Analysis of the Networks and Traceability Systems of Organic Kales Value Chains in Nairobi and its Environs, Kenya

By

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Declaration

I, Josphat Njenga Gichure, hereby declare that this dissertation report is my original work and has not been presented for the award of a degree in any other university.

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Dedication

This work is dedicated to my loving parents, Phares Gichure and Lucy Wanjiku, my siblings and nephew, Joshua, for their support during the entire period of this course. May the Almighty God always bless you abundantly.

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List of Abbreviations and Acronyms

EAOPS	East African Organic Products Standards
EAS	East African Standard
FAO	Food and Agriculture Organization of the United Nations
ISO	International Organization for Standardization
KOAN	Kenya Organic Agriculture Network
NGO	Non Governmental Organization
SNA	Social Network Analysis
SPSS	Statistical Package for Social Sciences
WHO	World Health Organization

Definitions

Certification: A third-party confirmation that a certain product or process complies with a set of requirements defined in regulations or standards.

Kales form of cabbage with green or purple leaves, in which the central leaves do not form a head. ***Brassica oleraceae***

Organic agriculture: An agricultural production system that relies on natural means like crop rotation, compost, biological pest control, and mechanical cultivation to maintain soil fertility and control pests, excluding the use of synthetic fertilizers and synthetic pesticides, plant growth regulators, livestock feed additives, and genetically modified organisms.

Supply chain: The system that moves a product from supplier to customers, emphasizing the perspective of sourcing

Value chain a chain of activities through which the product gains in value on its downstream journey from production to final consumption.

Specialty food: a premium-priced food product that provides an added value appeal for one or more of the following reasons: high quality, sensory appeal, flavor, consistency, texture, aroma and/or appearance; presentation (i.e. packaging or branding; origin and distribution (i.e. specialty food retail outlets or sections within supermarkets/grocery stores).

Traceability ability to follow the movement of a food through specified stage(s) of production, processing and distribution

Abstract

Some product information asymmetry is always present in food value chains; when the asymmetry is high, it increases food safety markets imperfection, reduces trust among stakeholders and could compromise food safety and quality. This study assessed information asymmetry through evaluation of the network structure and traceability strategies in the organic kales value chains around Nairobi. A survey of organic farmers and marketing outlets in Nairobi was conducted. Purposive sampling technique, based on organic food certification, was used and the data collected using semi-structured questionnaires during the interviews. The network data was analysed using Ucinet Version 6 while traceability data was analysed using SPSS version 17. From the analysis, there is a moderately high network centralization of approximately 61 percent although betweenness centrality is very low at approximately 6 percent. The stakeholders had functional traceability systems with most stakeholders using production, purchases and sales records to trace. Approximately 62 percent of all stakeholders had chain traceability; collective action and group activities existed that also enhanced traceability among stakeholders. The stakeholders in the certified organic products sector had internal monitoring and verification of the members' activities and relied on trust for information flow. Based on the findings, the study recommends reorganization of stakeholders to strengthen the networking structures to increase information flow. In addition, factors which influence traceability such as monitoring, training, documentation and certification and the subjective measures such as personnel perception on traceability should be improved to boost safety and quality of organic products.

Chapter 1: General Introduction

1.1 Background

Commercial vegetable production has increased recently in Nairobi and its surroundings. Kale is among the most preferred green leafy vegetables since it has high nutritional value while at the same time acting as an important source of income to peri-urban farming households (FAO/WHO, 2005). Since it is a highly perishable product, most of the kale originates from around Nairobi. Urban consumers demand good looking vegetables; colour, size and shape, attributes that have encouraged excessive use of chemical pesticides and fertilizers (Karanja *et al.*, 2010). A survey of peri-urban farmers growing vegetables for sale in Nairobi found that 96% of peri-urban kale farmers use pesticides in crop protection (Ngigi *et al.*, 2011). In organic kales production systems, no synthetic chemical inputs are applied and seeds are produced without the use of chemical inputs. Previous studies have shown that organic plant products have higher levels of dry matter, minerals (Fe, Mg), anti-oxidant micronutrients (for example, phenols and salicylic acid). In addition, 94–100% of organic foods have no pesticide residues. Organic vegetables such as kales contain far less nitrates, about 50% less (Lairon, 2011).

Middle and high income consumers nowadays are concerned about food safety and quality. These consumers are willing to pay for fresh leafy vegetables such as salads and juices, blanched or cooked vegetable whose safety and quality has been increased (Liu *et al.*, 2009). Consumers perceive organic food products to have reduced food quality and safety risks associated with chemical residues (Magkos *et al.*, 2006, Shanahan *et al.*, 2008).

A value chains is a strategic network between or among several independent business organizations (Hobbs, 2004). It is a collection of all actors in the production, processing and trading of a specific product. It is similar to a supply chain in that a supply chain focuses from primary input providers, while a value chain emphasizes on value addition at every step. A value chain is oriented by demand and not by supply, hence focus on consumer needs (Christopher, 2005). Value chain stakeholders share commitment to control product quality and consistency and they have a higher level of confidence allowing greater security in business and facilitation of the development of common goals and objectives (Ahumada and Villalobos, 2009).

Productivity in a value chain can be improved by provision of relevant, reliable and useful information to all stakeholders. This helps the stakeholders to make better decisions (Demiryurek *et al.*, 2008). Information flow is vital in management of foods value chains to enhance safety and quality of products. Traceability improves information management along a value chain (Souza-Monteiro and Caswell, 2010), within and between organic value chain stakeholder organizations.

According to the East African Organic Products Standard, EAS 456:2007, traceability is the ability to follow the movement of a food through specified stage(s) of production, processing and distribution. Tracking and tracing ability are prerequisites for identification of many food safety and quality issues (Fritz and Schiefer, 2008). Traceability systems will improve value chain operations and efficiency to meet regulatory and customer requirements (Sparling *et al.* 2006) and improve food safety and quality management (Viaene and Verbeke, 1998). Linking traceability with the entire information flow and documentation effectively improves operational efficiencies and increases food safety and quality (Ruiz-Garcia *et al.*, 2010). Traceability is a network problem and is affected by the status and position of an individual in the food supply chain network (Koo and Park, 2011; Souza-Monteiro and Caswell, 2010). Networks facilitate access to network social resources by stakeholders. A network is made up of actors or stakeholders who exchange resources, ideas and information and conduct activities as a group where individual independence is intact (Kapucu, 2005). It's a form of social capital with a potential for improving food safety and economic growth by improving information flow and informal access to resources (Cross and Parker, 2004). Organic certification forms an influential form of network organization based on social relations and regulatory policies (Raynolds, 2004). Understanding the network structure is fundamental to appreciate its operations, stability and also forecast how it adopts to disturbances (Namba *et al.*, 2008). Strong ties encourage information transfer which will facilitate traceability in the network (Gronum *et al.*, 2012).

Most of the organic products are produced and sold around Nairobi. More than 70% of certified organic farmers are also situated in Central Kenya in Ngong, Karen, Kikuyu and Muranga. Majority of their consumers are affluent higher middleclass persons who live around the capital city (Kledal *et al.*, 2008). The purpose of this study is to describe the traceability strategies and network organization of stakeholders in the organic kales for sale in high-end specialty outlets, restaurants and supermarkets in Nairobi and its environs.

1.2 Statement of the Problem

Information asymmetry and imperfections compromise on the safety and quality of food. Some supply chain actors withhold important product information. Normally, only part of the information flows along the supply chain since normally product flow is delinked from information flow. Producers and traders are more informed about product quality than consumers (Heyder *et al.*, 2012). Credence attributes in organic foods include production location, production process, producer identity, harvesting time, status of organic certification, transportation and storage time and condition among others (Hall, 2010).

The organization of food value chain networks have an effect on the information flow and hence the traceability effectiveness and efficiency (Souza-Monteiro and Caswell, 2010).

Information transfer in the food value chain and acknowledgment of agents minimize information asymmetry thereby increasing productivity (Banterle and Stranieri, 2008, Demiryurek *et al.*, 2008). There is inadequate empirical data on the information flow along the organic kale value chain network.

1.3 Justification

Organic production is a dynamic and rapidly-growing sector of the global food industry (Ponti *et al.*, 2012). Fresh vegetables are perishable and require more sophisticated logistics along the value chain. To ensure that quality organic kales reach the consumers, it is important that all stakeholders in the value chain from production, packing, storage, transport, distribution and marketing are 'visible' from 'farm to plate'. Organic food products have credence attributes and hence require traceability to verify their information (Golan *et al.*, 2004). Tracking and tracing ability is a prerequisite for identification of many food safety and quality issues (Fritz and Schiefer, 2008; Souza-Monteiro and Caswell, 2010).

Effective information exchange is the key to improving performance and competitiveness in complex and dynamic environments such as organic kale value chain (Heyder *et al.*, 2012, Ruiz-Garcia *et al.*, 2010). Information transfer along the food value chains and acknowledgment of agents minimize information asymmetry (Banterle and Stranieri, 2008, Demiryurek *et al.*, 2008).

Traceability is a network issue; activities of an individual actor are affected by the status and position of that individual in the network (Koo and Park, 2011). According to Lockie and Kitto (2000), network analysis focus on how localized stakeholders are in the food network. Networks facilitate products information flow which is vital in management of value chains to improve safety and quality of products. Effective information exchange is the key to improved network performance and competitiveness in complex and dynamic environments such as organic kale networks (Heyder *et al.*, 2012, Ruiz-Garcia *et al.*, 2010). Describing the network structure in the kale value chain will bring out the relationships in the sector (Martino and Spoto, 2006).

1.4 Risk Associated with Kale Production and Trade in Nairobi

Kale is considered an important leafy vegetable in urban and peri- urban areas of Nairobi since it is highly nutritious, preferred by consumers since it complements the staple food in Kenya and an important source of income to kale farmers and traders (FAO/WHO, 2005). The availability of waste irrigation water from residential areas and the easy access to city markets has also facilitated the growth in kale production (Prain *et al.*, 2007).

However, this creates food safety risk since most of kale have accumulated heavy metals, pesticide and fertilizer residues and microbial pathogens as most of the peri- urban farmers use fertilizers and pesticides intensively (KEMRI, 2004; Nyamwamu, 2009). Chemical residues such as pesticides and fertilizers residues are a major food safety concerns (Okello and Swinton, 2010). Sewer water use results in accumulation of heavy metals in soils hence potential higher uptake of heavy metal by crops; hence compromised food safety (Muchuweti *et al.*, 2006; Karanja *et al.*, 2010). Other potential hazards in the vegetable consumed in urban centres include contaminants from industrial wastes, exhaust from motor vehicles, dusts from the surrounding areas and the uncured animal manure used in production (Hide *et al.*, 2001).

1.5 Organic Products

Organic food products refer to food produced through mandatory soil building process, crop rotations and absence of synthetic inputs (FAO 1999). Organic agriculture is a holistic system promoting agro-ecosystem health. Organic systems increase agricultural productivity and sustainability through elimination of external inputs thereby maintaining high crop yields and improving food safety (Gosling *et al.*, 2010). It avoids use of synthetic drugs, fertilizers and pesticides and optimizes the health and productivity of interdependent communities of soil life, plants, animals and people.

1.6 Traceability systems

ISO 22000: 2005 states that an organization should establish and use a traceability system to identify products and their relation to batches of raw materials, processing and delivery records. The system should identify incoming products from their immediate suppliers and the initial distribution route for the end product. ISO 22005: 2007 and Codex Alimentarius (2006) define traceability as the ability to follow the flow of food through specified stage(s) of production, processing and distribution. A traceability system should trace and track a product. Tracing gives the product history and possibly identifies the sources of contamination. Tracking enhances products recall in case contamination is detected after food has been released (Meuwissen *et al.*, 2003). Product history and location should be recorded and documented along the food chain (ISO 22005).

Most food products traceability systems are paper based and / or electronic based. Electronic based rely on barcodes, databases and other tracking devices. These provide a means for tracing products through records kept at primary production, record changes in ownership, during product processing and distribution. Records are kept in computer files and / or onto a hard copy (Shackell, 2008). It's important especially if contamination is detected and a recall is required. If traceability had been adhered to, identifying the product by precise date/time and exact location is possible.

Traceability systems use unique identification data such as order number, production batch number, date/time in serialized sequence number either as barcodes or radio frequency identification (RFID) that can be traced along the food chain. RFID usage in animal products has been on the increase due to food safety concerns (Heyder et al., 2012; Popper, 2007).

Data at any point in the system along the food chain can be evaluated for completeness and correctness using traceability software to find the particular transaction and/or product within the supply chain. Tracking attributes used include lot numbers, supplier date codes manufacturing codes or any other data during data collection. Traceability systems should be verifiable, consistently and equitably applied, results oriented, cost economical, practical, compliant with the regulations or policies, and compliant with defined accuracy requirements (Pouliot and Sumner, 2008).

Traceability systems should achieve its objectives technically and economically. The system should be evaluated for costs and benefits. The costs and benefits may either be tangible or intangible (Henson and Holt, 2000) and vary among products, processes and markets. Movement relates to the input history, processing history and distribution. It addresses at least one step forward and one step backward during food production chain. Effective tracing systems enhance information exchange within the organizational information systems (Henson *et al.* 2005).

1.6.1 Benefits of traceability

Need for traceability in the food industry is driven by several factors such as legislation requirements, need for improved food safety and quality, enhanced sustainability of the organization, better welfare, for certification, to improve their competitive advantages, for improved communication along the value- chain, to improve bio- safety along the chain through prevention of terrorist threats, and for production optimization (Olsen, 2009). Food products with credence attributes require trace and track systems to verify reliability of the labels (Golan *et al.*, 2004).

In the organic value chain, traceability can improve management of product information within and between firms thereby reducing the risks associated with hazards in food along the supply chains (Souza-Monteiro and Caswell, 2010). It also improves value chain operation and efficiency to meet regulatory and customer requirements (Sparling *et al.* 2006) and creates opportunities for food safety and quality management although it does not guarantee safety and quality if used alone by management (Viaene and Verbeke, 1998). It identifies nonconformity and enhances product withdrawal and/or recall. Traceability systems also improve usage and reliability of information. Traceability enhances efficiency since better information about the food products and processes creates efficiency in the supply chains (Hall, 2010). Effective tracing systems enhance information exchange within the organization (Henson *et al.* 2005) and between stakeholders in the supply chain (Hobbs, 2004; Meuwissen *et al.*, 2003). It improves trade and increases efficiency along the supply chain.

Communication of traceability information between the food industry and consumers will not only regain public confidence in food safety and quality, but it also enhances better understanding of the difficulties in traceability. Effective information exchange is the key to improved network performance and competitiveness in complex and dynamic environments such as organic networks (Heyder *et al.*, 2012, Ruiz-Garcia *et al.*, 2010). All the stakeholders in a supply chain should get accurate information about a product. Information transfer throughout the food supply chain and attribution of specific responsibilities to agents along the supply chain minimize information asymmetry (Banterle and Stranieri, 2008).

In case of contamination, the source and distribution route are rapidly established thereby facilitating product withdrawal or recalls and identification of the problem (Hall, 2010). Traceability provides information to actors in the supply chain thereby increasing trust. This is important for credence attributes; that is, product attributes which consumers cannot be detected either prior or after consumption of the food. Credence attributes for organic foods include production location, how the products were produced, identity of the producer such as name, time of harvesting, status of organic certification, transportation and storage time and condition among others (Hall, 2010).

1.6.2 Documentation of Traceability Information

Adequate product and process information exchange is a valuable asset for organizations (Sporleder and Moss, 2002). Traceability systems at primary production and along the food supply chain require adequate documentation of all operations, hence better quality products along the value chain (Bertolini *et al.* 2006). It is necessary that records at all stages be complete and have integrity. A secure system is crucial for unquestionable reporting of the traceability result (Shackell, 2008). Traceability records should be kept for defined period for assessment in case of product withdrawal or recall. Traceability incorporates product flow and attributes into systems that enhance record keeping designed to track flow of products and its attributes along the production/ supply chain (Golan *et al.* 2004).

According to Meuwissen *et al.* (2003), there are three types of traceability systems in food supply chains. In the type 1, each stakeholder in the supply chain gets only part of the relevant information on the products from the immediate stakeholders. Information transferred is small hence low cost on traceability. The type requires a lot of trust to ensure correct information flow along the supply chain. In type 2, each stakeholder gets all relevant information from all previous stakeholders. This system is more expensive than type 1 but it allows for rapid and effective traceability. In type 3, traceability is conducted by a central organization. This resolves the danger of lack of trust and improves efficiency and effectiveness of traceability. There should be traceability upwards and downwards along the chain, that is, tracing and tracking along the value chain (Hobbs, 2004). Fig. 1 is a diagrammatic representation of the traceability systems in place in the food products.

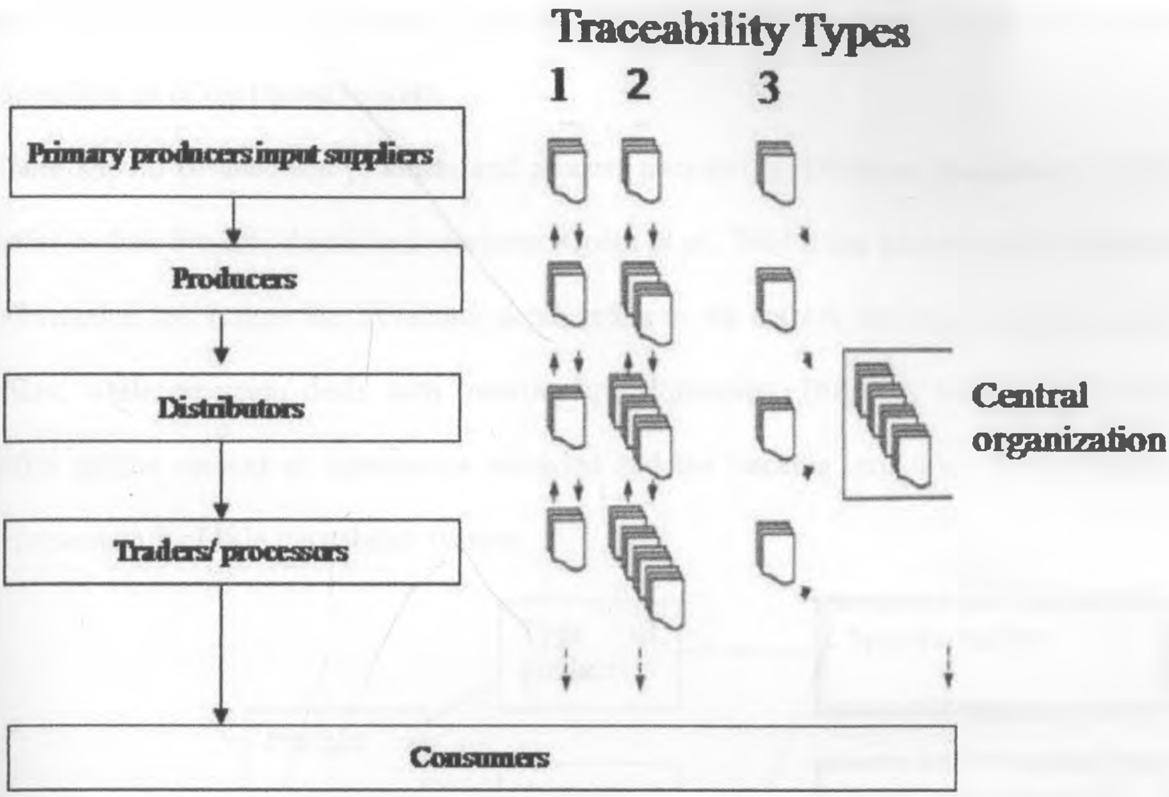

Figure 1: Organic kales supply chains traceability systems (adopted from Meuwissen et al., 2003)

1.6.3 Food traceability system requirements

According to Regattieri *et al.* (2007), a food product traceability system has four pillars namely traceability tools, product identification, data to trace, and product routing. Product identification describes the physical characteristics such as weight, volume, dimensions, and packaging. The data to trace is that information the system should manage including the confidentiality. Product routing is information on product life cycle along the supply system including the production, processing, and transportation activities. The traceability tool depends on the accuracy and reliability of data that is required.

Traceability systems can be investigated through analysis of products and transformation information. Transformation information deals with the identification of traceable units and transformation relationships. Product information covers product origin, processing history, and exact location of the product. Information is traceable by being linked to a unique identification of the traceable units.

There should be adequate products and process traceability. Different traceability systems differ in their breadth, depth, and precision (Golan *et al.*, 2004). The breadth is the amount of information the system has to record; depth refers to the sectors involved along the supply chain; while precision deals with tracking unit dimension. Different traceability systems differ on the amount of information recorded and the tracking unit. Fig 2 is a schematic representation of kale traceability system.

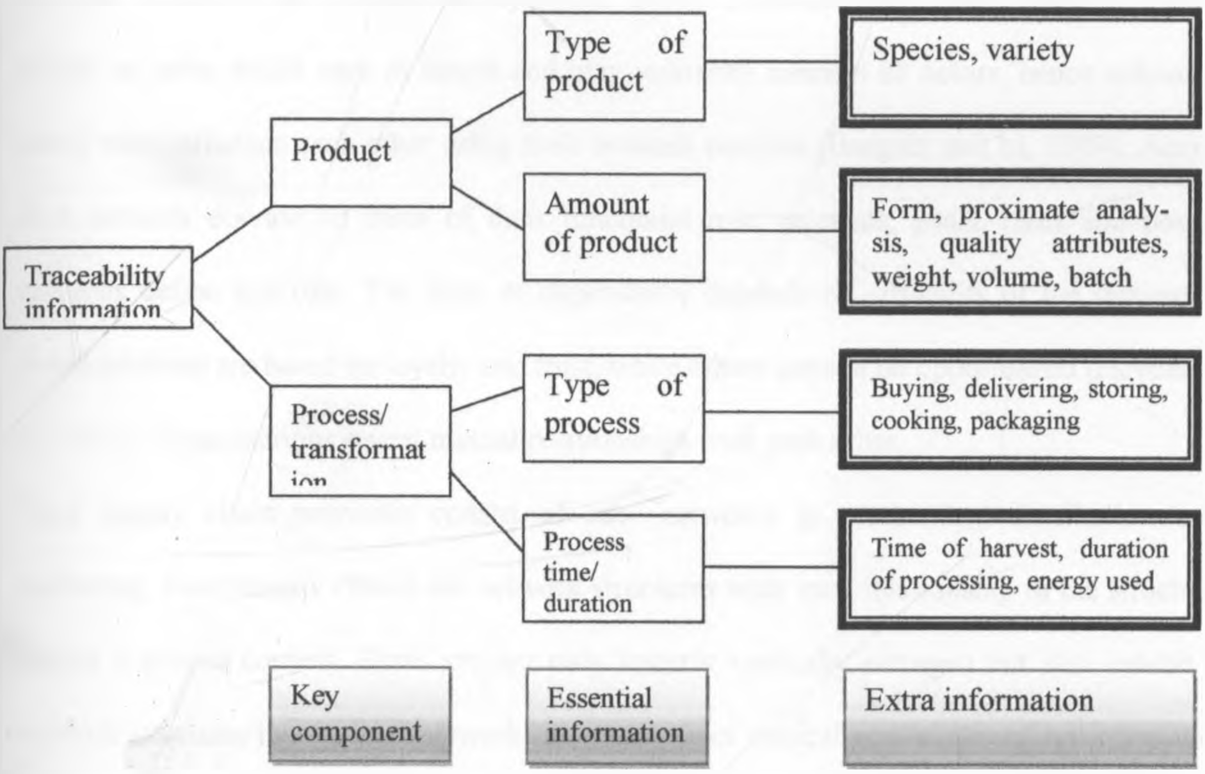

Figure 2: Basic components of kale traceability system (based on Golan et al., 2004)

The system should incorporate internal and external traceability through effective exchange of supply chain information (Henson *et al.* 2005). There should be traceability upwards and downwards along the chain, that is, tracing and tracking along the value chain (Hobbs, 2004). Previous research on traceability relate to information relational structures between organizations in a value chain network (Janetzko, 2001). In a food network structure, there must be traceability upstream along the value chain (Souza-Monteiro and Caswell, 2010). According to Pouliot and Sumner (2008), the extent of traceability is that chance of identifying accurately the source of a food product. Kale is mostly not processed; hence traceability of primary production and distribution/ packaging information is adequate. Traceable information is linked to unique identification of traceable units.

1.7 Food Supply Chains Network

Value chain actors' collaboration is not purely based on economic activities. Power and trust are also crucial in the network theory (Uzzi, 1997). Different actors link together to form chains or paths which vary in length and may indirectly connect all actors, hence unknown actors may influence each other using their network position (Borgatti and Li, 2009). Actors in a network operate on basis of their functional role; interests, goals, rules and power relations define this role. The level of dependency depends on criticality of the resources. Some relations are based on loyalty and trust, while others depend on opportunism (Heyder *et al.*, 2012). Organizations reveal mutual relationships with each other.

Food supply chain networks consist of sub- networks in production, distribution and marketing. Food supply chains are network structures with each relationship in the structure having a unique context. Firms are not only linearly vertically arranged but also exhibit a network structure, that is, food networks are made up of vertical and horizontal links between different organizations along a value chain (Kothandaraman and Wilson, 2001). A network structure has both the dyadic level (for example, the supplier relation) and the network level (Ritter and Gemünden, 2003). Relations at network levels are interrelated (Ritter *et al.*, 2004). Relationships in a food supply chain network have specific background and uniqueness.

Along food products value chains, there are different relationships (linkages) based on activities and actors within and outside an organization (Porter, 1985). Vertical relationships along the supply chain deals with buyers and suppliers. A linkage shows relationships between activities and their effects on the performance showing interdependence between activities. Coordination of interdependence creates efficiency and effectiveness. Stronger linkages increase interdependence between activities (Dekker, 2003).

According to Lazzarini *et al.*, (2001), there are two facets of inter-organizational relationships based on the nature of linkage between two firms or agents. Relationships can be arranged as chains (vertical ties) or networks (horizontal ties) based on the reason for interdependence. The food products value chain network encompasses activities linking product, process and information flow from production, through to the consumer; products and information flow both up and down the supply chain (Lazzarini *et al.*, 2001). Fig. 3 represents an example of a generic kale value chain network.

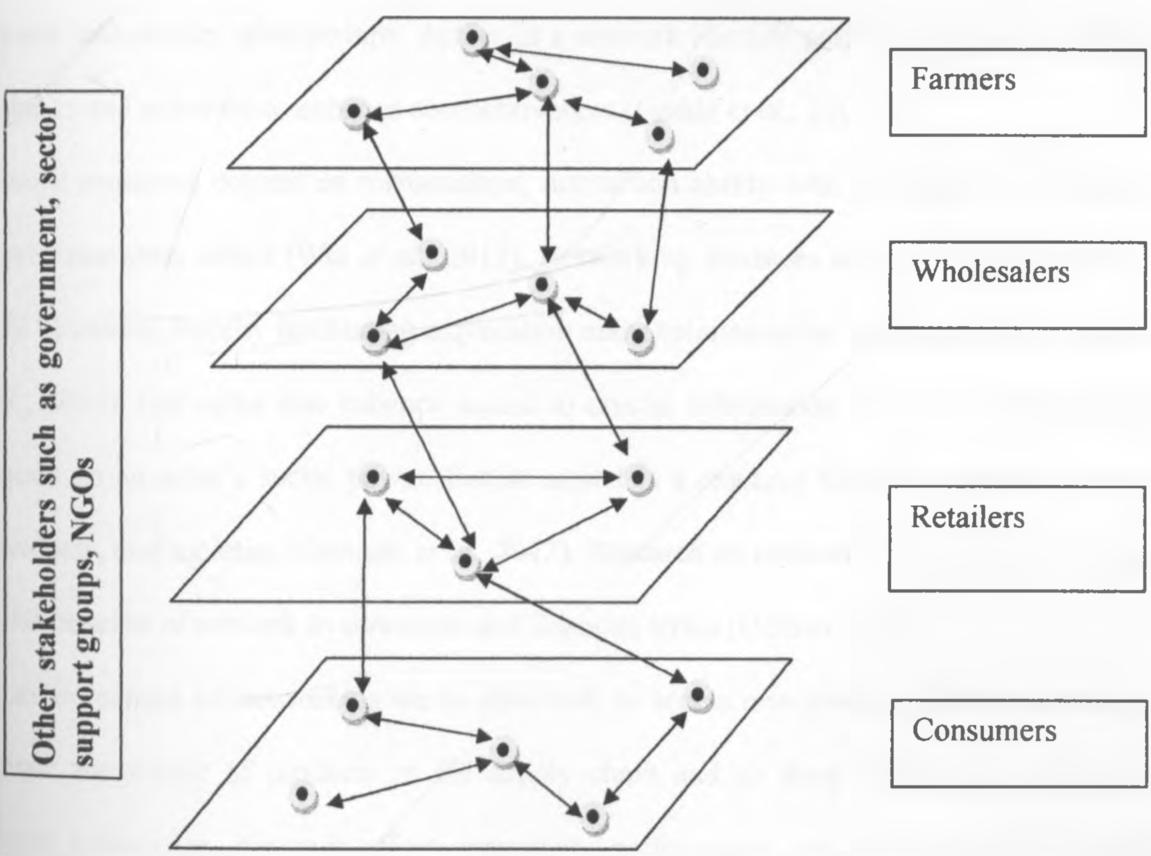

Figure 3: Schematic representation of kale value chain networks (based on Lazzarini et al., 2001)

According to Ondersteijn *et al.* (2006), a food supply chain network can be decomposed to form a ***network structure*** and a ***food value chain***. The network structure describes the main participants, their roles and there institutional arrangements. The value chain describes the flow of products and process information from the producers to the consumers.

1.7.1 Network Analysis among stakeholders

A network has three main elements namely; actors, activities and resources (Chang *et al.*, 2012). An actor has different relationships with other actors depending on the activities and resources of the actors. Activities are the roles performed by an actor inclusive of knowledge sharing. Resources in a network are normally not fully exploited since some possess a hidden attribute to other actors. Resources create need for cooperative strategies between upstream and downstream actors. Networks create stronger value linkages with strategic partners to improve stakeholder relationships. Actors in a network identify particular scope by relating resources and activities to enhance competitiveness (Gadde *et al.*, 2003).

Network resources depend on relationships, interaction ability with stakeholders and ability to influence other actors (Wei *et al.*, 2012). Networking enhances access by stakeholders to social resources thereby facilitating exploration and exploitation by small enterprises (Florin *et al.*, 2003). Networks also enhance access to crucial information and power. Information depends on an actor's social power. Social capital is a resource found in networks among individuals, and societies (Gronum *et al.*, 2012). Research on network at the firm level brings out the benefits of network in economic and financial terms (Ozman, 2009).

The main reasons for networking are to share risk, to access new markets and innovations, to enhance movement of products in the supply chain and to share knowledge and access external knowledge. Network affect innovation, performance and productivity in a value chain (Pittaway *et al.*, 2004). Networks form part of social capital; they rely on the strength of weak ties and are essential in marketing. Economic transactions are socially embedded to form a network.

A member who has a better position in a network have more control and can collaborate with other network members (Powell *et al.*, 1996). Activities of an individual actor are affected by the status and position of that individual in the network (Koo and Park, 2011). The position in the network depends on exchange relationships, the consequence of establishing, maintaining, and developing such relationships. The exchange relationships create opportunities and constraints in the network. Describing the network structure will enhance the understanding of social processes in food value chains (Martino and Spoto, 2006).

Network analysis gives an actor's position in a network and shows the influencing stakeholders and role of collective action (Lazzarini, 2001). Network analysis focuses on relational patterns connecting individual people, groups or organizations within a system and describes how these patterns relate to characterize the system (Cumming *et al.*, 2010). Social network analysis provides systematic assessment of networks of relationships through mapping and analysis of relationships Social network approach will be used to analyze the structural, topological, and quantitative attributes of the network. Quantitative network analysis gives measures for network description and form a basis to investigate relationship patterns (Moschitz and Stolze, 2009).

Network analysis describes three types of organizational networks namely socio-centric, ego-centric and open-system. Ego-centric networks analyze relationship starting with a single actor. Socio-centric networks analyze networks in systems with well defined boundaries such as networks specific organizations or specific departments. Open-systems networks analyze networks where the boundaries to the network are not well defined for example a society (Racherla and Hu, 2010).

An organization's ability to manage its position and relations determines the network competence (Ford *et al.*, 2003). Network competence is an organization's ability to handle, use, and exploit inter-organizational relationships (Ritter and Gemunden, 2003). According to Ritter (2000), creating network competence is in two stages. The first stage involves maintaining relationships through initiation, coordination and exchange while the second step involves maintenance of the network. The market orientation is related to network competence (Ritter, 2000). Network competence will affect an organizations access to network resources which may include physical, financial, personnel and information (Ritter and Gemunden, 2003).

1.7.2 Centrality in Network Analysis

The structure of a network influences its dynamics and stability (Namba *et al.*, 2008). The strength of a relation between/ among actors is normally measured using frequency of interactions. Centrality and power are fundamental properties that describe aspects such as role in the network, leadership, intermediaries, isolated stakeholders, actors who are central or at the peripheral (del Pozoa *et al*, 2011). Power is assumed to be inherently relational. There can be considerable variations between these characteristics of a position; an actor can be positioned in a way that is advantageous in some ways, and disadvantageous in others.

Organizations maintain a tie mainly because of a single relationship although there may be a variety of relationships (multiplexity of ties). Strong ties share more voluntary, supportive information since they form a solid basis for trust whereas weak ties enhance access to a wider source of resources (Gronum *et al.*, 2012). Centrality measures evaluate the relative significance of an actor. It shows relationships focusing on some individuals thereby showing individual social power. Higher centrality measures shows that the actors are powerful in the network due to their central position hence more accessible to other actors in the given network. Burt 1992 hypothesized those organizations with high centrality values can mediate and maximize on information flows or other resources in a network (Henry, 2011). This is useful for accessing network resource such as information and ability to control the resources. All nodes are not equally important for the dynamics and stability in the sector. Importance of nodes is usually measured using centrality values. Different centrality measures give different aspects based on an actor's position within a network. Measures of centrality include degree centrality, closeness centrality, eigenvector centrality and betweenness centrality (del Pozoa *et al.*, 2011).

Degree centrality is a measure of the ties of an actor in relation to other actors in the network (del Pozoa *et al.*, 2011). A high degree centrality value represent more direct connections to other actors in that network (Opsahla et al., 2010; Wasserman and Faust, 1994) hence better communication flow (Freeman, 1979). In non- symmetric data, the in-degree (incoming connections) indicates the popularity of an actor while the out-degree (outgoing connections) shows how an individual is influential in the network.

Bonacich centrality evaluates the connections of the linkages in the actors in the networks by calculating centrality based on the connectivity of a connection. Based on Bonacich centrality, the more connections an actor has, the more central the actor is while the fewer the connections, the more powerful the actor is. Centrality and power depend on the neighbours' connections (Costenbader And Valente, 2003). Bonacich approach is a fairly natural extension to centrality and makes two assumptions; centrality depends on the connections of an actor's connections and the assumption that power comes from connection to weak links, rather than to strong links.

Degree centrality values might be criticized since they use an actor's immediate ties or the links of the actor's neighbours and doesn't use the indirect ties to all others. An actor can be linked to many other actors although these other actors can be relatively disconnected from the network, hence the actor becomes central only in a local neighbourhood, hence the use of eigenvector centrality (Opsahla et al., 2010). Eigenvector centrality measures the strength of relationships and centrality of other network members (Faust, 1997). According to Bonacich (1972), a node which is connected to nodes that are themselves well connected are considered more central than a node which is connected to an equal number of less connected nodes.

Closeness centrality is a measure of the possibility to interact with many others depending on a minimum number of intermediaries (del Pozoa *et al.*, 2011). It is then a measure of reachability of the actors and it includes indirect ties. It indicates the integration and/ or isolation of actors in a network. It utilizes the sum of the geodesic distances between a given actor and the rest of the network members. It concentrates on the distance of an actor to others in the network using geodesic distance; hence it identifies a member's integration within the network (Borgatti et al., 2002). High closeness centrality means greater autonomy of an individual person, since he or she is able to reach other individuals easily while low closeness centrality means higher individual actor dependency on others, that is, the willingness of other actors to provide access to the resources in a network (Costenbader and Valente, 2003; M'chirgui, 2007). Farness is the sum of the distance from each node to all others. To transform "farness" into "nearness" the reciprocal of farness is taken. With farness and nearness measures, inequality in the distribution of distances across the actors can be measured (Borgatti et al., 2002; Zemljic and Hlebec, 2005).

Betweenness centrality is a measure of an actor's position on the geodesic paths by expressing the number of shortest paths between network actors that pass through a given organization (Borgatti et al., 2002; Henry, 2011). It gives the extent to which certain network members are more central thereby able to have more influence based on their location on the paths with other members (Wasserman and Faust, 1994). It captures an organizations' actual access to network resources (Freeman, 1979). It emphasize on the communication control.

High node betweenness values signify greater potential for information and resources flow between actors (Faust, 1997). It identifies gatekeepers and knowledge brokers within a network. It shows if an actor has a relatively important role, and has a high potential to control indirect ties, either as a gatekeeper or a knowledge broker. Gatekeepers and knowledge brokers have an important role in knowledge communication processes. High betweenness value means an actor can go between many pairs of actors either directly or indirectly, that is, the node lies along many 'shortest paths' between pairs of other actors. Betweenness centrality views an actor as being in a better position based on the extent that the actor falls on the geodesic paths between other pairs of actors in the network (Madhavan et al., 1998). The more other stakeholders depend on actor to make connections with others, the more powerful is that actor. When two actors are connected by more than one geodesic path, and the actor is not on all of them, some power is lost (Everett and Borgatti, 1999).

1.7.3 Empirical methods in network analysis

A network is a map of the relevant ties; each tie having its own specific form and pattern. Networks have been described based on different structural characteristics such as size, nature of its relationships among the actors (intensity of strength or reciprocity), centrality (closeness or peripheral), density (connectedness), and clustering/ clique (Tichy *et al.*, 1979). Network density depends on factors such as network size, the number of network questions asked during the interviews, the number of answers expected per question, and the type of interview questions. Generally, network density increases as network size decreases (Scott, 2000).

Activities of an individual actor are affected by the status and position of that individual in the network (Koo and Park, 2011). Describing the network structure in organic kale value chains will enhance the understanding of social processes in the organic sector (Martino and

Spoto, 2006). Network analysis focuses on relational patterns connecting individual people, groups or organizations within a system and describes how these patterns relate to characterize the system (Cumming *et al.,* 2010). Quantitative network analysis gives measures for network description and form a basis to investigate relationship patterns (Moschitz and Stolze, 2009).

Network density and centralization have previously been used to analyze network characteristics. Network density shows the level of cohesion in a graph while centralization shows the extent cohesion is organized around particular focal points. The network density shows the extent to which all stakeholders are linked to one another, that is, network cohesiveness. Centralization is the control and power structure in a network, organizations. Centralization gives the extent to which network actors are connected to other actors. Density and centralization gives complementary measures in network studies. Better position in a network creates more control and collaboration with other network members (Powell *et al.*, 1996).

Network effectiveness can be described by showing the integration among the network actors. Value chain approach in network study enhances design and implementation of appropriate development programs and policies to support stakeholders, individually or in groups, in production and market participation (Hess, 2008). Strong ties share more voluntary, supportive information since they form a solid basis for trust whereas weak ties enhance access to a wider source of resources.

Snowball sampling technique contributes to the dynamics of social networks research. It is defined as "a procedure applied when the researcher accesses informants through contact information that is provided by other informants" (Noy, 2008). The technique emphasizes on two concepts namely social knowledge and power relations. Snowball sampling is essentially social since it uses and activates current social networks (Noy, 2008). The technique is applicable when other sampling techniques are used. In this case, it synergistically contributes to the overall research design thereby improving on the amount and type of information collected in qualitative social sciences (Noy, 2008). Information about informants in snowball sampling is from the informants themselves hence the researcher relinquishes some control during the sampling stage to key informants. However, the researcher can direct key informants on the sample based on the preferred sample characteristics.

1.8 Value chain approach

Value chain approach captures interactions in complex and dynamic markets in developing countries and examines the inter-relationships among actors along the production and marketing channel (Rich *et al.*, 2011). Value chain approaches are normally used to show interactions dynamics and complex markets in developing countries. It also brings out inter-relationships between various actors along a marketing channel (Rich *et al.*, 2011). Such approaches have been used to study governance in the supply chain and emphasize on potential entry and exit points for smallholders (Hess, 2008). It provides a framework for analyzing the competitiveness and its determinants along value chains especially where there are small holders. It assists in design and implementation of support activities in networks. Value chain approach is used to characterize complex networks, actors' relationships, and incentives in food systems (Rich *et al.*, 2011).

Value chain analysis assists in assessment of linkages between and amongst productive activities. It provides a basis for analysis of the nature and determinants of competitiveness along value chains where small holders can participate. Value chain approach in network study enhances design and implementation of appropriate development programs and policies to support small scale farmers, individually or in groups, in market participation (Hess, 2008).

Value chain integration in network analysis will assist chain stakeholders to develop a sustainable competitive advantage. Stakeholders with social capital have more connections (both strong and weak linkages) than the rest thereby making them more central (Urry, 2003). Power depends on an actor's perceived dependence or independence to other network members (Henneberg *et al.*, 2006).

Economic activities in a value chain depend largely on network relations and the position within the social network (Gulati, 1998). According to Wilkinson and Young (2002), the network perspective views the network as a whole by extending the focus from a single actor to the network and focusing on relationships and interactions between and among actors within the network. The relationships create competitive advantage within the supply chain network. Formal and informal relationships determine innovation in a network (Mahroum *et al.*, 2007). Relationship helps an organization to share ideas, facilitate learning by addressing constraints to growth, facilitate development of supply chain and addressing the impact of isolation (Mahroum *et al.*, 2007).

1.8.1 Food supply chain

Supply chain management is the systemic coordination of operations by stakeholders in a supply chain with an aim to improve the long-term sectoral performance by intra- and inter-organizations (Mentzer *et al.*, 2001, Estampe *et al.*, 2010). A food supply chain shows the movement of food from the primary production all the way to the ultimate consumer. Food supply chains comprise of organizations responsible for the production and distribution of animal-based or vegetable products. Agri-food supply chains describe the flow of products and information from production through to distribution of agricultural products, that is, from the "farm" to the "fork" (Ahumada and Villalobos, 2009).

The products physical flow downward while information flows is both upstream and downstream along a supply chain; downstream stages share actual and forecasted product demand information, actual orders, and advertisement information with upstream partners while upstream stages share production schedules, transportation information, and product availability. Information sharing in both directions facilitates coordination of product flows with an aim of matching supply with demand (Geuner and Pardalos, 2003).

1.9 Purpose and Objectives

1.9.1 Purpose of the study

The purpose of this study is evaluating information flow along the organic kales value chains.

1.9.2 Objectives of the study

The overall objective is to evaluate the network organization and traceability systems in the organic value- chains in Nairobi.

The specific objectives of the study are;

1. To illustrate the network organization for organic foods value- chains in Nairobi.
2. To evaluate the traceability systems along organic foods value- chains around Nairobi.

1.10 Dissertation Layout

This study will be in 4 chapters outlined as follows:

Chapter 1: A general introduction of the dissertation outlining the different research areas covered in this study based on the activities carried out under different sub- objectives.

Chapter 2: Network analysis of the organic kales value chain in Nairobi. This chapter gives a detailed analysis the network organization in the organic kales value chain.

Chapter 3: Evaluation of the Traceability Systems in the Organic Sector Networks in and around Nairobi City. The chapter describes the traceability strategies currently in place and gives factors that influence traceability along organic kales value chains

Chapter 4: This chapter gives a summary of the major conclusions of the study and gives the way forward as recommendation.

Chapter 2: Network Analysis of the Organic Kales Value Chain in Nairobi and its Environs

Abstract

A network is a social capital and network organization constitutes a distinct form of coordination of economic activities thereby improving efficiency and reduction in agency problems for organizations. Measure of centrality in social networks describes actors' positions and integration relative to others in the network. The aim of the study was to determine the network organization for organic kales value- chains around Nairobi. A survey of stakeholders (producers and traders) in the organic kales value chain was conducted between February 2012 and June 2012. Purposive sampling technique, based on organic certification, was used, data collected using unstructured questionnaires during the interviews and data analysed using Ucinet Version 6. Degree centrality was 61 percent signifying that the stakeholders were fairly networked. The closeness centrality (56 percent) shows that the stakeholders are not close to one another despite being fairly networked. The low node betweenness centrality value (5 percent) signifies short linkages between stakeholders and most can interact directly. Farmers are most central in the network, but due to their small scale nature, they are exploited by other stakeholders. Traders are at the network periphery which limits their access to information flow. Regulators such as organic certification bodies and sector support groups such as KOAN and KIOF had highest centrality values while small NGOs, training institutes and government official had least centrality values. The study recommends reorganization of the network structure to facilitate information flow and to minimize exploitation of farmers so that all stakeholders benefit from the organic kales networking structure.

Keywords: Organic, Network structure, Centrality, Value chain

2.1 Introduction

Kale is among the most consumed leafy vegetables in urban areas of Kenya. It is highly nutritious and acts as an important income source to households; both traders and peri- urban farmers. A food value chain brings out activities required to get a food product from the farm to the final product ready for consumption (Kaplinsky and Morris, 2000). It is designed around activities aimed at adding value to the end product. Different stakeholders occupy different positions along the value chain; primary input providers occupy the upstream position while customers are at the downstream position. Value is added along the chain by various stakeholders to form a food value chain network.

Networks are made up of complementary nodes and links, that is, actors/ stakeholders who exchange resources, ideas and information and also conduct activities as a group where individual independence is intact (Kapucu, 2005; Jarillo, 1988). Relationships are interdependent, that is, what happens in one relationship has an effect on other network members (Andersson *et al.*, 1994). Networks affect innovation, performance and productivity in a value chain (Pittaway *et al.*, 2004). Networks are a form of social capital with a potential for improving economic growth. Organic produce certification forms an influential form of network organization based on social relationships and regulatory policies (Raynolds, 2004).

An actor's position in a network determines information flow and access to network resources (Cross and Parker, 2004). Food safety to an extent depends on the position in the network (Gulati, 1998). There is no universal optimal network structure. Strong ties encourage information transfer although it causes exploitation and reduces innovation, whereas weak ties are important to new knowledge creation or exploration although they hinder complex information transfer (Gronum *et al.*, 2012). The objective of this study is to describe the network organization of organic kales value chain in Nairobi and its environs.

The specific objectives are to map the organic kales value chain and to describe the relationships among the actors.

2.2 Methodology

2.2.1 Study Area

The study was conducted around Nairobi since most of the local organic markets are found around the capital city where majority of the consumers are affluent higher middleclass persons (Kledal *et al.*, 2008).

2.2.2 Study design

The study used survey design approach that involves getting specific information on a given population at a defined time (Mugenda, 2008). A two step study approach was adopted. The first step mapped the formal network structure while the second step focused on the relationships between the identified network entities (Hansen, 1999; Tsai, 2002).

Step 1: Mapping the stakeholders in the organic value chain around Nairobi

i. All stakeholders in the organic system were listed. This was done through review of literature and other secondary data source to identify all the certified stakeholders in Kenya's organic produce networks. Most of these stakeholders had been registered by the Kenya Organic Agriculture Network (KOAN).
ii. This list of stakeholders was complimented by asking these stakeholders to identify others who had not been previously listed. This gave additional stakeholders to be included in the survey.

Step 2: Definition of the relationship among the actors

i. The identified actors were listed in a table.

ii. Key informants were identified and interviewed to evaluate the relationship between/ among them and the actors. The actors were asked to state their relationships and indicate the strength and importance of these relationships

2.2.3 Sampling procedure

Stakeholders in the organic kales value chains around Nairobi were identified using secondary data from KOAN. Purposive sampling based on organic certification was used to identify the initial respondents. The initial respondents were asked to name other stakeholders such as transporters, traders, customers, suppliers, and sector support groups in their networks with whom they interacted in the organic kale chain.

2.2.4 Data needs and collection

A total of 38 organic kales farmers, 10 traders and 2 organic farmers' market officials were interviewed during the period between February and June, 2012. The data was collected using semi- structured interviews of the stakeholders in the value- chain. Three sets of questionnaires were used depending on the target respondent. The survey instrument provided a guide to the interview, covering, suppliers, customers, competitors, sector support groups, government officials, infrastructure providers, challenges and opportunities in marketing organic vegetables. Most of the response format was open- ended.

2.2.5 Data analysis

Centrality measures were used to analyze the network structure to capture the positional scores of the organizations in the organic products network around Nairobi. Four centrality measures were used namely Freeman degree centrality, node betweenness measure, closeness centrality and Eigenvector centrality (Wasserman and Faust, 1994; Borgatti *et al.*, 2002; Faust, 1997). Degree centrality was measured by the total number of positions in direct contact with an individual. Betweenness centrality was measured as the probability that communication between any two actors is through a focal individual. Closeness centrality was measured as the distance between one individual and all others in the network. Eigenvector centrality was measured using the influence an actor has on the network.

Analysis assumed that ties between stakeholders were symmetrical, that is, two actors were assumed to relate to one another if at least one of the actors reported a relationship. The ties were dichotomized; hence a relationship was presented with a positive one (+1) while lack of relationship was a zero (0).

Ucinet 6 for windows (version 6.408) was used to generate centrality measures (Borgatti *et al*., 2002). UCINet is social network analysis software (SNA software) that facilitates quantitative or qualitative analysis of social networks through description of key network properties, both numerically and using visual representation. Statistical Package for Social Sciences (SPSS) version 17 was used to analyze the descriptive quantitative attributes of the networks.

2.3 Results

2.3.1 Overall Network Overview

The organic kales supply chain had several actors such as input providers, producers, traders, regulators, sector supporting groups and consumers. Fig 4 represents the organic kales supply chain network in Nairobi. Farmers were most central the network and could be reached easily by other stakeholders, while traders, regulators (certification bodies), and sector support groups were towards the periphery and accessed limited number of stakeholders only.

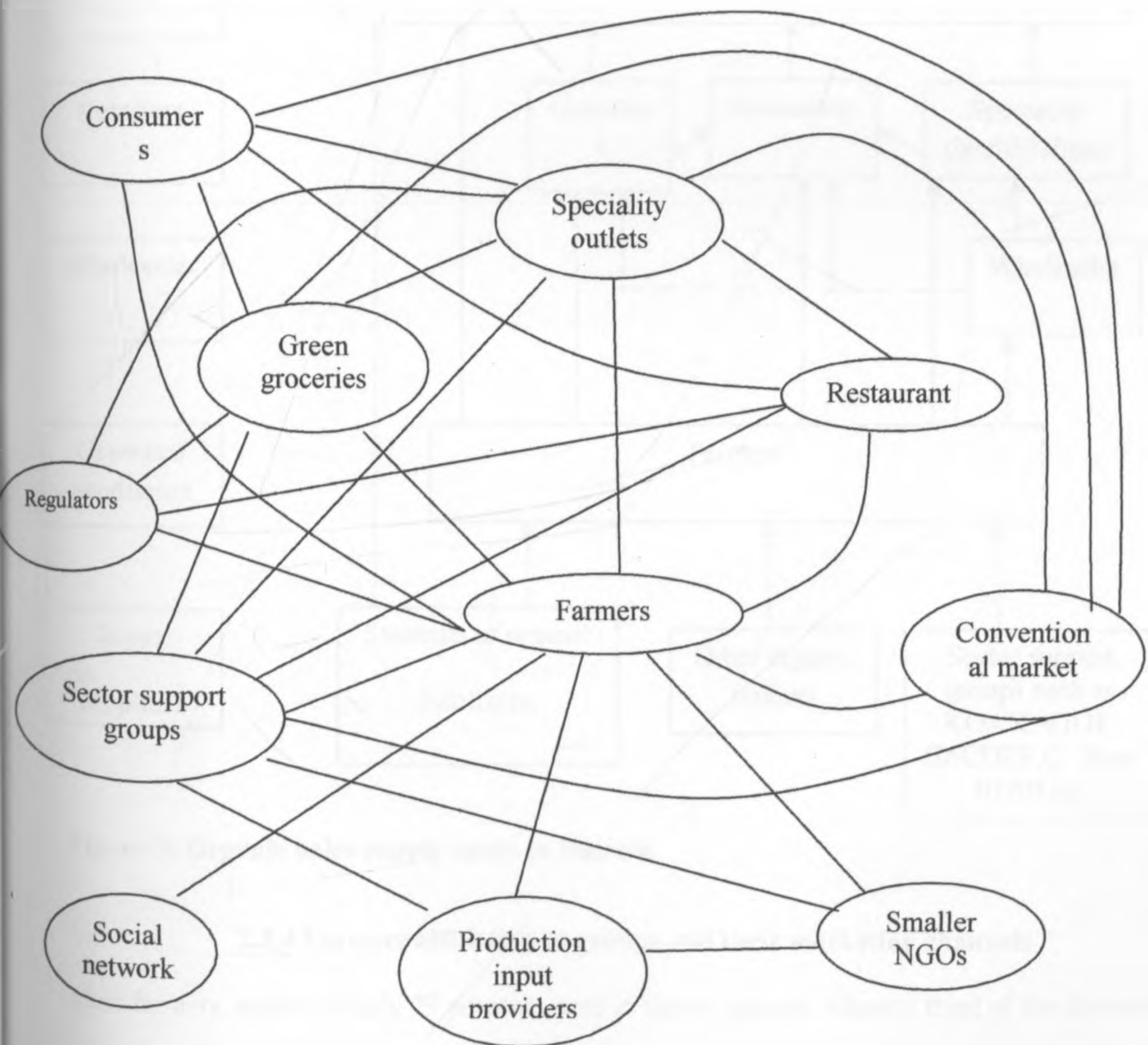

Figure 4: Diagrammatic representation of organic kales supply chain network

2.3.2 Organic kales Supply Chain in Nairobi

The organic supply chain in Nairobi had several actors such as producers, input providers, traders and consumers. Agrochemical shops, sector support groups and other farmers provided the primary inputs to farmers while green groceries, restaurants, specialty shops and wholesalers were the traders. Fig 5 is a diagrammatic representation of the organic supply chain around Nairobi.

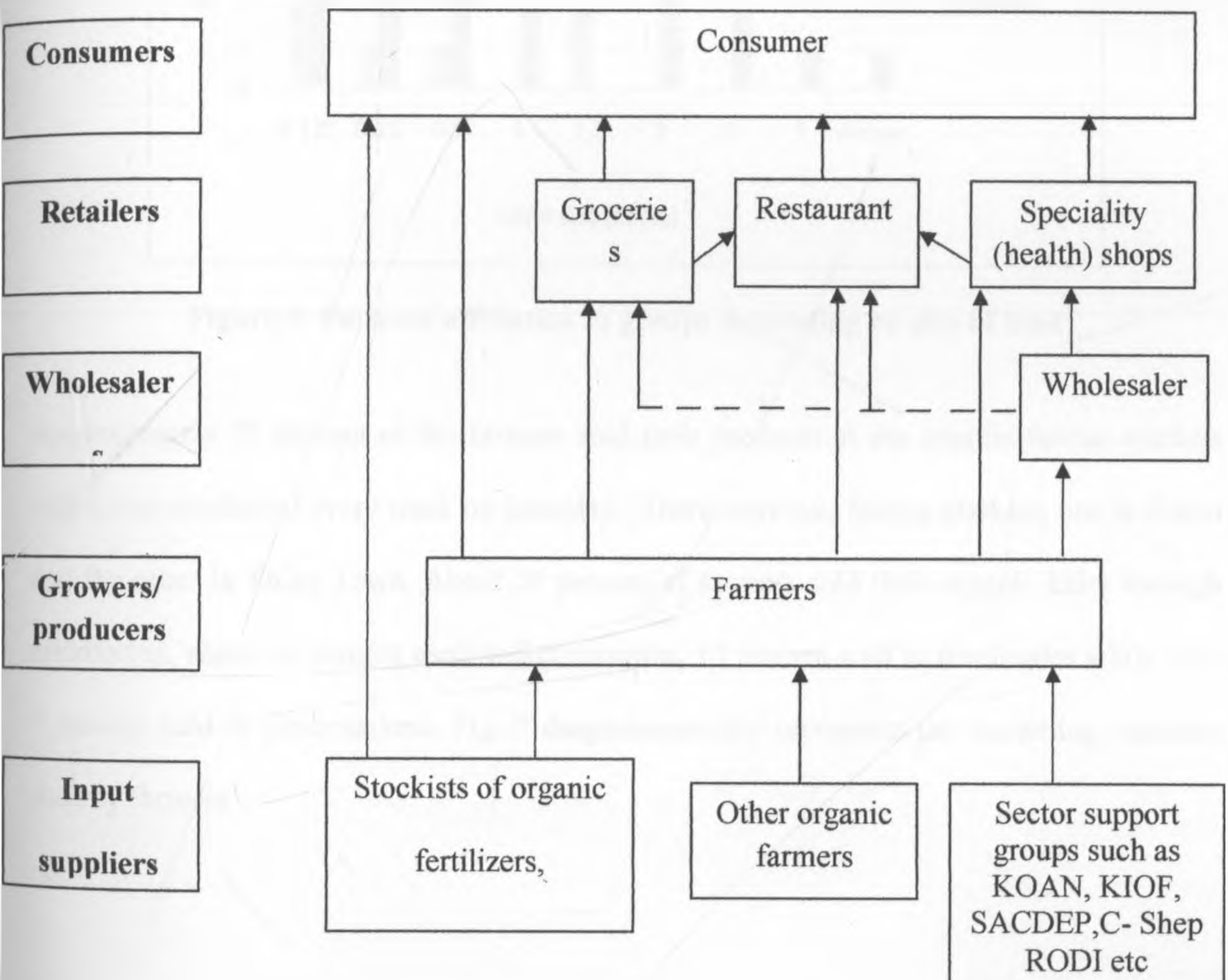

Figure 5: Organic kales supply chain in Nairobi

2.3.4 Farmers affiliation to groups and their marketing channels

Most farmers, approximately 79 percent, were in farmer groups. About a third of the farmers had farm size exceeding one acre with approximately 4 percent owning less than quarter of an acre, about 20 percent had between 0.26 and 0.50 areas. Fig 6 shows the farmers affiliation to groups based on land size.

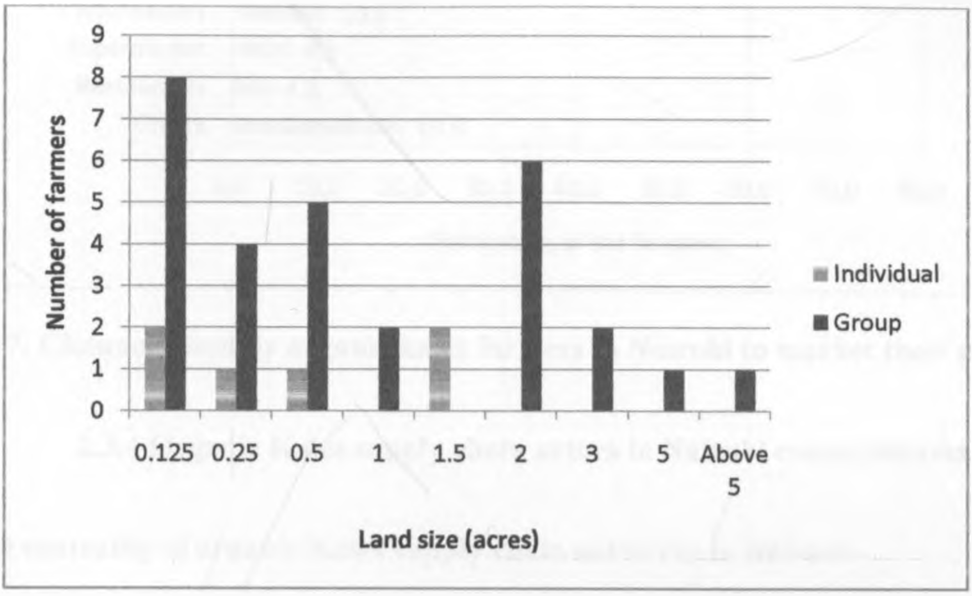

Figure 6: Farmers affiliation to groups depending on size of land

Approximately 70 percent of the farmers sold their products at the organic farmer markets which was conducted every week on Saturday. There were two farmer markets; one in Karen and the other in Thika Town. About 50 percent of farmers sold their organic kales through middlemen, about 13 percent used basket schemes, 10 percent sold to wholesales while only 7 percent sold to supermarkets. Fig. 7 diagrammatically represents the marketing channels used by farmers.

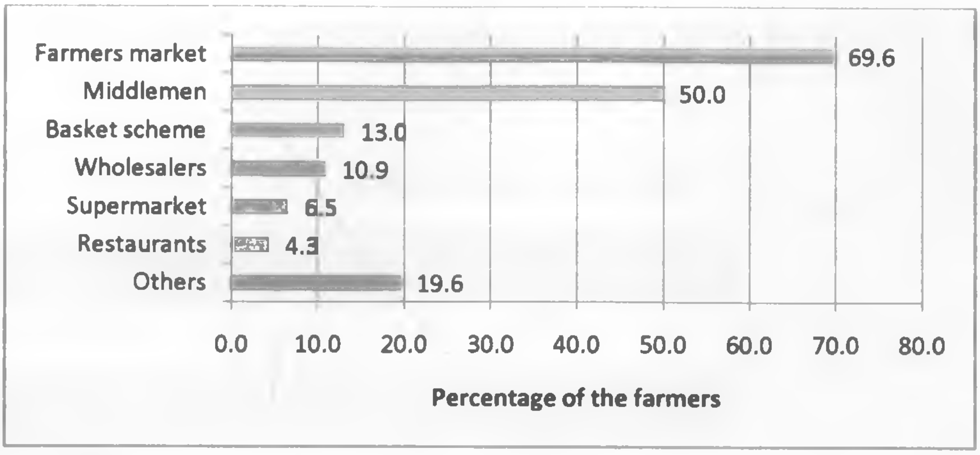

Figure 7: Channels used by organic kales farmers in Nairobi to market their produce

2.3.4 Organic Kales supply chain actors in Nairobi connectedness

a) Degree centrality of organic Kales supply chain networks in Nairobi

Based on Freeman's centrality measures, the sector support groups such as KOAN, KIOF and SACDEP, ENCERT (certifiers) and individual farmers had the greatest degrees, and might be regarded as the most influential. Traders had degree centrality value greater than 50% while the government ministries, some sector support NGOs and some food stores ranked lowest. The Freeman's degree centrality values have been expressed as percentages of the number of actors in the network, less one (ego). On the average, actors had a degree centrality of 61.2 ± 20.3% and a network centralization of 42.3%. Based on Freeman's degree centrality measures, the actors were fairly linked together. Based on Bonacich Power (beta centrality), sector support groups such as KOAN, KIOF and SACDEP were most central centrality while some retail outlets and the government ministries were least central. Table 1 shows the average degree centrality measure, its standard deviation and network centralization measure using the degree centrality measure in the organic sector.

Table 1: Overall Degree centrality values of organic Kales supply chain actors in Nairobi

	Freeman's degree centrality
Maximum centrality	100%
Minimum centrality	21.7%
Average centrality	61.2%
Standard deviation	20.3%
Overall network centralization	42.3%

b) Eigenvector centrality of organic Kales supply chain networks in Nairobi

The eigenvector centrality value was about 28, that is, the overall variation in distances that was accounted for by the actors locations in the supply chain is about 28%. About 1/3 of all of the distances among actors are reflective of the direct relationships between stakeholders. Table 2 show the eigenvector values for the first 4 factors based on the distance between actors. A direct linkage was factor 1 while factor 2, 3 and 4 were indirect linkages based on the number of actor between any two actors.

Table 2: Eigenvector factor value of organic Kales supply chain networks in Nairobi

Factor	Value	Percent	Cum %	Ratio
1	15.371	28.1	28.1	4.164
2	3.692	6.7	34.8	1.164
3	3.171	5.8	40.6	1.561
4	2.031	3.7	44.3	1.452

Based on the eigenvector centrality scores of each actor, sector support groups such as KOAN and KIOF, regulators (certification body Encert) and farmer groups were more central and had higher score of greater than 0.2. Higher scores indicate that actors are "more central" to the main pattern of distances among the actors. Lower values indicate that actors are more to the peripheral and from the results, retailers, government ministries and some farmers had a lower eigenvector centrality; hence they were at the periphery of the network structure. Table 3 shows the average eigenvector centrality values, its standard deviation and overall network centralization based on eigenvector centrality measure.

Table 3: Overall Eigenvector centrality measure of organic Kales supply chain networks in Nairobi

	Eigenvector centrality	nEigenvector centrality
Maximum centrality	0.3	40.8
Minimum centrality	0.1	11.5
Average centrality	0.2	27.8
Standard deviation	0.1	7.8
Overall network centralization	17.08%	17.08%

Based on the overall centralization (17.08%) of the graph, and the distribution of eigenvector centralities, there was relatively little variability in centralities (standard deviation 0.1) around the mean (0.2). This shows that, overall, there were not great inequalities in actor centrality or power. When centrality was measured using the eigenvector centrality; the degree of inequality or concentration was approximately only 17 percent.

2.3.5 Organic kales actors proximity

a) Node betweenness measure of organic Kales supply chain networks in Nairobi

Betweenness is the frequency of an actor's position relative to others' positions in the network. The sector had a lot of variation in actor betweenness (from 0.1 to 18.6) considering that the network had only 24 nodes. The variation was large with a standard deviation of 5.2 relative to a mean betweenness of 4.5. The overall network centralization was relatively low with an index of 5.82% which meant that most connections in the network could be made without using an intermediary, which further explains the low betweenness scores. In the sense of structural constraint, there was not a lot of "power" in this network. Sector support groups and farmer groups were relatively a bit more powerful than other actors based on this measure and were perceived to be the deal-makers who made things happen while traders such as restaurants and specialty outlets who had relatively low betweenness value were less powerful. Table 4 shows the average network betweenness centrality values, its standard deviation and network centralization value based on betweenness centrality measure.

Table 4: Overall Node betweenness values of organic Kales supply chain networks in Nairobi

	Betweenness centrality
Maximum centrality	18.6
Minimum centrality	0.1
Average centrality	4.5
Standard deviation	5.2
Overall network centralization	5.82%

b) Closeness centrality of organic Kales supply chain networks in Nairobi

Based on nearness and farness, sector support groups ranked highest while the government ministries and individual food stores ranked lowest. The average farness measure was 31.9 ± 4.7 percent while the closeness measure was 73.7 ± 11.5 percent. The network centralization based on closeness was 56.1% which is an indication that the stakeholders in the organic sector were fairly close. Table 5 shows the average farness and closeness values, its standard deviation and overall network centralization value based on this measure.

Table 5: Closeness centrality values of organic Kales supply chain networks in Nairobi

	Farness	Closeness
Maximum centrality	41.0%	100%
Minimum centrality	23.0%	56.1%
Average centrality	31.9%	73.7
Standard deviation	4.7	11.5
Overall network centralization	56.10%	56.10%

2.4 Discussion

2.4.1 Organic Supply Chain

Most of the organic produce was sold directly to consumers mostly at the farmers market, basket schemes, home deliveries, farm gate sales and through conventional vegetables market. Excess was sold to retailers (specialty outlets, groceries, restaurants and supermarkets). Only a small portion, about 7%, was sold through wholesalers. This was in contrast to Yussefi and Willer, (2003) whose study indicated that supermarket represent the most dynamic organic vegetables marketing channel in developed countries.

2.4.2 Connectedness of an actor stakeholders

Actors with high degree centrality had access to more information in the network. High degree means an actor is more active in the network and acts as the main path for information flow (Freeman, 1979). From the study, actors with high degree centrality scores included sector support groups and farmers. The major sector support groups were KOAN and KIOF. There were several other sector support groups in the network; this included SACDEP, C-shep, Rodi Kenya, COSDEP among others. They are regarded as more influential actors in the network. Less connected actors such as traders were more isolated since they had fewer connections. In this network, both the degree and eigenvector centralities had similar results.

2.4.3 Proximity of an actor to all other actors

a. Closeness centrality gives the proximity of an actor to others in a network (Freeman, 1979). It gives the sum of distances between all other nodes; distance is defined in terms of the number of links in the shortest path between two nodes. From the study, the major sector support groups such as KOAN and KIOF and farmers were in the middle/ near the middle of the network structure and required fewer connections to link to everyone in the network while most traders were at the periphery and required more connections to link to other actors. According to Freeman (1979), actors with high closeness centrality value are close to most of the other firms, and hence are able to avoid the control of others. The network centralization based on closeness centrality measure was about 56 percent; hence indications that the stakeholders in the organic kales value chain were fairly close.

b. Betweenness centrality shows an actor's importance as a connector between other actors in the network (Freeman, 1979). Based on network betweenness centrality, centralization was approximately 6 percent which was quite low. This may encourage creativity and reduce exploitation. Sector support groups were strongly linked which discouraged innovations and creativity although it facilitated information flow. An actor with high betweenness centrality can act as gatekeeper for sector related information flowing through the network (Feeley, 2000) hence posses the potential to control communication and group processes (Freeman, 1979).

2.5 Conclusion and Recommendation

2.5.1 Conclusion

The study explored the relationships among the actors in the organic value chain. This study gives preliminary data on the network structure of the Kenyan organic kales enterprise in Nairobi. From the network analysis, sector support NGOs and farmers are centrally located while traders such as restaurants, specialty shops and groceries are at the periphery. The actors are fairly connected to one another. The actors are also fairly close to one another with high closeness value, low farness and betweenness value.

Despite the fact that farmers are centrally located in the network with high centralization, most farmers are smallholders making them disadvantaged as they have limited access to information, technology, and other network resources which restricts their ability to network. These show fairly inadequate networking in organic kales networks which are a pointer to insufficient development of the sector. The centrality of individual actors varies rather considerably; hence the benefits of networking are rather unequally distributed along the organic kales value chain.

2.5.2 Recommendations

The study recommends that relations that encourage value addition of organic kales either by farmers or traders should be encouraged. Value addition and diversification will facilitate entry of organic kales and kale products into high market ends such as the tourism sector.

Farmers are centrally located in the network; this encourages their exploitation by other network actors and does not benefit from the network structure. Furthermore, most farmers are in group and have limited access to directly interact with other stakeholders. They should be provided with more information such as market information, training on food safety and quality and post harvest products handling. These will give them an opportunity to minimize their exploitation. For smallholder farmers, implementation of group activities in production, marketing and certification should be encouraged while traders should strengthen their ties with other members to improve their position to create more control and collaborations.

Chapter 3: Evaluation of the Traceability Systems in the Organic Sector Networks in and around Nairobi City, Kenya

Abstract

Information asymmetry is always present in food value chain and when it's high, it increases the imperfection which reduces trust that may compromise the safety and quality of food. Traceability has been used for information sharing and disclosure along the food value chain to address information asymmetry. The study aims at assessing the traceability systems along the organic kale value chain. A survey of certified farmers and organic outlets in Nairobi was conducted. Purposive sampling technique, based on organic certification, was used and data collected using semi structured questionnaires during the interviews. The data collected was analyzed using SPSS version 17. From the analysis, traceability along the organic kales value chain was limited since smallholder farmers had no functional traceability system. 61.5% of stakeholders had chain traceability. Presence of traceability was positively related to two factor groups, that is, organizational activities and personnel perception. Variables in the organizational activities were also interrelated and include documentation, certification by other quality management standards, training on food safety and traceability system monitoring. In addition, collective action and group activities facilitate traceability among small scale holders. Based on the findings, the study recommends strengthening of networks structure to improve information sharing and design of standard traceability systems to improve safety and quality of organic kales and kales products.

Keywords: Traceability, information flow, kale

3.1 Introduction

Food safety markets are sometimes characterized by high information asymmetry since food safety is a credence attribute. Only part of the information flows along the supply chain since product flow is normally delinked with information flow (Heyder *et al.,* 2012). Food safety and quality is a credence attribute which creates imperfections in the supply chains. Credence attributes in organic foods include production location, production process, producer identity, time of harvesting, status of organic certification, transportation and storage time and condition among others (Hall, 2010). Producers, processors and retailers are more informed about the quality than consumers (Heyder *et al.,* 2012).

Information flow is vital in food safety and quality management along the value chains. Inadequate credible product information creates imperfection that can compromise safety and quality of food products. Information asymmetry and imperfections may affect traceability effectiveness and efficiency (Souza-Monteiro and Caswell, 2010). Lack of transparency along food supply chains has created mistrust within many consumers (Coff, 2006). Adequate information exchange is a valuable asset for organizations (Sporleder and Moss, 2002).

Traceability can improve the information management along a value chain (Souza-Monteiro and Caswell, 2010), that is, within and between organic value chain stakeholder organizations. In East Africa, production and trade in organic food is certified using the East African Organic Products Standard, East African Standard 456:2007. Traceability is the ability to follow the movement of a food through specified stage(s) of production, processing and distribution (EAS 456:2007). Traceability systems enhance tracking and tracing of products and information along the value- chains. Linking traceability with the entire information flow and documentation effectively improves operational efficiencies and increases food safety and quality (Ruiz-Garcia *et al.*, 2010).

The objective of the study is to describe the traceability strategies used by organic kales farmers and traders in Nairobi's high market ends. This study will assess presence of product traceability along organic kale value- chains in Nairobi and also evaluate the factors that determine traceability along organic foods value- chains around Nairobi.

3.2 Methodology

3.2.1 Study design

The study used survey design approach that involves getting specific information on a given population at a defined time (Mugenda, 2008). The study adopted a two step study approach. The first described the organic kales supply chain while the second evaluated the traceability strategies along the supply chain.

3.3.2 Study Area

The study was conducted around Nairobi since most of the local organic markets are found around Nairobi where majority of the consumers are foreigners and affluent higher middleclass persons (Kledal *et al.*, 2008). Nairobi is largest and fastest growing city in Kenya and is the capital city of the country.

3.2.3 Sampling procedure

Stakeholders in the organic kales value chains around Nairobi were identified through a network study. Purposive sampling based on organic certification was used to identify the initial respondents. Purposive sampling involves choosing elements to sample based on certain criteria (Patton, 1990). Snowballing was conducted by asking the initial respondents to name other stakeholders in the supply chain with whom they interacted with in their organic kales enterprise. Since the total population was small, complete census was used to conduct the interview.

3.2.4 Data collection

A total of 38 organic kales farmers, 10 traders and 2 organic farmers' market officials were interviewed during the period between February and June, 2012. The data was collected using semi-structured interviews. Three sets of questionnaires were used depending on the target respondent. The survey instrument provided a guide to the interview, covering details of the traceability strategies used, presence and employee perception on chain traceability, documentation, training, monitoring and review of traceability systems, and the challenges faced during tracing and tracking organic kales. Five-Point Likert scale was adopted as the basic scale for ranking questions.

3.2.5 Data analysis

Descriptive data from interviews was used to draw inferences on the traceability systems in place (Manikas and Manos, 2008). Content analysis was used to analyze qualitative data. Descriptive statistics was used to analyze means, standard deviation, percentages, and cross tabulations. Exploratory factor analysis was used to uncover to underlying variables which influence traceability. A factor can be described in terms of the variables measured and their relative importance. Factor loading was used to calculate the correlation of the original variables to the factors to get the substantive importance of the particular variables to the factors (Field, 2000). The Kaiser-Meyer-Olkin (KMO-test) and Bartlett's test were used to check adequacy of the factor analysis. Extraction of the factors was done using the eigen values of the correlation matrix (Rietveld and Van Hout, 1993). Since some factors could be related, oblique rotation was used. SPSS version 17 was used to run the analysis.

3.3 Results

3.3.1 Response rate and respondents traceability strategies

The overall response rate was about 70 percent. Restaurant had 100% response rate, specialty shops had 83.3 percent, farmers group had 60 percent while farmers had 67.9 percent response rate. Table 6 shows the response rate for various organizations.

Table 6: Response rate for the study on organic kales supply chain in Nairobi

	Target respondents	Actual respondents	Response rate (%)
Farmers	56	38	**67.9**
Farmers groups	5	3	**60**
Specialty shops	6	5	**83.3**
Restaurants	3	3	**100**
Total	**70**	**49**	**70**

All farmers had paper based traceability systems in form of production inputs purchase and sales records while all traders had products information in soft copies. 38.5 percent of traders (specialty and restaurant) used both paper based system and computer typed in data. Paper based systems filed traceability data in hard copies while typed in data saved traceability information as soft copy. Approximately 62 percent of the respondents shared traceability information with other organizations along the chain, that is, they had chain traceability. Specialty outlets scored highest with 80 percent, followed by farmers with 67 percent while only 33 percent of restaurants had chain traceability along the chain.

3.3.2 Organizational perception to traceability

The study also aimed at establishing if organizational perception to traceability influences traceability. Majority of the respondent about 51 percent indicated that perception influences traceability to a great extent, 19.5 percent to a very great extent, 14.6 percent to moderate extent, and 9.8 percent and 4.9 percent said that perception influences traceability to a little extent and to no extent respectively. Fig 8 shows how the extent of perception on traceability influences the decision to trace and track operations.

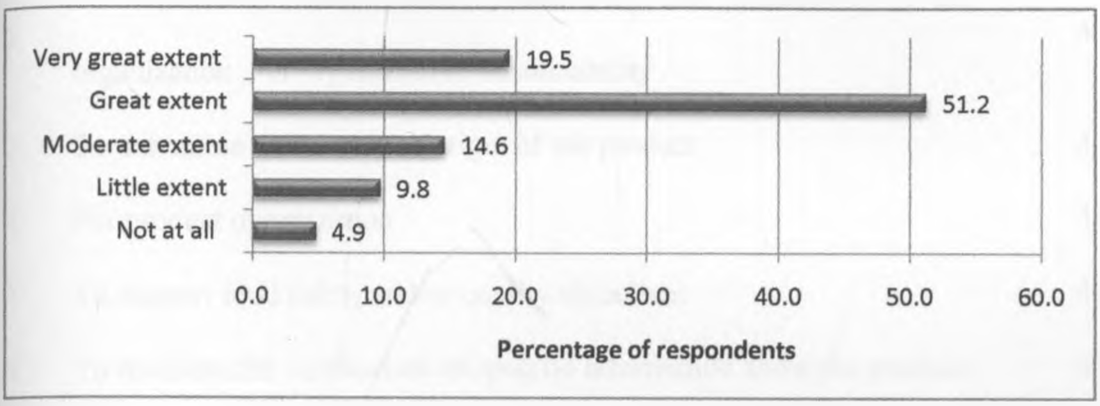

Figure 8: Organization extent perception on traceability influence on traceability

There were several reasons for tracking and tracing organic kales along the value chain. Based on a 5 point Likert scale, most respondents had a traceability system for competitive advantage. The next two reasons were for organizational sustainability and determination of the product history. All the reasons had a mean greater than 4 which shows that all the reasons were important to the stakeholders. Table 7 gives a summary of the reasons for traceability along organic kales value chains.

Table 7: Reasons for trace and track along organic kales value chains in Nairobi

	Reasons for having a traceability system	Score out of 5
1	For competitive advantage	4.85
2	To improve the effectiveness, productivity and profitability of the organization. For organizations sustainability	4.77
3	To determine the history or origin of the product	4.77
4	For product optimization	4.69
5	To support food safety and/or quality objectives	4.69
6	To facilitate the verification of specific information about the product	4.69
7	To improve bio- safety	4.62
8	To identify the responsible organizations in the supply chain	4.46
9	To meet customer specification(s) and customers demands	4.46
10	For certification	4.31
11	To communicate information to relevant stakeholders and consumers	4.23
12	To facilitate the withdrawal and/or recall of products	4.15
13	To fulfill any local, regional, national or international regulations or policies, as applicable	4.08

3.3.3 Organizations certification by other quality management standards

Most of the respondents (35.7%) indicated that certification by other quality management standards influenced the traceability strategy to a moderate extent, 21.4% to a little extent, 19.6% to a great extent while 12.55 and 10.7% indicated that certification influences traceability to no extent and to a great extent respectively. Figure 9 represents the extent certification by other quality management standards influence traceability,

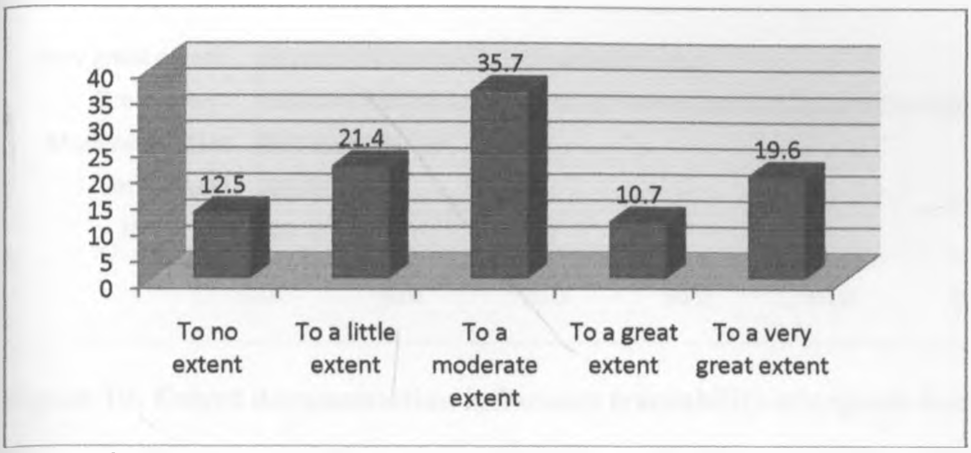

Figure 9: Extent certification influences traceability by organizations in the organic kales value chains in Nairobi

The study also reported that only 23.1% of the respondents had been certified with at least one other quality management standard. The main reason for non- certification was lack of knowledge about other quality management standards (61.5%), implementing and maintain the standards was expensive (53.8%), certification not demanded by customers (15.4%) and lack of management support (7.7%).

3.3.4 Documentation of products and processes

The study also aimed at establishing the extent documentation influences traceability. Majority of the respondents (56.1%) indicated that documentation influences traceability to a great extent, 26.8% to a very great extent. Only 9.8% of the respondents indicated documentation influences traceability to a moderate extent, and 4.9% and 2.4% said that documentation influences traceability in the hotels to a little extent and to no extent respectively. Fig 10 represents the results on the effects of the perception of documentation on traceability.

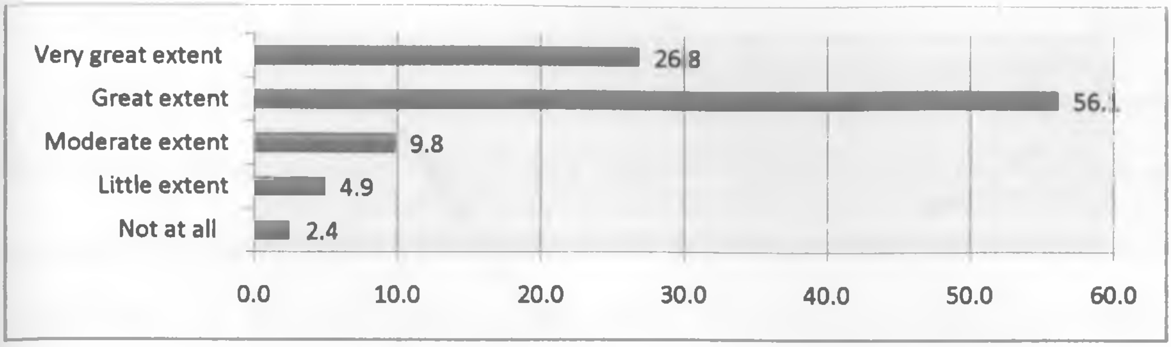

Figure 10: Extent documentation influences traceability of organic kales in Nairobi

The study also aimed at establishing the extent of documentation by stakeholders along the value chain. 92.3% of the respondents had a documentation system for their operations. All the respondents documented activities and flows along the value chain while 83% documented information about products received. Only 58.3% of the respondents documented the results of verification and audits, actions taken in case of non conformity and descriptions of the relevant steps in the chain while only 25% documented management responsibilities and document retention times. Fig.11 gives an overview of documentation by organizations along the supply chain.

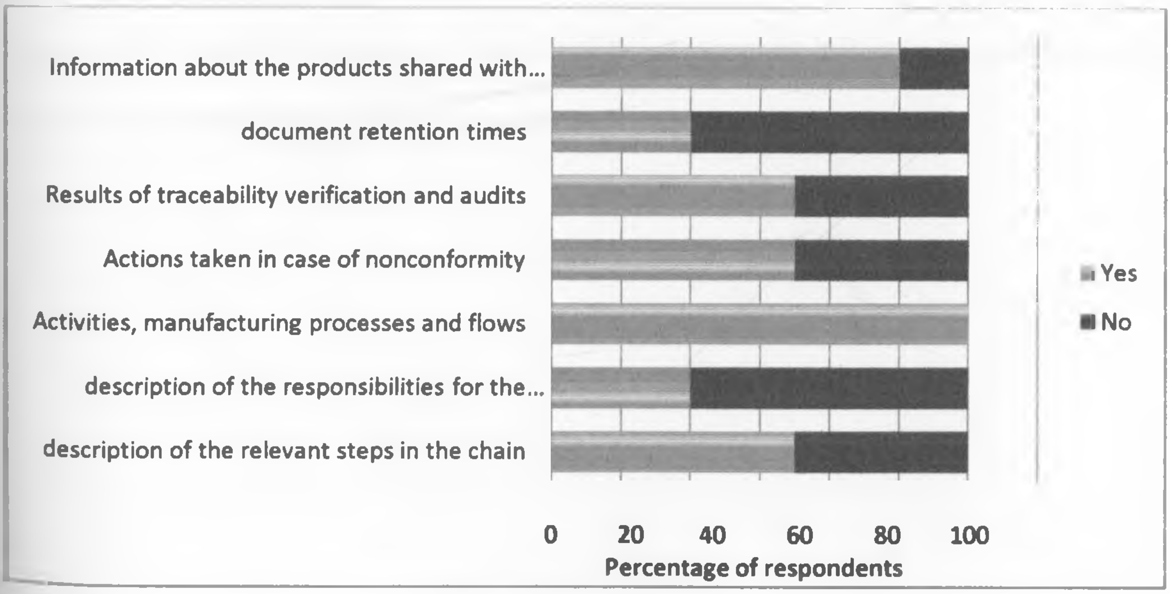

Figure 11: Overview of documentation by organizations in the organic kales supply chain in Nairobi

All farmers kept own production records to show date of planting, production input used, date of application of production input, source of production inputs and sales records of output. The group officials conduct regular field visits to ascertain compliance to production standards by members. Such a traceability system is quite unreliable and relatively slow to retrieve data. At the retail outlets, products data is keyed into software that tracks the products and kept as soft copy for centralized data management. In some cases, bar code system is used to automatically input data into the system. The software usually checks at products movements. Physical stock taking at regular intervals is used to verify the computer records. Such a system is reliable for product traceability and information can be readily and easily accessed.

3.3.5 Influence of training on food safety and quality management programs on traceability

Most of the respondent (46%) indicated that training on food safety and quality management systems influences traceability to a great extent, 37% to a very great extent, 10% to moderate extent, and 7% said that training on food quality management influence traceability to a little extent. These are diagrammatically represented in fig. 12.

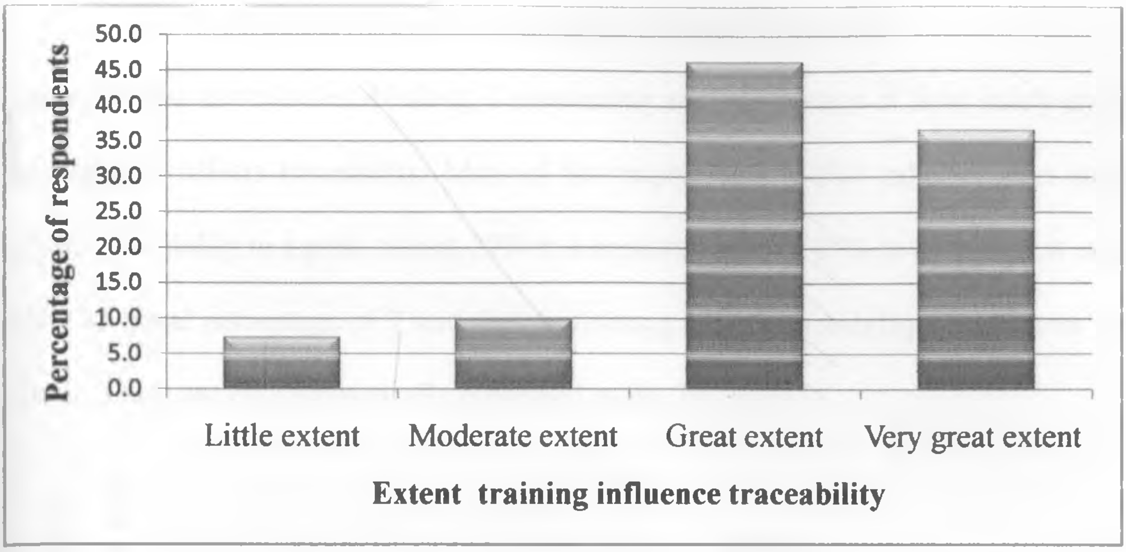

Figure 12: Extent Training influences Traceability by organizations in the organic kales supply chain in Nairobi

All farmer groups trained their group members on food safety and quality, 75% of the specialty outlets and 67% of restaurants had employee training programs. Most of the respondents (67% of farmers, 87% of specialty outlets and 67% of restaurants) were adequately trained on food safety and quality management programs. However, most stakeholders were trained on food production and safety and not traceability. Fig. 13 shows the presence of training program on food safety and quality management and presence of adequate trained staff on food safety and quality management programs.

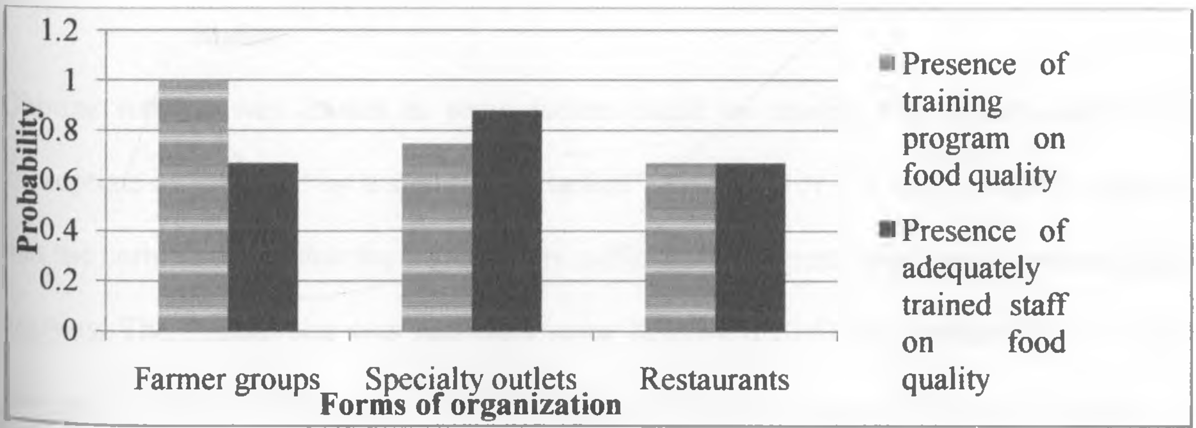

Figure 13: Influence of training on food safety and quality management programs on traceability along organic kales supply chain in Nairobi

3.3.6 Monitoring of food safety and quality systems

The study also aimed at establishing if monitoring and verification of food safety and quality management affects traceability. Most of the respondents (34%) indicated that monitoring affects traceability to a great extent, 27% to a moderate extent, 25% to a very great extent while an equal percentage of 7 said that monitoring affects traceability to no extent and little extent. These are diagrammatically presented in fig. 14.

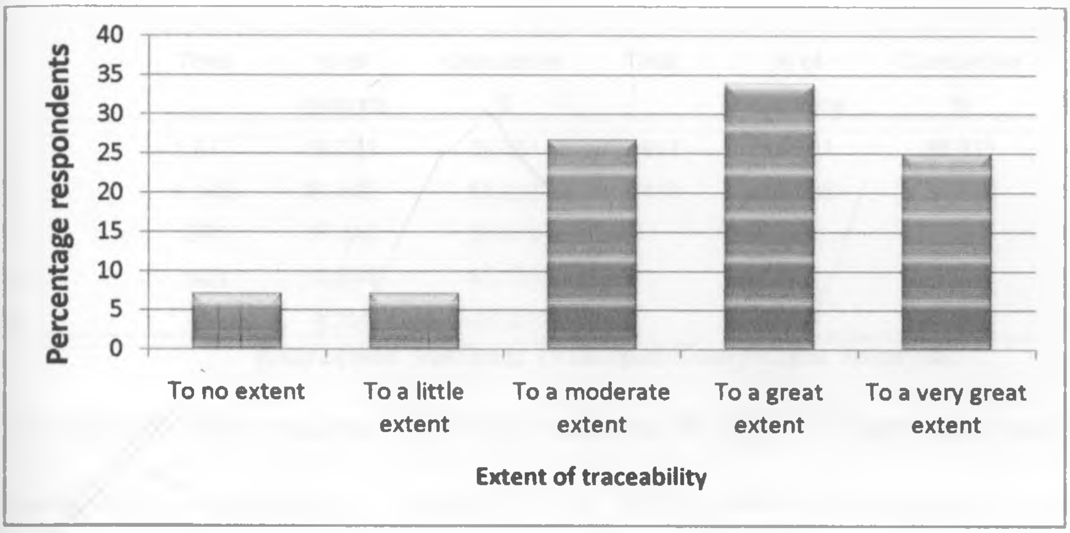

Figure 14: Effect of monitoring of the food safety and quality systems on extent of traceability of organic kales along the value chain in Nairobi

3.3.7 Factors influencing the extent of traceability in organic kales value chains

Oblique rotation was chosen as some factors could be related. The factor analysis was appropriate as indicated by a significant Bartlett's test (χ^2 (10) = 19.1, $p < 0.05$) indicating that the correlations within the R-matrix are sufficiently different from zero to warrant factor analysis. The sample size was sufficient since KMO-test (0.6) was greater than 0.5. Two groups of factors influencing traceability were extracted based on Kaiser's criterion of retaining factors with eigen values greater that one (Table 8). The relative importance of the four factors was equalized. Factor 1 accounted for considerably more variance (38.3%) while factor 2 accounted for 22.9% of the variance.

Table 8: Total variance explained by the five factors influencing traceability in the organic kales value chain in Nairobi

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	1.917	38.331	38.331	1.917	38.331	38.331	1.899
2	1.145	22.895	61.226	1.145	22.895	61.226	1.159
3	.872	17.449	78.675				
4	.603	12.064	90.739				
5	.463	9.261	100.000				

Extraction Method: Principal Component Analysis

This pattern matrix revealed two groups based on the factors. Factor group one represented monitoring, documentation, certification and training while factor group two represented perception (Table 9). Several variables loaded highly onto factor group one because the variables were interrelated.

Table 9: Pattern matrix for extent to which factors influencing traceability in the organic kales value chains in Nairobi grouped into separate components during factor analysis

Factors	**Component**	
	1	2
Monitoring	.770	
Documentation	.754	
Certification	.711	
Perception		.856
Training	.444	-.494

3.3.8 Challenges in organic kales traceability along the supply chain

Content analysis was used to analyze the challenges in traceability by stakeholders. The sector is dominated by small scale stakeholders with minimal assess to finances to implement a traceability system. There is also lack of an appropriate and rapid traceability system to trace organic kales and includes losses due to spoilage, withering and dehydration. Seasonality of organic kales also affects the tracing system. Lack of adequately trained personnel also affects traceability as they keep incomplete records.

3.4 Discussion

Traceability along food supply chains represents potential means for improving food safety and quality by smallholders. The study revealed that most organizations certified as organic had adopted product and information traceability. The organic products standard stipulates that all stakeholders should have a functional record keeping system. According to Golan *et al.* (2004), these systems should provide, to some extent, product tracing information. From the study, organic kales traceability was limited and there were variations in the information traced, the precision, depth, breadth, and accessibility to information by other members in the supply chain which had an impact on chain traceability.

Traceability system effectiveness is a factor of its ability to transfer necessary information along the chain (Bertolini *et al.*, 2006). Most of the systems at primary production level were paper based, had no rapid response and were inefficient. Traceability systems by the traders were mostly computerized had rapid response which enhanced information flow hence were fairly effective.

Traceability strategies were influenced by two factors which are correlated. Variables in the first factor, that is, monitoring, documentation, certification and training were physical and represented the organizational activities during traceability. The second group was based on subjectivity of the personnel, that is, their perception to traceability. In addition, the variables in the first group, that is, monitoring, documentation, certification and training were interrelated. This was in line with previous research (Gawron and Theuvsen, 2009). Similar results were also found in terms of personnel perception that traceability as being important will positively determine the extent of traceability (Pouliot and Sumner, 2008; Heyder, 2012). Organizational activities such as certification by other quality management standards (Gawron and Theuvsen, 2009), documentation and labelling (Raynaud *et al.*, 2009) have a positive effect on traceability.

About three-quarters of the respondents had a positive perception on traceability which is similar to previous research (Heyder, 2012). Certification by quality management standards other than East African Organic Products certification is non mandatory. However, as indicated by Maldonado-siman *et al.* (2012), organizations operating under these standards have been reported to have implemented better traceability and quality verification system. 35.7% of respondents perceived that certification by other quality management standard influence extent of traceability although only 23% were certified with other food safety and quality management standards.

As reported by previous research, the main challenge to traceability is the high cost of implementing a traceability system (Xiaoshuan *et al.*, 2010). Personnel were inadequately trained on traceability. In addition, there was no standard rapid traceability system in the organic kales sector hence stakeholders relied on production and marketing records to trace their products.

3.5 Conclusion and Recommendation

3.5.1 Conclusion

The study explored how stakeholders conduct traceability in the organic kales networks. Traceability along organic kales value chain was limited; labeling and use of lot/ batch numbers was used by only a few traders. The basic information traced included primary production characteristics, product quality and identity of immediate actors upstream and downstream the chain. Majority of the stakeholders had no external/ chain traceability strategies to transfer information along the value chain. At the primary production level, group affiliation enhanced traceability through implemented information verification, monitoring and audit systems by group officials.

Traceability depends on two factor groups that are interrelated. Factor group one represented the organizational activities such as monitoring of food safety and quality systems, documentation, certification with quality management systems and training on food safety while factor group two represented perception of stakeholders to traceability. The factors had positive effects on each other and improving one improved the rest and enhanced traceability. The main challenges to traceability is the perceived high cost of implementing a traceability system by smallholders who are the majority, lack of rapid and effective traceability system that will incorporate losses due to dehydration and spoilage and inadequate knowledge on food traceability.

3.5.2 Recommendations

The basic traceability information that needs to be transmitted among stakeholders includes the name of producer, time of harvesting, product characteristics and product batch number. The system should facilitate information transfer along the supply chain for detailed information retention by suppliers for easier and more rapid access by all stakeholders along the chain when need arises. The system should incorporate losses from dehydration and spoilage. Identification tags and proper labelling with adequate product and process information should be used to identify and differentiate products from different farmers and/ or traders at the traders' outlets. Emphasis should be on the two factors that affect traceability. Variables affecting the first factors are interrelated and each variable affects the rest; improving one variable has a positive effect on the other variables and hence the factor. The two factors are further related; hence improving organizational activities such as monitoring, documentation, certification and training which form the first factor improves perception. Collective/ group activities such as training, design and implementation of traceability system, certification with other quality management systems, monitoring, documentation and training are more cost effective if done collectively since the major challenge to traceability is the perceived high cost to set up a traceability system.

Chapter 4: General discussion, conclusions and recommendations

4.1 Discussion

The study revealed that traceability information flow is dependent on the network structure which was similar to previous research (Feeley, 2000). Actors with high closeness centrality are likely to perform better in tasks that require integrating information. Actors with more ties (high degree centrality) exchange more information to a point that that information has an impact on other things such as safety and quality. Stakeholders linked to well connected actors (high eigenvector centrality) have even more information than the actors connected to an equal number of less connected ties. Stronger linkages among stakeholders in the organic vegetables subsector could facilitate to harmonize activities, eliminate duplication and exploit synergies in implementation of safety and quality during production and marketing.

The network centralization is fairly high with degree centrality of 61.2 percent and closeness centrality of 73.7 percent. This facilitates information flow which is a prerequisite in traceability. Farmers have the highest degree centrality; this may encourage information flow although it may cause encourage exploitation to farmers by other network actors and limits their access to network information. This may increase information asymmetry along the chain hence affect traceability.

At the primary production level, most farmers use paper- based records to track and trace their products. There was incomplete record keeping by farmers, no coding, and no use of batch numbers or labeling of kales by farmers. The relatively high connections among stakeholders thereby facilitate information flow and traceability. Most of the organic kales farmers market their products directly to consumers using basket schemes, at the farmers' markets and farm gate. 67% of farmers shared traceability information with consumers and traders. 79.8% of the farmers were in groups which have well designed monitoring schemes.

The farmer groups' officials conducted regular field visits to primary producers' farms to monitor and verify production procedures. In addition, group activities and collective action by farmers facilitate chain traceability. Two factor groups influence traceability; factor group one represents organizational activities which encompassed monitoring, certification, documentation and training while factor group two was personnel perception to traceability. The two factor groups were interrelated and the factors in the groups were positively correlated to one another.

At the traders level (specialty outlets and restaurants), most systems were computerized. This provided more rapid trace and track of products. Most of these systems were designed for stock management thereby facilitating flow of basic product and process traceability information. The computerized system coded the vegetables into batches/ lots depending on name of immediate supplier, time and date of delivery and product characteristics.

The main challenges to information flow is the perceived high cost of implementing a traceability system since most stakeholders are smallholders, lack of rapid and effective traceability system that incorporates losses due to dehydration and spoilage and inadequate knowledge on food traceability. Organic kales traceability is positively dependent on positive perception, adequate documentation, certification by other quality management standards, training, and monitoring and review of food safety and quality systems in place.

4.2 Conclusion

The organic kales value chain networks are fairly networked. This creates trust which facilitates transfer of basic product information among stakeholders. The basic information traced included product characteristics, product quality and identity of immediate actors upstream and downstream the chain. For fresh produce, full traceability requires farming and distribution information. Distribution information includes lot and packaging information.

There is adequate traceability of distribution information. However, production information traceability is limited since most farmers have incomplete farm records. Production and distribution information traceability of organic kales depends on the network structure. Traceability depends on variables in two factor groups. Factor group one were the organizational activities such as monitoring, training, certification and documentation. All these variables were interrelated. Factor group two was the personnel perception to traceability which was subjective. All these factors had a positive influence on one another.

The value chain is fairly networked; more networks should be developed and strengthened to facilitate information flow between stakeholders to improve product safety and quality. In addition, trade and sector support groups especially NGOs should be strengthened to encourage information transfer which will minimize exploitation thereby improve safety and quality of organic kales.

4.3 Recommendations

1. Sector supportive measures and incentive structures are needed to encourage more formal sector participation in the organic products traceability. Provisions to improve institutional support should be made,
2. Design of a traceability system that will enhance sharing information among stakeholders. This system should incorporate losses, both normal and abnormal losses, such as dehydration and spoilage. For full fresh vegetables traceability, the systems should adequately transfer production and distribution information. Stakeholders (including farmers) must receive product and process information from others and sector support organizations to effectively participate in the market.

4.4 Recommendations for further research

1. Opportunities and constraints faced by stakeholders as a function of an actor's position in the supply network. For example, impact of the number of ties on performance.
2. Design of an information system for use in the organic sector that will include group activities.

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Appendices

Network Analysis Questionnaire: Kales Traders (Groceries, speciality shops and restaurants)

1. Of your total sales, account the proportion accountable to sukuma wiki?

   [1] 0% -20%
   [2] 21% - 40%
   [3] 41% - 60%
   [4] 61% - 80%
   [5] 81% - 100%

2. What quantity/ volume of sukuma wiki did you sell last month? *In Kgs/ bags*
3. To whom do you sell sukuma wiki? *If possible, indicate percentages for each?*
   (i) Large firms...
   (ii) Small firms...
   (iii) Wholesalers...
   (iv)Exporters...
   (v) Retailers...
   (vi)Direct to consumers...
4. To what extent is the strength for organic sukuma wiki markets?
5. Who are your main suppliers for sukuma wiki? *Including sukuma wiki transporters. If possible, indicate percentage supplied via this channel*
   (i) Large firms...
   (ii) Small firms...
   (iii) Wholesalers...
   (iv)Importers...
   (v) Retailers...
   (vi)Direct from producers...
6. Who provides you with sukuma wiki market information and market assistance?
7. Who provides you with sukuma wiki suppliers' information?
8. Which other stakeholder do you interact with? *Name of person/ organization*

   Sector support NGOs...

Competitors...

Government officials (ministry extension officers)..

Financing/ credit...

Infrastructure...

Media (newspapers, magazines, internet)...

Processors...

Regulators...

Certifiers...

9. What challenges do you face in organic sukuma wiki business? *How do you address them*
10. What do you think are the main opportunities in marketing organic sukuma wiki?

Network Analysis Questionnaire for farmers

1. Were you certified as an individual organic farmer or as a group?
2. If certified as a group, what is the name of your group?
3. What is the size of your farm that is certified organic?
4. Source of information for specialized techniques?
    (i) Local price of your products
    (ii) Price at end market
    (iii)Quality requirements
    (iv)Best place to sell your products
    (v) Potential buyers
    (vi)Production in other areas
5. How do you market your products?
6. Who are your major suppliers?
7. Who are your customers?
8. Who are your major extension service providers?
9. Who else provides information?
10. Who provides marketing and business support services?

Questionnaire for Traceability systems analysis

1. Do you track and trace your operations? Yes/ No ___

2. How do you track and trace kales and kales products?

Trace and track	Products
Paper records	
Typed in data	
Bar codes	
Radio Frequency Identification	
E- exchange	
Others (specify)	

3. Do you record and maintain the name of the firm, address, telephone number, and e-mail address of the transporter's immediate previous source? Yes/ No ____
4. Do you record and maintain the name of the firm, address, telephone number and e-mail address of your suppliers? Yes/ No ____

5. Do you share the trace and track information with any other organization? Yes/ No _____

Perception

6. In your own opinion, to what extent do you think the organization's perception towards traceability affects traceability?

7. Why do you trace and track your products? Rank the reasons on their importance. 1 being the least important reason while 5 being most important?

Reasons for tracking and tracing	1	2	3	4	5

	Very	Not	Not sure it's important	Somehow	Very
a) to support food safety and/or quality objectives					
b) to meet customer specification(s) and customers demands					
c) to determine the history or origin of the product					
d) to facilitate the withdrawal and/or recall of products					
e) to identify the responsible organizations in the supply chain					
f) to facilitate the verification of specific information about the product					
g) to communicate information to relevant stakeholders and consumers					
h) to fulfill any local, regional, national or international regulations or policies, as applicable					
i) to improve the effectiveness, productivity and profitability of the organization. For organizations sustainability					
j) for certification					
k) for competitive advantage					
l) improve bio- safety					
m) for product optimization					

Certification by other food safety and quality management standards

8. In your own opinion, to what extent does certification by other food safety and quality management standards influence traceability?

9. Are you certified with any other quality management standard such as ISO 9000, ISO 14000, ISO 22000, ISO 22005 or BS OHSAS 18000? Yes/ No ____

10. If No, why not:

Reasons for not being certified	**Tick where applicable**
Do not know about quality management standards for foods	
Cost of certification	
Quality certification not demanded by the customers	
Other reasons (specify)	

Documentation

11. To what extent do you think documentation influence traceability?

12. Do you have a documented flow of materials within the organizations control? (Yes/ No)___

Does the documentation include?

		YES	NO
6.1	description of the relevant steps in the chain		
6.2	description of the responsibilities for the management of traceability data		
6.3	Activities, manufacturing processes and flows		
6.4	Actions taken in case of nonconformity		

6.5	Results of traceability verification and audits		
6.6	document retention times		
6.7	Information about the products shared with transporters		

Training

13. In your own opinion, to what extent does training on food safety and quality management influence traceability?

14. Does the organization have a training plan on trace and track system? Yes/No__

15. Are the personnel who can affect the track and trace systems adequately trained and informed? Yes/ No____

Monitoring

16. To what extent do you think monitoring affects traceability?

17. Does the organization monitor its systems for tracking and tracing? Yes/ No _____. If yes, give details of the monitoring scheme

18. Which are some of the challenges that you face during tracing and tracking

19. How do you address these challenges

20. Do you think there is another potential way to address these challenges? If yes, give details