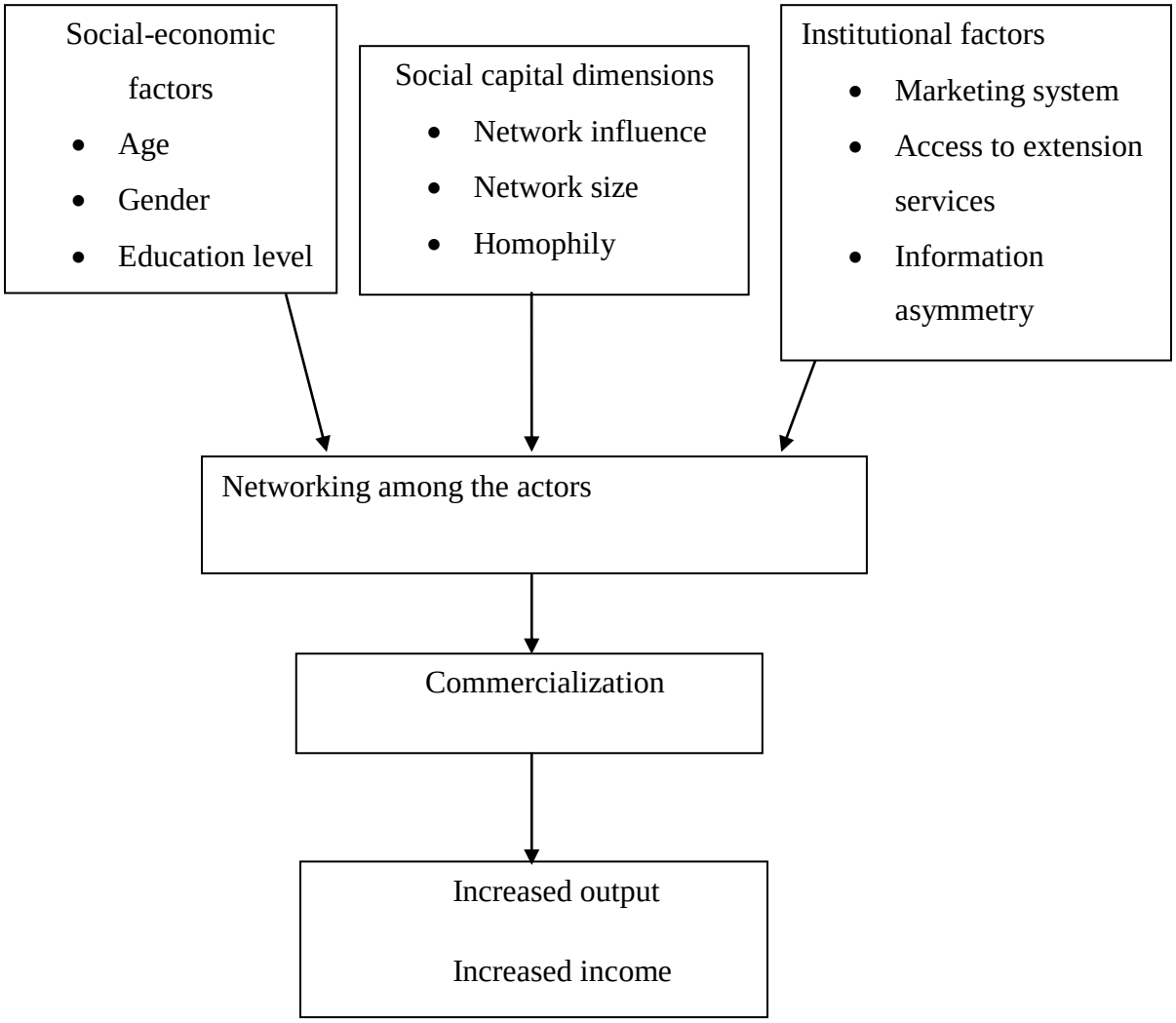

Figure 1: Conceptual framework.

Source: Own conceptualization

CHAPTER THREE
METHODOLOGY

3.1 Study area

Murang'a County is one of the counties of Kenya's former Central Province. The County covers 0.4% of the total land mass in Kenya, over an area of 2,558.82 km^2 in the central part of Kenya. It is bordered by the Counties of Nyeri to the north, Nyandarua to the west, Kiambu to the south, Machakos to the south east, Embu to the east, and Kirinyaga to the north east. Having a total of 942,581 people living there, it is a host to 2.4% of the total population in Kenya. The county lies on coordinates*:* 0°45′S 37°7′E and has a density of 3.7 people per household (KNBS, 2009). The County has seven sub-counties namely; Kigumo, Kiharu, Kangema, Maragua, Kandara, Gatanga, and Mathioya (Mathioya Constituency Strategic Development Plan, 2011).

The study was carried out within two sub locations of Kahuro administrative ward. These were; Weithaga, and Mugoiri. Small scale banana production is practiced in these areas throughout the year due to rainfall reliability and availability.

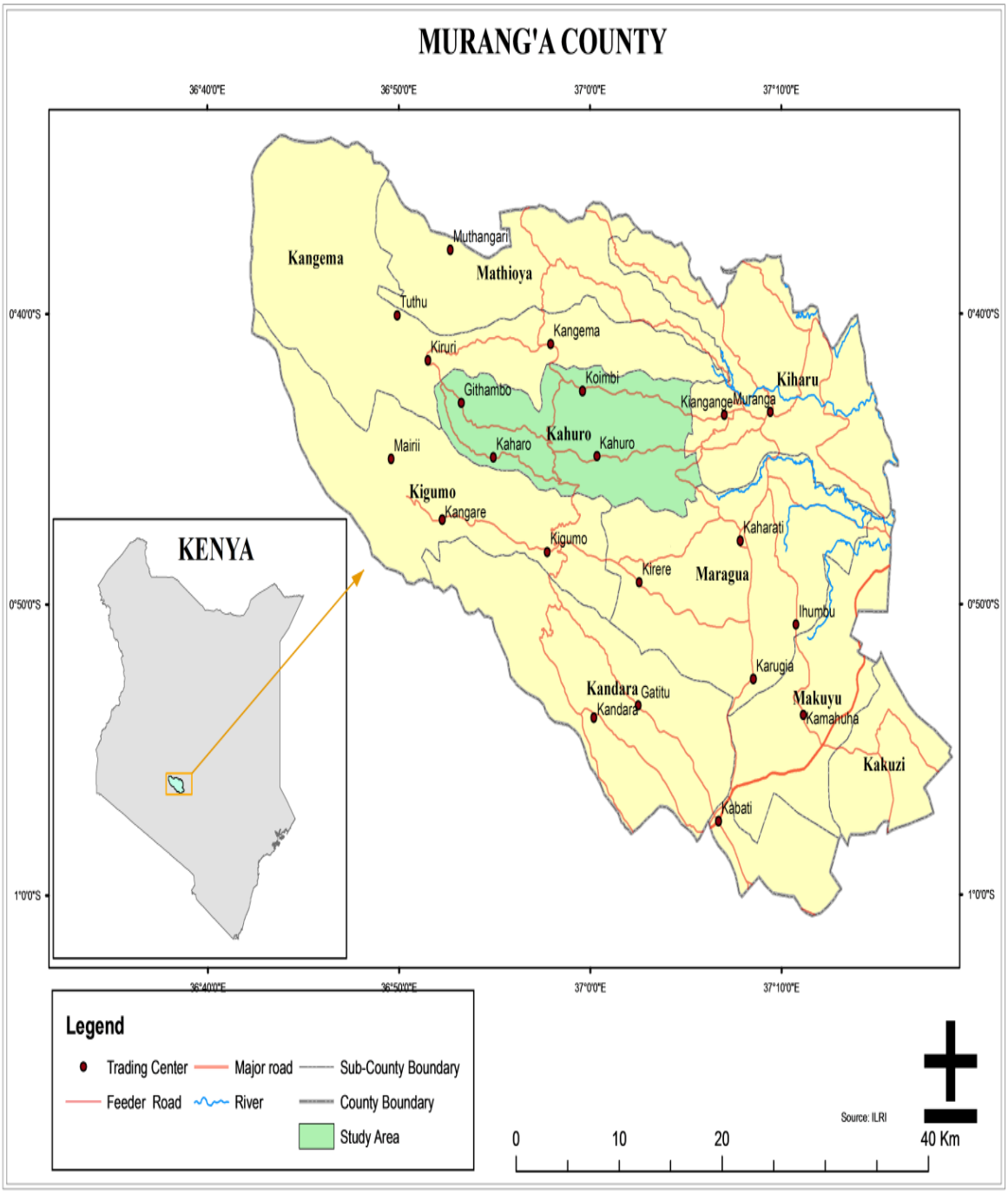

Figure 2: Map of Kahuro Sub-County, Murang'a County.

Source: ILRI

3.2 Sample and sampling method

The sample unit for this study consisted of smallholder banana farmers drawn from Kahuro administrative ward in Murang'a County. First, Murang'a County was purposively selected because of the large number of small-scale banana farming. Within the County, Kahuro Sub- County was also purposively selected because this is where intensive banana

farming is done. Two sub-locations were also purposively selected from this sub-county. Households were randomly selected within the sub-locations to yield the desired sample size. These sub-locations were selected based on their similar rural classification, close proximity to each other and their similarities in terms of livelihood activities, which predominantly are banana farming areas.

3.3 Sampling method

The required sample size was determined by proportionate to size sampling methodology (Anderson *et al*., 2007).

$$n = \frac{pqZ^2}{E^2} \quad \text{..... (1)}$$

Where n = sample size, p = proportion of the population under banana farming, q = 1-p, z = confidence level (α = 0.05), E = acceptable/allowable error. Since the proportion of the population was not known, p=0.5, q = 1-0.5= 0.5, Z = 1.96 and E = 0.075. This resulted to a sample population of 171 Household Heads.

3.4 Data types, data sources and data collection methods

Structured questionnaires were prepared to collect quantitative data for the study. Primary data sources for the study were the sampled farm households, both male and female head. The developed questionnaires were pretested to evaluate for consistency, clarity and to avoid duplication. Network interviews were conducted as part of the household survey during the fieldwork. A person-based data collection strategy was employed within the household survey questionnaire and from this; a set of indicators, each referring to different aspects of social networks, were constructed.

A name generator approach was employed when the interviewed household heads (egos) were asked to name people from whom they get information from. The first step was whether from extension officers, radio, television or from fellow farmers. Those who indicated to get information from fellow farmers (alters) qualified for network mapping and therefore a follow up question was to list the alters names and attributes.

The alters' names were recorded in response matrices which were later coded during the analysis. Further questions were posed concerning attributes of the network partner (sex, age and geographical locations), the nature of the relationship between network partner and

household heads and multiple role relationships. These relationships included; neighbours, traders, co-farmers, group members and friends. This data formed the 'interaction' network of the household head.

3.5 Methods of data analysis

3.5.1 Social network analysis (SNA)

Social network analysis (SNA) technique was used in the first objective that identified the characteristics of social networks maintained by smallholder banana farmers in Murang'a County. For each ego network, farmer responses were coded as binary variables, where the presence or absence of a directional knowledge tie was entered into a name-based adjacency matrix (Hanneman and Riddle, 2005). A corresponding attribute file was also created for each matrix, where farmer attributes were coded with binary variables.

Using UCINET 6 (Borgatti et al., 2002) software, these adjacency matrices and the attribute files were used to compute values for network size, degree, density, ego betweenness as well as coordinator and gatekeeper brokerage roles for each network. Values for ego betweenness, coordinator and gatekeeper brokerage roles were normalized so that differences in network sizes were accounted for.

Social network variables fall into three main categories – structural, composition and affiliation. The study was interested in social networks and network relationships as the basis for access to resources contained within the network, and ultimately what this means for smallholder farmer production decisions.

Structural variables described the structure of the network. They relate to the shape or pattern of links in the network and describe the ties between the actors. Measures used in the discussions included: size of network, network density, measures of centrality and power and influence of the networks. Network size depicted the overall network pattern of the farmers who were indeed connected to each other in terms of sourcing information. Network density captured the ratio of the those farmers who had direct ties with each other to that of the other farmers if they were all connected to each other in the network. Centrality, power and influence were identified through key farmers in the network who were found instrumental in the sense that many farmers identified them as resource generators in the network.

An affiliation network is a specific type of network involving relations between a set of actors and a set of 'events' that the actors 'belong' to, such as participation in a particular organisation and this was extended to informal social occasions. Affiliation variables give the

subset of actors that belong to each 'event'. Affiliation was captured where egos and their alters were members to both formal and informal groups.

Composition or attribute variables refer to the data on individual actors' attitudes, opinions, characteristics and behaviour. They encompass characteristics such as age, sex, income, education etc. that are measured as values of particular variables. Thus the positions of actors within a network and the strength of ties between them became critically important. Social positions were then evaluated by finding the centrality of a node identified through a number of connections among network members. Such measures were used to characterize degrees of influence, prominence and importance of certain members.

All Ucinet data were ultimately stored and described as collections of matrices. Network analysts do classify data as graphs. A graph is a set of points (also known as nodes or vertices) together with a set of lines (links, ties, edges) that connect the points. The information in a graph (who is connected to whom) was represented by a matrix known as the adjacency matrix, in which a given cell X (*i*,j) contains a value of 1 if nodes *i* and *j* are connected, and 0 otherwise.

Table 1: Example of an Adjacency Matrix.

	A	*B*	*C*	*D*	*E*
A	0	1	0	1	1
B	1	0	1	0	0
C	0	1	0	0	1
D	1	0	0	0	0
E	1	0	1	0	0

In this network, actor A has a tie with actors B, D and E, but not with C and not with him/her self. Actor B has a tie with A and with C, actor C has a tie with B and E, actor D has a tie only with A, and actor E has a tie with A and C. Raw data was coded in an excel spreadsheet and then exported to Ucinet for analysis. The analyses chosen were:

Density: This is the proportion of possible ties in a network that are actually present, and a network's density is commonly used to measure the extent to which all actors in a network are tied to one another (Wasserman and Faust 1994). A density score of 1 indicates that all actors in the network are directly tied to one another and a density score of 0 indicates the network is fully disconnected.

Centralization: A centralization score of 1 indicates that the maximum number of ties concentrated around one actor is present, and a score of 0 indicates a fully connected network, where all actors are directly connected to each other. Degree centrality refers to how many others an actor is directly connected to. Betweenness centrality refers to how many times an actor rest on a short path connecting two others who are themselves disconnected.

3.5.2 Quadratic Assignment Procedure (QAP) Regression

To examine the factors leading to dependence on social networks by smallholder farmers in the County, Double Dekker Semi-Partialling Multiple Regression Quadratic Assignment Procedure (MRQAP) approach in Ucinet was used (Borgatti et al., 2002). Social network data are dyadic by definition in the sense that they refer to the relations between pairs of objects. Since the unit of analysis is a dyad, it cannot be assumed that the observations are independent of one another (Krackhardt, 1988); this generates a problem of auto-correlation, or non-independence of observations, that makes the standard regression techniques not viable for analysis of this kind of data. More specifically, standard inferential tests cannot be used in the case of network data, given the lack of independence between the observations within the rows and within the columns, which in turn may lead to biased test results (Dekker et al., 2007; Krackhardt, 1988).

This problem has been widely recognized in the literature. Based on the work of Mantel (1967), Hubert and Shultz (1976) proposed a method for testing hypotheses when dealing with dyadic relational structures; this method was developed further by Hubert (1985) and Krackhardt (1988).

The QAP procedure can be summarized as follows: through a series of random permutations of the *n* objects of a matrix O*j* and the creation of new isomorphic matrices, identical to the original but for the order of the objects, the QAP procedure provides a permutation- or randomization-based nonparametric test of the dependence between two square matrices of the same size (Dekker et al., 2007).

The study also extended this model to include control and interaction variables to investigate some of the factors that may strengthen or weaken the social embeddedness among these farmers. The results from this analysis were interpreted in a similar manner as the results that come from an ordinary multiple regressions (Tsai, 2002).

The main aim of this method was to regress a dependent relation (matrix) on one or more independent relations (matrices). So this procedure is in principle a nonparametric statistical algorithm used to model a social relation using values of other relations. An

advantage of this regression in network data is that it can be very effective in computing the correlation between network and non network data (Carpenter et al., 2012).

The basic linear model for square matrix data considered in this study was:

$Z = \beta X + \gamma Y + \cdots + nN + \varepsilon$

Where Z is an $n \times n$ matrix for those farmers who rely on fellow farmers, β, γ and n are scalars, X, Y and N are an $n \times n$ matrices that captures the drivers to networking. The diagonals of the matrices were ignored since they capture an actor's relation with him/her self. The null hypothesis was $Ho: \beta, \gamma, n = 0$. The matrices X, Y and N are not assumed to be independent.

3.5.3 Ordinary Least Square

The third objective, to evaluate the extent to which social network drivers influence banana commercialization (based on the percentage sale of the total output of banana harvested), simple ordinary least square (OLS) was used. The quadratic equation used in this analysis is given by:

$Y_i = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \ldots\ldots\ldots + \alpha_n X_n + \varepsilon$

Commercialization Index (Y_i) = α_0 + α_1* (ageyrs) + α_2* (gender) + α_3* (trder) + α_4* (friend) + α_5* (group) + α_6* (edulevel) + ε

The variables in parenthesis are the drivers to networking.

3.5.4 Commercialization index

Commercialization of subsistence agriculture can take place on the output side as well as on the input side (von Braun and Kennedy, 1994). On the output side of production, commercialization is manifested by the increased marketed surplus while on the input side it is shown by the increased use of purchased inputs. This study assessed the commercialization of banana production from the output side.

The Commercialization Index (CI) was used to determine the degree of commercialization of banana production. Deriving from Bekele et al. (2011), Strasberg et al. (1999), and von Braun and Kennedy (1994) commercialization index (CI) for banana production was defined as:

CI= [Proportion of banana sold/Total banana output]*100

This index measures the extent to which household banana production is oriented toward the market. A value of zero would signify a totally subsistence oriented household; the closer the index is to 100, the higher the degree of commercialization.

CHAPTER FOUR
RESULTS AND DISCUSSION

This chapter analyses the social networks of survey respondents from smallholder banana farming households in Kahuro sub-county. Social networks variables were constructed using social network analysis techniques. The data is concerned with exchanges between the respondent (ego) and their network partners (alters), the ties between ego and alter, and how the egos perceive their alters.

4.1 Household social-economic characteristics

Table 2 presents the socioeconomic characteristics of 171 sampled respondents. These features were found to be of great help in terms of clearly depicting the diverse background of the respondents and how these characteristics influence their social life.

Table 2: Household characteristics

Social economic attributes	*Proportion of respondents (%)*
Gender	
Male headed households	56.00
Female headed households	44.00
Age	
Household heads above 45 years	61.14
Household heads below 45 years	38.86
Education level	
Household heads without formal education	10.86
Household heads with primary education	42.29
Household heads with secondary education	37.14
Household heads with college education	8.00
Household heads with university education	1.70

Characteristics	**N**	**Mean**	**Min**	**Max**
Education	171	8.50	0	16
Nonfarm income	171	4444.44	0	14000
Land size (ha)	171	2.43	0.25	6
Age	171	49.85	27	73

Source: Survey data (2014)

From table 2, the ratio of male to female-headed households in the sample was almost one. The table shows that majority (about 60%) of banana farmers in the study area were over 45 years with a mean age of 49.9 years. This may be attributed to the fact that young people always try to avoid farming and go for other "lucrative" businesses in urban areas. Also, the proximity of the study area to the country's capital city might also be a push factor to the young populace in the area. On average, a typical household head attended about nine years of formal education.

Majority of the farmers (about 90%) were literate, indicating that most of the household heads could, read and write. The mean years of schooling was found to be 8.5 years. This was taken as an important factor towards commercialization of banana farming. The mean land size was 2.4 ha and this is a reasonable base for agricultural commercialization.

4.2 Network structure among banana farmers

This section was based on the assumption that, sourcing of tissue-culture banana planting materials as well as market search involved complex interactions of individuals as they exchanged information. Analysis of the interactions was based on data collected from the sampled farmers, with the individual farmer as the unit of analysis. The networks presented here are, therefore egocentric networks; they depict the informational ties of the respondent. The section views the network at two levels: first, at the individual farmer's level, and secondly, at the level of the entire network

4.2.1 Network size

The study revealed that very few farmers obtained information about tissue-culture banana planting materials, or about the market, directly from agricultural extension officers. As shown in Figure 3, fellow farmers were the most important contact source. This clearly depicts the context of low extension agents to farmer ratio that characterize the country.

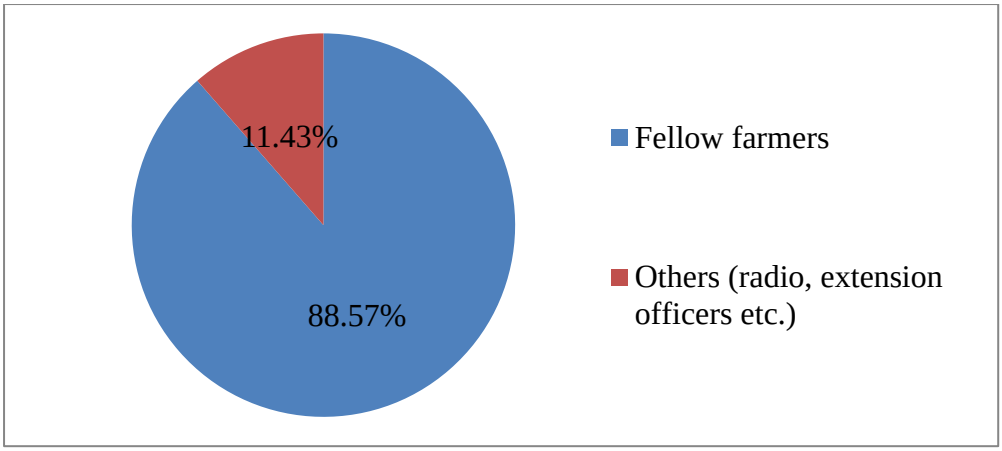

Figure 3: Proportion of farmers by source of planting material or market information

Source: Survey data (2014)

Majority (70%) of the farmers that indicated fellow farmers as their major sources of information had a direct network of 2 to 3 alters (see Table 3), while about 18% had 4 to 5 alters. In determining an individual farmer's direct network, the study placed weight on the first, second, and third contacts, respectively, in the order in which the farmers mentioned them. This was based on the assumption that, when a farmer is prompted to specify who his or her information sources are, the most valuable sources will come to mind first. In SNA, the size of the ego's direct network is an important indicator of the ego's network value.

According to Burt *et al* (2001), the direct network size give an indication of the likelihood of the ego being connected to an alter who possesses a resource that an ego needs. The larger the ego's direct network, the higher the likelihood of it containing alters with valuable resources and information. This means that, with respect to a given ego, the probability of networking with an alter who has what the ego needs increases with the ego's network size.

Table 3: Distribution of sample households by network size

Number of alters	Proportion of egos in %
Egos with zero alter	8.00
Egos with one alter	3.43
Egos with two alters	31.43
Egos with three alters	38.86
Egos with four alters	15.43
Egos with five alters	2.86
Egos' attributes	
Alter as ego's friend	40.00
Alter as ego's neighbor	8.57
Alter and the ego in the same group/organization	18.29
Alter as a trader in banana market	21.71
Others	11.43

Source: Survey data (2014)

Table 3 also shows that farmers viewed their information contacts as falling into four major categories. Friends weighed heavily, traders, followed by fellow members in organized groups, and the least was alter as ego's neighbour. This means that there is diversity of information in the network in the sense that; for example, traders may be well conversant with market information for the produces while the rest may have information on production management. (See section 4.7.2)

4.2.2 Freeman's Betweenness centrality

Figure 4 presents a network map of betweenness centrality generated using net draw in the Ucinet visualization. Pedants (egos with only one contact) and isolates (egos without any contact) were excluded. The logic behind this is that farmers without any partner or even one contact don't qualify for networking. Figure 4 reveals that the network covers a total of 373 actors. For the sake of anonymity and confidentiality, the network participants were coded in two distinct ways. Numerical codes represent the egos, while numerical plus alphabetical codes represents alters that were identified by the egos as sources of information during the production and marketing process.

Betweenness centrality gives an indication of the degree of control exerted by individual participants (Williams and Hummelbrunner, 2011). It is the shortest path between any pair of nodes. In figure 4, betweenness centrality is represented by the size of the nodes. The larger a nodes is, the higher the level of betweenness centrality and vice versa.

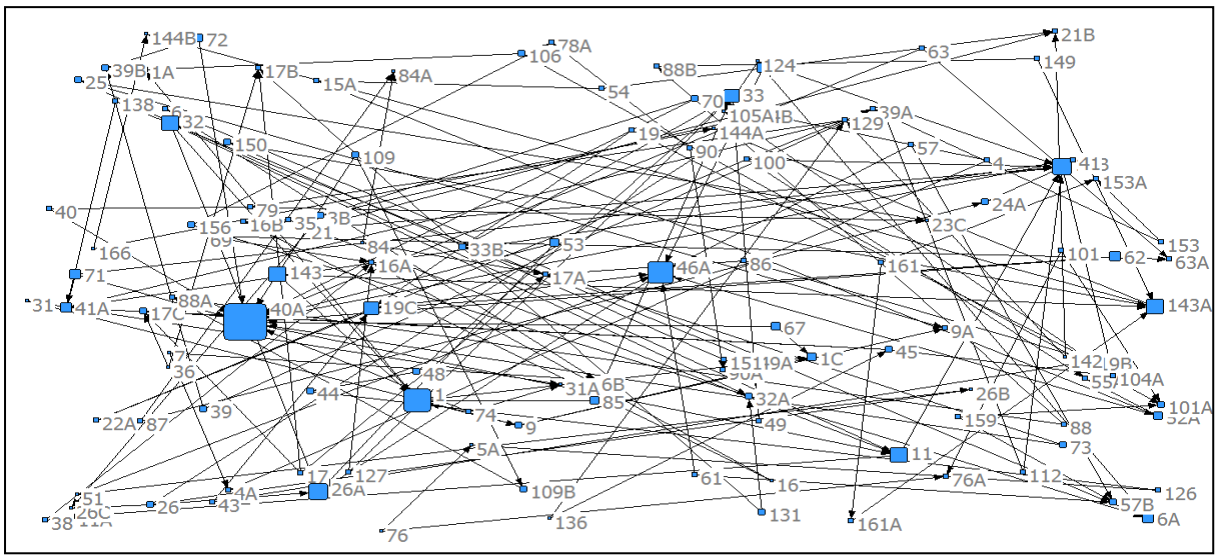

Figure 4: Farmer's degree of power

Fundamentally, betweenness centrality measures the extent to which a participant is a gate keeper in the network; that is, which participant must a pair of other participants pass through for them to connect. Betweenness centrality captures another aspect of importance in a network — the ability to act as a bridge between other nodes, the ability to connect otherwise unconnected others. Farmers 40A, 46A and 1 respectively shows the highest level of betweenness centrality. Farmer 40A is critical since he can direct the flow of information across this network because he has the power to either pass information on or not. A node with low betweenness, on the other hand, may be redundant because there are other paths by which one might cross from one side of a network to another.

Farmers 40A, 46A and 1 are very crucial in this network because of their attributes (see table 4). They are very critical in the flow of information throughout the network of 373 farmers. If the three farmers stopped participating, there will be less information flow in this network. Fundamentally, these farmers act like "village extension officers" and the result shows that their ratio to the other farmers is far much lower than the ratio of agricultural extension officers to farmers. This has an important implication for extension service. Identifying and empowering "village extension officers" with knowledge and resources would facilitate information transmission to the wider society in a cost effective way.

4.2.3 Freeman's Degree Centrality

Degree centrality is a measure of the number of direct ties that a net member has. From Figure 5, the degree of centrality is depicted by the size of the nodes. The larger the node, the higher the degree of centrality and vice versa

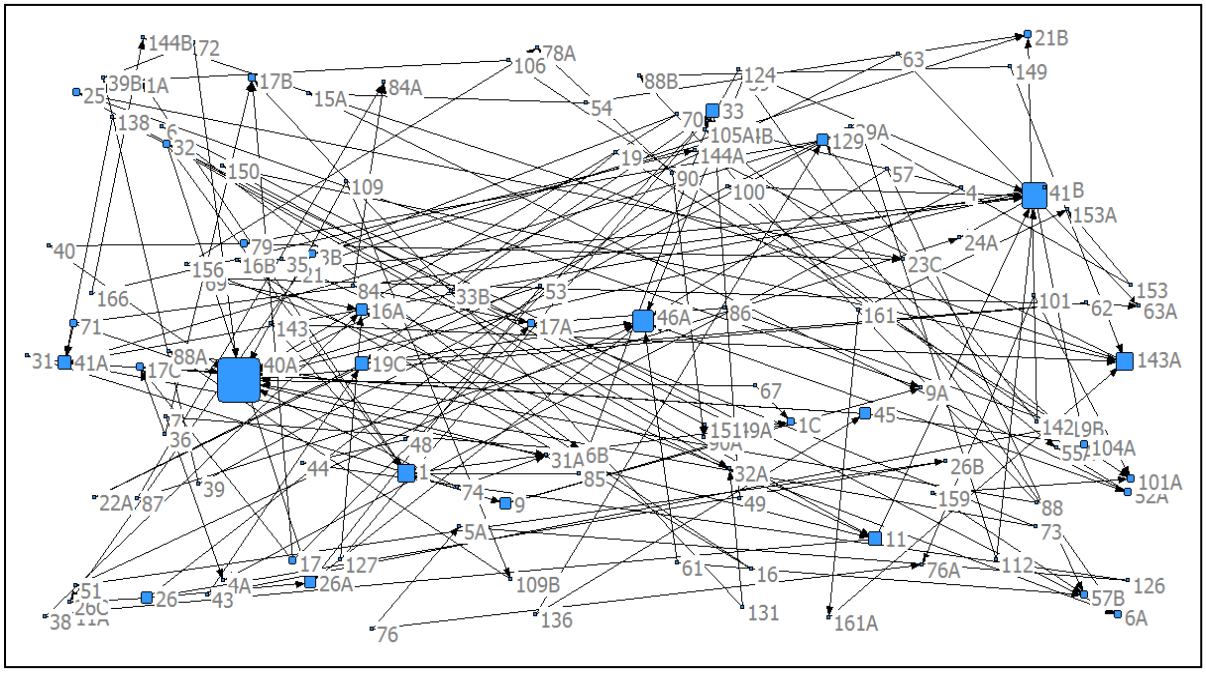

Figure 5: Degree centrality

Basically, participants with high degree centrality have the largest number of participants connected to them. In this case, the role they play in the network is not of prime interest but how many egos in the study mentioned them as sources of information. This measure of centrality capture the number of alters that an ego has. Within the context of this study, highly connected members have a high probability of exploiting resources and information presented by the net.

In the network under study, farmers 40A, 41A and 46A respectively were the most central in the sense that they had the highest number of egos considering them as sources of information and planting materials. Based on betweenness centrality, farmer 1 was very critical in transmitting information.

Figure 5 reveals that the farmer was not active in sourcing information from other farmers. It can therefore be concluded that he acquired his information first hand, either from agricultural officers or maybe his experience in farming and therefore highly considered by most of the participants in the network.

Farmer 41A has a number of farmers connected to her but not very crucial in transmitting information; she is a kind of information "sink". Thus, in her absence, information will still flow. Nonetheless, the farmer is a necessity but not a mandatory player in the network. Farmer 40A is very critical in the network, whichever the angle of approach. He is the core of the network among banana farmers.

Table 4: Farmers' attributes

ID	*Freeman's Degree*	*Freeman's Betweenness*	*Freeman's Closeness*	*Harmonic closeness*	*Bonacich's Eigenvector*
40A	12	3609.0	3254	35.30	0.534
41B	9	1096.0	3396	29.69	0.051
46A	7	3777.5	3223	34.13	0.390
1	6	2543.5	3308	30.09	0.021

Source: Survey data (2014)

Farmer 40A has the highest number of egos who consider him as a source of banana resources and information. The degree of a node is the number of ties connecting it to other nodes in the network. While the degree for the above farmers in the network measures how many ties the farmer has, the eigenvector centrality of these farmers measures how many ties the farmer's alters have.

Farmer 40A has his alters more connected to other farmers than any of the rest. The combination of a high degree and a high eigenvector centrality score revealed by farmer 40A is very crucial. People who have contact with other participants who are in turn well connected may be influential because they know the right people, the popular people, and the people who can effectively get a message out. The efforts of such people of influence are likely to be efficient because the messages they deliver to each of their contacts would spread far.

McPherson *et al.,* (2001) argues that actors who have more ties with other participants in the network are in advantaged positions because they have alternative ways to satisfy their needs. Because they have many ties, they may have access to, and be able to call on more of the resources of the network as a whole.

Closeness centrality is the only measure of centrality that the smaller the number, the better. Farmer 46A has the lowest average path link and this means he is the closest link to

other nodes in the net. Fundamentally, if this farmer has certain information or unique production traits, it takes only a few steps for this information to spread from this farmer to the rest in the network.

4.4 Network Density

Network density is a ratio of the existing ties to the possible number of ties if all the actors were possibly connected to each other.

Table 5: Network density

Density	No. of ties	Avg degree
0.003	375	1.011

Source: Survey data (2014)

The larger the network, the lower is the density. A simple formula for calculating network density is given by:

Network density = No. Of existing ties/Total possible no. of ties

From table 5, the network density for banana farmers in Kahuro sub-county is given by 0.003 or 0.3% which indicates a sparse network. Denser network may mean greater likelihood of sharing very similar resources, whereas more open or sparse networks might mean better access to better or more varied resources or Information (Burt, 2001).

Based on Burt (2001), the network depicted by banana farmers in Kahuro division is sparse implying that chances of diversity in input varieties and diversities in production and marketing information are very high. In other words, if the farmers are clustered together, there is high chance that they will have a lot of similarities in their production and market information.

4.5 Diversity in resource and composition

Diversity in this context refers to knowing mixture of people and hence enhancing the chances of the banana farmers having the right contact for a given purpose. Farmers in Kahuro had their contacts ranging from group members, traders, friends and neighbours. High diversity implies integration into several spheres of society or social circles/contexts

and this is considered to be advantageous for mobilising resources and for instrumental actions like gathering information (Lin et al, 1981; Campbell et al., 1986; Kadushin, 2012).

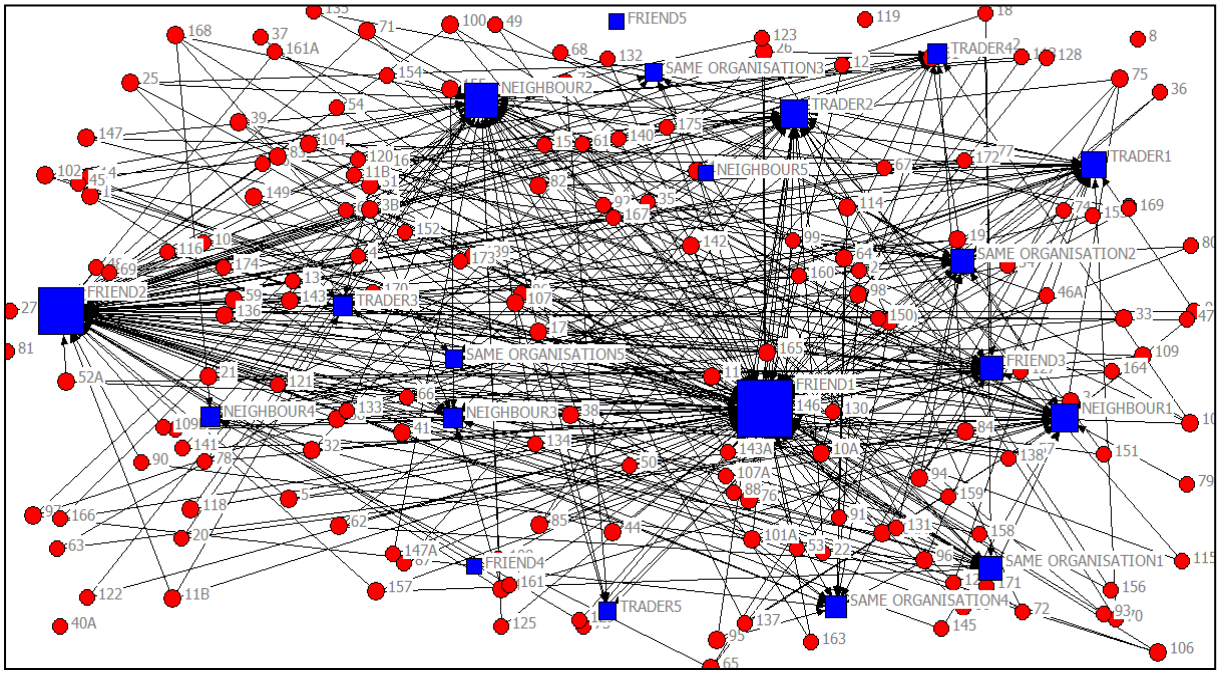

Figure 6: Network composition

From figure 6, the size of the node is proportional to the weight of the resource generator. FRIEND1 to FRIEND5 represents alter one to five (maximum number of alters recorded). The same applies to the rest of the nodes. About half of banana farmers in the area prefer getting resources from their friends while the other half of the farmers get information from neighbours, banana traders, and group members. This means that at any point in time there is diversity of production information, diversity in banana varieties and diversity in market information in this network.

The assumption in this network is that the first to third network partners who are mentioned by the respondent are those who interact frequently and in this study, more weight is put on the first alter and his/her attributes and the alters relationship with the ego. From figure 6, the problem of recall sets in when the respondent is probed to identify more than two network partners and only a few of the farmers identified five partners in the network. This is depicted by the decrease in the size of the nodes from one to five. Majority of the farmers had an average of two to three partners whom they considered as sources of information and planting materials. As the probe for more alters increased, the lesser the number of egos who were in a position to make an accurate recall.

Diversity in composition refers to the probability that, by chance alone, any given network should be a representative of both genders at an equivalent ratio.

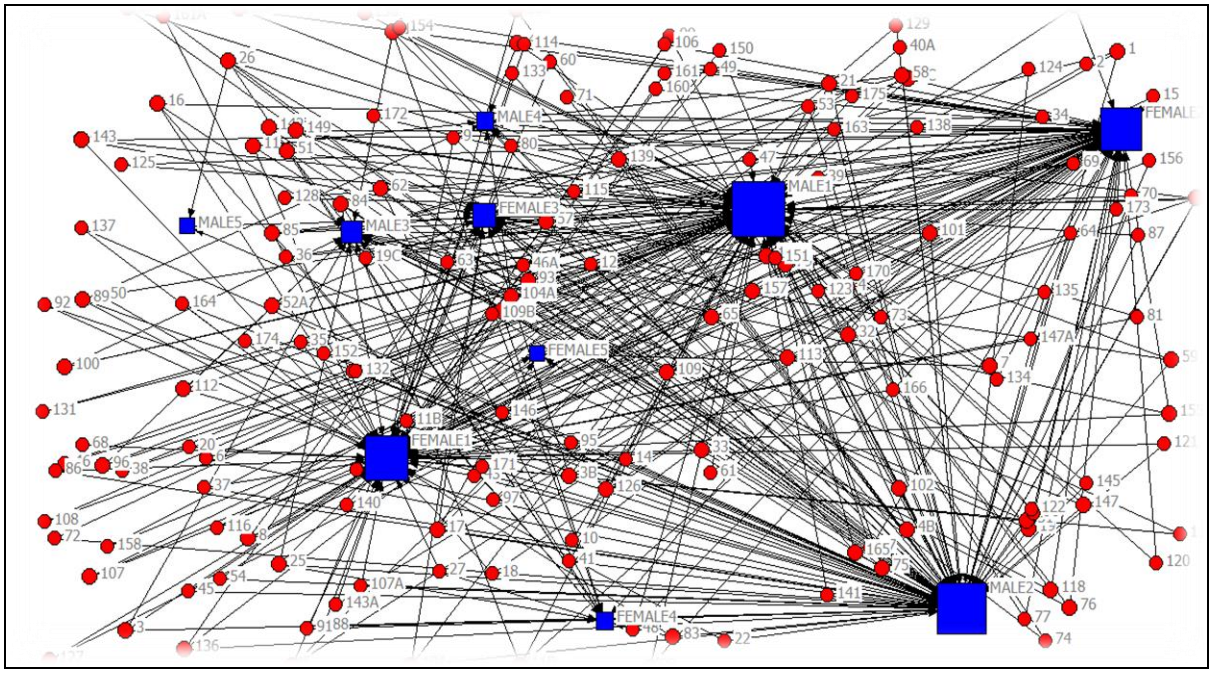

Figure 7: Network heterogeneity

In figure 7, male1 and female1 represents the gender of network partner one and the rest up to male5 and female5 which is the gender of network partner five mentioned by the ego. The maximum number of alters mentioned by the farmers during the interview was five.

From figure 7, both male and female seems to report the same size of the network partners. Respondent's networks may be highly heterogeneous in some aspects yet homogeneous in others, for example in the way they vary by for example age or sex. Farmers in Kahuro are heterogeneous in terms of gender of network partner. This diversity is very critical in terms of resource acquisition by an ego in that one gender, for example, might be good maybe in management practices during banana production while the other is a good avenue for gathering market information.

4.7 Factors leading to dependence on social networks among banana farmers

In this section, Quadratic Assignment Procedure (QAP) regression has been used to test the hypothesis that networking among banana farmers has no relationship with gender, friendship, neighborhood, farmers who are also market traders, education, and similarity in an organization (proxy for group membership). An *n* by *n* matrix of the farmers who rely on fellow farmers form the dependent variable. In this procedure, Ucinet software is used to

compute thousands of computations to verify whether the above variables contribute to the interdependence among banana farmers in the study area.

REGRESSION COEFFICIENTS

The point of focus in this section was the be the p-values which meets the QAP threshold of statistical significance; i.e. farmers who considered their neighbors, farmers of their gender, those whom they are in the same group and farmers who are banana traders as the sources of information and planting materials. In the discussion below, the dependent variable is farmers who rely on fellow farmers. The independent variable enters the QAP regression as matrices where in all the variables, the rows are similar (egos) while the columns capture the variables' attributes. All the data were coded in binary form to generate an adjacency matrix.

The regression coefficients in table 6 shows that farmers a physical neighborhood share resource and information 0.024times often more than those people who are not neighbors with a probability 0.412% that this will occur by chance. On the other hand, banana farmers get information from farmers who are also banana traders 0.089 times often more than with non traders with a probability of 1.99% that this is by chance. Male banana farmers network among themselves 0.097 times often more with a probability of 0.5% (p-value) that this is by chance (male farmers were coded 1 and therefore the base case) Finally, farmers in the same group or organization network 0.07 times often more among themselves with a probability of 6% that this is by chance. To ascertain that the above output were not merely by chance, QAP correlation test for significance on the same data was performed to permit more discussion (see section 4.7.1).

Table 6: Coefficients for network regression

Network Affiliations	Stdized Coef	P-value	Std Err
Age (below 45yrs)	0.003	0.388	0.019
Education	0.019	0.368	0.005
Friendship	-0.018	0.144	0.015
Neighborhood	0.024***	0.004	0.010
Gender	0.097***	0.005	0.066
Same group	0.071*	0.060	0.039
Trader	0.090**	0.020	0.042

	R-Square	Adj R-Sqr	P-Value	Obs	Perms
Model	0.3319	0.3175	0.005	30800	2000

Source: Survey data (2014)

4.7.1 Test of Significance

Essentially, what the QAP does is to scramble the dependent variable data through several permutations. By taking the data and scrambling it repeatedly, resulting in multiple data sets with the dependent variable, then multiple analyses are performed from these data. In QAP correlation, each variable was measured using a different matrix in which all matrices feature the same node but have different relations in the cells representing a different idea about how the nodes could possibly relate to each other.

This study analyses how networking among banana farmers is correlated with the independent variables. Essentially, it tries to capture whether similarities in various aspects breeds or acts as a pull factor towards networking. What it does is trying to explain how farmers of the same gender, same education level, same group, traders and neighborhood breed connections. The horizontal variables are a copy of the vertical ones.

Table 7: QAP correlations

	Age <45yrs	*Educat-ion*	*Friend-ship*	*Gender*	*Neighbor*	***Network***	*Same group*	*Traders*	*P-Value*
Age<45yrs	1.000	0.003	-0.012	0.001	-0.008	**0.01**	0.012	0.006	0.582
Education	0.003	1.000	0.006	0.032	-0.009	**0.15**	0.002	0.006	0.398
Friendship	-0.012	0.006	1.000	0.001	-0.038	**0.17**	0.102	0.303	0.005***
Gender	0.001	-0.032	0.001	1.000	-0.003	**0.28**	0.001	0.008	0.035**
Neighbor	-0.008	-0.009	-0.038	0.003	1.000	**0.42**	0.018	0.055	0.159
Network	**0.01**	**0.15**	**0.17**	**0.28**	**0.42**	**1.00**	**0.57**	**0.86**	**0.000**
Same group	0.012	0.002	-0.102	0.001	-0.018	**0.57**	1.000	0.148	0.012**
Traders	0.006	0.006	0.303	0.008	0.055	**-0.86**	0.148	1.000	0.085*

***: significant at 1% level; **: significant at 5% level; *: significant at 10% level.

Source: Survey data (2014)

There is a positive correlation (0.17) between friendship and networking. The correlation coefficient has a p-value of 0.005 which far meets the QAP correlation test of significance. This shows that it is not by chance alone that banana farmers in Kahuro division considered network partners as friends. From the methodology in chapter three, the study considered an ego network where information from the ego is unidirectional i.e. one farmer regards the other as a source of information and materials regardless of whether the opposite is true. In the network fraternity, friendship is a reciprocal variable and therefore all farmers in their particular networks considered each partner in their networks as friends and this is a critical component in the process of sharing resources and information among participants in a network.

These findings are relevant for understanding the role of friendships in a given society. It is undeniable that people select and influence each other; thus, social networks are powerful in spreading information, beliefs and behaviors. An immediate consequence of homophily is segregation (Centola et al.; 2007; Golub and Jackson; 2011).

The study considered a heterogeneous sample selection in terms of gender composition. The correlation coefficient between networking and gender is 0.28. This is a positive correlation which is statistically significant at 0.035. Male farmers tend to network with male farmers while female farmers tend to network with their female counterparts. This is induced homophile where birds of the same feathers flock together. However, there is a

slight diversity of gender in the network. This ensures that there is a perfect mix in terms of information generation. This diversity is very critical in terms of resource acquisition by an ego in that one gender, for example, might be good maybe in management practices during banana production while the other is a good avenue for gathering market information.

Previous studies have attributed group membership as a proxy for social capital where members of a group take advantage of group formation to increase their bargaining power. In this study, a group is defined as any form of informal organization among actors. There is a positive correlation of 0.57 (0.012). The argument in this is that people in the same group enjoy similarity in resources and information and therefore members of a common group tend to network with non-similar others as much as they interact with themselves.

Fundamentally, this means that banana farmers enjoy diversity of information and resources and therefore chances of an alter in this network lacking the information or resources that an ego farmer needs is very low.

Banana farmers tend to network with trader (farmers who are also traders) 0.86 times less often than they do with non traders with a p-value of 0.085. This means that as much as the farmers rely on each other to share resources, a credible number rely on non traders to get information. This disagrees with the findings by Fafchamps et al. (2003) who concluded that farmer relationships with other traders will among other things helps economize and reduce on transactions costs. This may be attributed to the fact that trader farmers tend to be exploitative to their counterparts so as to maintain their dominance in the market.

Relationships and social networks may thus enable agents to economize on transactions costs even though they would probably fail to achieve the same level of aggregate efficiency as perfect markets. Of course, there may exist yet other omitted unobservable that may bias the results. In the absence of panel data, these effects can unfortunately not be controlled for.

4.8 Extent to which networking influence commercialization

Govereh et al. (1999) define agricultural commercialization as "the proportion of agricultural production that is marketed". According to these researchers, agricultural commercialization aims to bring about a shift from production for solely domestic consumption to production dominantly market-oriented. In line with the above definitions, Sokoni (2007) defined commercialization of smallholder production as "a process involving the transformation from production for household subsistence to production for the market."

Table 8: Degree of commercialization

CI(Percentage)	0-25	26-50	51-75	76-100	Total
Frequency	14	42	56	59	171
Percentage	8.0	26.3	32.0	33.7	100

Source: Survey data (2014)

From table 8 above, 115 (65.7%) banana farmers have more than 50% of their banana output sold and this falls to the range of high degree of commercialization. This is a vivid indicator of the high level of commercialization in the study area which can be attributed to the unique advantage of its proximity to the largest city in the region, Nairobi. The dependent variable is the commercialization index.

Table 9: OLS results

Number of observations	171
R-squared	0.4619
Adj R-squared	0.4319

Commercialization Index	Coefficients	Std. Err.	P-value
Gender	0.480***	0.059	0.000
Education	0.003	0.006	0.602
Age	-0.045	0.052	0.383
Non-farm income	-0.136**	5.90E-06	0.022
Land size	-0.014	0.023	0.540
Friend	0.007	0.064	0.889
Neighbor	0.046	0.031	0.373
Traders	0.017	0.051	0.744
Same group	0.159***	0.059	0.008
_cons	0.382	0.104	0.000

***: significant at 1% level; **: significant at 5% level; *: significant at 10% level.

Source: Survey data (2014)

Gender of the household head affects the degree of commercialization with male headed households (base gender) positively influencing the extent of banana sale by 0.4798. The results are consistent with that of Cunningham *et al*. (2008) who argued that men are

likely to sell more due to their acumen in bargaining, negotiating and enforcing contracts. This argument was advanced from Dorward *et al*. (2004) who concluded that the discriminatory tendencies against women tend to weaken their negotiation prowess and therefore making them less influential in agro-commodity trade.

Group networking positively and significantly influences the extent of market participation. The result showed that the banana farmer who networks with a group member had a higher probability of increasing the proportion of banana (0.16 times). Group networking has enabled the farmers to access resources and share resources among themselves. This finding is in line with the argument by Jari and Fraser (2009), who stated that the farmers who participate in groups have ability to reach a distant market because they are able to share information and broaden social capital within the groups.

Non-farm income is found to negatively influence the amount of banana that is market oriented. Farmers who were found to have alternative sources of income were found to exercise low degree of banana commercialization. This is attributed to the fact that non farm income acts as supplement to agrarian practices and therefore acting as a push factor towards agricultural commercialization, especially in this area where transaction cost and information asymmetry acts as deterrence towards this venture.

CHAPTER FIVE
CONCLUSIONS AND RECOMMENDATIONS

The study revealed that there are critical farmers in the network structure of 373 banana farmers who are instrumental in the flow of information and resources. If these farmers stopped participating, there will be less information flow in the entire network of banana farmers. Fundamentally, these farmers act like "village extension officers" and the result shows that their ratio to the other farmers is far much lower than the ratio of agricultural extension officers to farmers. This has an important implication for extension service. Identifying and empowering "village extension officers" with knowledge and resources would facilitate information transmission to the wider society in a cost effective way.

To identify drivers towards farmers networking, gender, group membership and friendship were found to be influential in dependence on farmers' network. This ensures that there is a perfect mix in terms of information generation. This diversity is very critical in terms of resource acquisition by an ego in that one gender, for example, might be good maybe in management practices during banana production while the other is a good avenue for gathering market information.

Farmers who were relying on fellow farmers for information were found to possess a high degree of commercialization. This is attributed to the fact that networking among the farmers is a form of human capital on its own and is able to minimize transaction costs involved in farming and marketing which has always been identified as a barrier to agricultural commercialization.

Commercialization of smallholder farming is getting priority in the developing world in general and Kenya in particular. This prioritization of smallholder farming has been reflected in the policy agenda of many developing countries. Smallholder commercialization is part of an agricultural transformation progression in which individual farms shift from a highly subsistence-oriented production towards more dedicated production targeting markets both for their input procurement and output supply.

In a broader sense, one could also see smallholder commercialization as a pathway to the overall economy's structural transformation in which larger proportions of economic output and employment are generated by the non-agricultural sectors. To attain this essential goal of structural transformation through a smooth process of smallholder agricultural commercialization, policy and strategy interventions to improve the functioning of input and

output marketing, improvements in service provision, and the development of infrastructure stand out prominent.

Therefore, this research indicate that networking among smallholder farmers has the potential to enhance agrarian commercialization in the area, and take smallholder farmers out of poverty if constraining factors such as lack of capital, high transaction costs, lack of infrastructure, lack of information and lack of knowledge could be eliminated. In this case, government, in collaboration with NGOs and the private sector, should identify and locate the most central individuals in a given society and equip them with needed skills and resources and this can cost-effectively supplement the role of extension officers. This will ensure that new agrarian ideas are disseminated across the target beneficiaries while minimizing chances of information 'sink' during the process.

Future research

This study considered networking from an egocentric perspective. Any other study should consider how networking is possible and its effectiveness not from an egos point of view but rather among different farmer groups or organization. This would view networking not from an individual perspective but rather viewing egos as organizations or various groups and try to draw a comparison among intra-organization and inter-organizational networking.

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APPENDIX: RESEARCH SURVEY QUESTIONNAIRE

RESEARCH TOPIC: INFLUENCE OF SOCIAL NETWORKS ON AGRICULTURAL COMMERCIALIZATION: CASE OF BANANA IN MURANG'A COUNTY, KENYA

AGRICULTURAL ECONOMICS AND AGRIBUSINESS MANAGEMENT DEPARTMENT

EGERTON UNIVERSITY

Questionnaire no. ☐

Section A: General Information

A1. Date of interview .....

A2. Name of enumerator .....

A3. Division .....

A4. Location .....

A5. Sub-Location .....

Section B: Social-economic background information

B1.Gender of the Household Head

Male ☐

Female ☐

B2.Education of the Household Head

No school ☐

Primary ☐

Secondary ☐

College ☐

University ☐

B3.Age of the Household Head

15-30 ☐ 1

31-45 2 ☐

46-60 3 ☐

>60 4 ☐

B4.What are the sources of House Head income?

…….. …….%

…….. …….%

…….. …….%

B5. What is your monthly income?

0-1000 ☐

1001-5000 ☐

5001-10000 ☐

>10001 ☐

Section C: Production

C1. What is the size of your farm (acres)?

0.0-0.5 ☐

0.6-1.0 ☐

1.0-3.0 ☐

3.0-5.0 ☐

>5.0 ☐

C2.What is the size of the plot under banana production?

0.0-0.5 ☐

0.6-1.0 ☐

1.0-3.0 ☐

3.0-5.0 ☐

>5.0 ☐

Section D: Marketing of the output

D1.What is the use of the output?

Domestic Consumption/Subsistence ☐

Commercialization ☐

D2.If the answer is 2 above, where do you get input and market information from?

Networks (kins, friends, neighbours etc) ☐

Others (radio, TV etc) ☐

D3.If the answer is 1 in D2 above, then name all those people, neighbours, kin, friends, and co-workers, from whom you get market information from outside your own households. This is to be filled in the table below. If 2, go to **D18.**

Persons id	Names of people you network with: First name	Second name	Sex 1 Male 2 Female		Age Estimated Years	What do you do with these people? activity codes below		Why do you prefer getting information from this [NAME]? **Codes below**					What is the relationship of [NAME] to you? 1 A friend 2 My neighbour 3 A trader in banana market 4 Belongs to an organisation I belong to (e.g. Church) 7 Other (specify)	
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														

Activity codes

1.Trade 4

2.Attend same church 5

3 6

Networking codes (His/Her)

1. Influence	6. Similarity with me
2.Connections	7.
3.Proximity	8
4.Gender	9
5.Education level	10

D4. Out of those people mentioned above, who do you normally consider first as most influential (Bank of input and market information)?.....

D5. What kind of farming do those mentioned above practice?

Subsistence ☐

Commercial ☐

No idea ☐

D6. Why do you prefer getting input and selling your output via the [NAMES] above rather than on your own?

No market ☐

High cost involved ☐

Market inefficiencies ☐

D7. Do you have problems in accessing information on new varieties and market information in your production process?

Yes .....

No .....

D8 How long does it take to reach or access the above [NAMES]?

D9.Which are the greatest challenges experienced when getting your inputs and marketing your outputs?

.....

.....

.....

.....

D10. In your opinion, do you think the mentioned [NAMES] are different from you?

Yes .....

No .....

D11.In your opinion, does networking with the above [NAMES] mitigate the problems above?

Yes ☐

No ☐

D12. If yes, please motivate your answer

.....

.....

.....

.....

D13.For how long have you been practicing banana production?

0-3 years ☐

4-7 years ☐

8-12 years ☐

>13 years ☐

D14.After how long did you start selling your banana production?

0-3 years ☐

4-7 years ☐

8-12 years ☐

>13 years ☐

D15.What made you shift from subsistence to commercialized banana production?

[Names] above ☐

Household members ☐

High demand/Ready market ☐

Nobody ☐

D16.Has your income increased since you started networking with [NAMES] above?

Yes ☐

No ☐

D17.In your opinion what should be done to improve on the access of inputs and marketing of banana produces through the networks?

.....

.....

.....

.....

D18. Do you have contractual agreements or a guaranteed/ ready market (formal or informal) with any agribusiness outlet e.g. schools, supermarkets e.t.c? Yes { } or No { }

D19 How do you sell your output?

Individually ……

As a group …….

D20. Do you have regular customers, who always buy from you? Yes { } or No { }

D21. If yes, how long have you been trading with these customers? .....

D22. How is your produce moved to the marketing point (tick appropriate)

	Type of transport				
	Bike	Motorbike	Truck	Nissan	Other (specify)
Own transport					
Hired vehicle (individual)					
Hired vehicle (group)					
Public transport					
Buyer transport					

D23. How far is marketing point.....? Km

D24. What is the average cost incurred in the production and marketing of your produce? Ksh ……..

D25. What general problem do you experience in moving your produce?

Lack of transport	*Low prices*	*Lack of demand*	*Others (specify)*

D26. When selling do you combine, with other farmers?

Yes	*Reason*	*No*	*You don't sell at the same time*
	It is lower cost		You don't sell at same market
	Increase bargaining power		You conflict
	Share market knowledge		They will degrade you produce
	Specify (others)		Specify (others)

Section E: Level of Commercialization

E1. How much banana do you harvest in a year.....?

E2. Of the above harvest how many does the household consume and how many are sold?

Consumed .....

Sold .....

E3. In your opinion, why is it not possible to maximize on your sales?

.....

.....

.....

.....