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Vertical market linkages between smallholder African indigenous vegetables farmers and other market actors in Bungoma County

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The study aimed at determining the vertical market linkages that exist between smallholder African indigenous vegetable (AIV) farmers and other actors in Bungoma County, Kenya. Multistage sampling was employed to identify a sample of 384 respondents. Primary data collection was accomplished through observations and interviews using a pretested semi-structured questionnaire. Data were analyzed using STATA. The results indicated that African nightshade was the most commonly produced AIV at 73.9%, followed by cowpeas at 68.8%, spider plant at 63.3%, jute mallow at 34.4%, and vegetable amaranth at 21.9%. Smallholder AIV farmers had links to various market actors such as retailers, wholesalers, processors, and final consumers. However, these farmers also faced several challenges including transaction uncertainties, limited access to market information, and high transaction costs. Thus, there was a need for vertical market linkages in order to increase the competitiveness of AIV producers in the market. Vertical market linkages in Bungoma County mainly consist of producer-final consumer (98.7%), producer-retailer (91.7%), producer-processor (29.2%), and producer-wholesaler (19.8%) linkages. The producer-retailer and other vertical market linkages were predominantly informal, encompassing 94% of the total. Farmer-processor linkages, however, had a higher proportion of formal (11.9%) relationships. AIVs are popular in local Kenyan cuisine and this provides a major source of income for smallholder farmers. The informality of the relationship between farmers and market actors is a time-saving and less-complex option. Establishing community-based organizations and associations can improve access to formal markets and facilitate sourcing in large quantities at regular intervals.

Key words: Vertical market linkage, African indigenous Vegetables, smallholder farmers, market actors.

INTRODUCTION

Agricultural products in Africa reach the market through various formal and informal means, embedded in the

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relationships that smallholder farmers cultivate with other market actors, forming vertical market linkages. African Indigenous Vegetables (AIVs) are regarded as crop vegetables that originated naturally in Africa, whose roots, fruits, or leaves are used and largely accepted by local and rural communities and, increasingly, in urban and peri-urban communities through habit, custom, and tradition (Muhanji et al., 2011). In Kenya, over 200 different species of AIVs (Bokelmann et al., 2022) are grown on 45,099 ha, with a total production volume of 224,751 MT worth \$56,215,149 annually (Alulu et al., 2020). The most widely produced AIVs in Kenya are African nightshade and cowpeas (Kebede and Bokelmann, 2017), along with spider plants, vegetable amaranth, black nightshade, cowpea, jute mallow, and pumpkin leaves (Riziki, 2018). AIVs are produced mainly by rural smallholders in Western Kenya, particularly in Kisii, Kakamega, Nakuru, Kiambu, and Kajiado Counties. Peri-urban areas also account for over 10% of the total national production of African nightshade in Kenya (Kebede and Bokelmann, 2017). AIVs have become increasingly popular in cities due to their nutritional value, compared with other leafy vegetables (Henze et al., 2020). However, they are mainly consumed by people living in rural areas; accounting for about 90% of the total locally produced vegetables in Kenya (Mahlangu et al., 2020). AIVs are largely supplied to urban areas through informal and formal markets (Bokelmann et al., 2022). This trade is typically carried out by women, and is often influenced by the perishability, price, quantity, seasonality, product, and geographic specialization of the AIVs (Riziki, 2018). AIVs are largely marketed while fresh across vegetable species, destinations, and location. Rural dwellers prefer buying AIVs from local open-air markets while urban dwellers prefer green food markets (Bokelmann et al., 2022). Most of the AIV smallholders' farmers prefer selling their AIVs produce in open air markets due to immediate payments while some farmers prefer right from the farm marketing due to the accessibility to buyers (Riziki, 2018). Most AIV markets activities starts very early in the morning and remain active throughout the day (Bokelmann et al., 2022).

The market forces of supply and demand of AIVs determine the prices of the products but the prices drops in the rainy season and goes up during the prolonged dry weather (Bokelmann et al., 2022). Over 35% of AIV producers in Kenya produce for commercial purposes, and only 30% of the total AIVs produced in Kenya is marketed (Krause et al., 2019). This implies low levels of commercialization of AIVs in Kenya. Barriers to the marketing of AIVs include market distance that is attributed to perishability of products; variation of the market charges due to seasonality plus opportunistic market behavior deprives farmers of profits (Bokelmann et al., 2022). AIV marketing is affected by lack of reliable market information, lack of price setting mechanism, high transaction cost, transaction uncertainty, high

perishability, inadequate market linkages and high post-harvest losses due to lack of storage facilities (Agbugba et al., 2011). AIV farmers face challenges due to limited access to markets information on prices and new technologies, they lack linkages that connects them with other market actors, due to the to this they incur high transaction costs and face challenging credit constraints (Wabwoba et al., 2015). In order to overcome the barriers to commercialization, a multidimensional approach that involves increasing smallholder farmers' access to sustainable markets is required (Musotsi and Onyango, 2018). This can be achieved through close vertical market linkages between farmers and other market actors (Musotsi and Onyango, 2018). Vertical market linkage refers to closer vertical coordination that exists between specific players in the supply chain as the agricultural sector moves from commodity spot markets towards a tighter, more specified linkage (Momanyi, 2016). Vertical market linkages are the relationships that exists between actors with adjacent roles within the value chain, as product or services is improved or services added through the chain (Kibuchi, 2017). Vertical market linkages connect farmers to lucrative markets which imply that farmers are made better off with production and marketing risks addressed thus contributing to resilience building. Vertical market linkages enable farmers to bounce back to normal or better position after facing shocks (Musotsi and Onyango, 2018). Vertical market linkages enhance information sharing on market prices, and consumer changes, enhancing timely delivery of the products and enhancing desired product quality and quantity thus transaction costs reduction (Thongrattana, 2012). In Kenya vertical market linkages reduce uncertainty and information asymmetry and influence performance of producers (Kibuchi, 2017). Studies in relation to AIVs in Kenya have largely focused on production, marketing, consumption, income, and nutritional benefits of AIVs. Specifically, they have focused on production practices, structure, conduct and performance of AIV markets, marketing channels and outlets and the role of AIVs towards improving, food, income, and nutrition security. Limited studies have had scanty discussion about vertical linkages within the AIV value chain. Besides, however, smallholder AIV producers are not connected to actors beyond their local community.

This paper is aimed to providing understanding and facilitating vertical market linkages that is required to provide information access on high value markets. AIVs smallholder farmers need the transformation of AIVs production particularly focusing on vertical market linkages in the AIVs supply chain.

This expansion will provide new channels for AIVs commercialization in Bungoma County. Therefore, there is a need to evaluate the different vertical market linkages in terms of the types that exist, their nature and actors involved.

LITERATURE REVIEW

Production of African Indigenous vegetables

African Indigenous vegetables (AIVs) are traditional vegetables that are African native in nature that have been grown and consumed by local communities for century (Mugwagwa et al., 2020). Some popular AIVs in Kenya include amaranth, spider plant, cowpeas, and nightshade. Kebede and Bokelman (2017), Just in few years ago there has been renewed interest in the production and consumption of AIVs in Kenya, as they are highly nutritious and have the ability to contribute to improve food security and income generation, more specifically for smallholder AIVs farmers. The production of AIVs in Kenya can be categorized into two groups which are traditional and commercial production. Traditional production involves smallholder farmers who grow AIVs for subsistence purposes or for the sake of locally marketing using traditional farming methods. On the other hand, commercial production involves smallholder farmers who are fully oriented for production for marketing (Oloo et al., 2013). African Indigenous Vegetables are produced by rural smallholders largely in Western Kenya and other parts of the country. They are produced in Kisii, Kakamega, Nakuru, Kiambu, Kajiado among others others (Kebede and Bokelmann, 2017). However, AIVs are mainly produced on a subsistence basis (Bokelmann et al., 2022). In most cases, they are intercropped and rarely occupy a significant proportion of the farm occupying areas around the house (Oloo et al., 2013). Traditional production of AIVs in Kenya is typically characterized by low inputs and low yields, with farmers relying on rainfall and natural soil fertility. However, there has been a push to improve traditional production methods through the use of improved seeds, irrigation, and organic fertilizers to improve AIVs production. According to Kebede and Bokelman (2017), the most widely produced AIV in most of the areas in Kenya is African nightshade and cowpeas produced by over 72 and 48% of smallholder farmers respectively. This has led to increased yields and improved incomes for small-scale farmers. According to Alulu et al. (2020), Commercial production of AIVs in Kenya in early stage but there has been increased investment in recent years. Modern agricultural farming such as good agricultural practices is being used by smallholder AIVs farmers to produce AIVs for marketing in locally and international markets. This has created a new impact in income generation among smallholder AIVs farmers and increased in nutrition benefits of AIVs among households (Agbugba et al., 2011). The production of AIVs in Kenya is a growing sector that contributes directly to food security contribution and generation of improved income for smallholder AIVs farmers. Both traditional and commercial production methods have their advantages, and there is a need for continued investment and support to ensure the sustainable growth of the sector

Marketing of African indigenous vegetables in Kenya

According to Muhanji et al. (2011), AIVs are largely sold in informal markets that are either undesignated areas near farming communities or in peri-urban areas where door-to-door and roadside markets do exist. They are wet spots where formal partnership between suppliers and buyers exists with very few or no transaction documents. These markets are characterized by several market players, lacking market information and formal market institutions. Some traders who are linked to farmers buy AIVs at farm gate or collection centers and sell to informal markets in the neighboring counties and small vegetable vendors in Nairobi. Mahlangu et al. (2020) assert farmers sell their products to three output markets, namely, locally, and neighbouring villages, and in towns. The decision to participate in either of the markets largely depends on factors such education level of the farmers, farming experience, gender, price offered, skills, age, rural or urban location, language, physical well-being, marital status, the profitability of the market, distance to the market, land ownership, source of labour, family size, farming experience, and farm size (Mahlangu et al., 2020; Omotayo et al., 2020). Literature does not differentiate the kind of roadsides where AIVs are sold, thus it is difficult whether the roadsides in question are tarmacs, feeder roads, murrum roads nor highways. According to Mahlangu et al. (2020), most farmers sell their produce while still fresh while a small percentage sell dried AIVs. Dried products attract higher prices compared to fresh ones due to the additional processing and packaging. They also noted that most of the farmers set their prices based on the prevailing market prices with a few agreeing to the prices dictated by the buyers. The prices of AIVs in Kenya vary across different locations but range between Ksh 10 and Ksh 15 per bunch (Muhanji et al., 2011). In addition to not knowing the price of value added AIVs, the exact percentage of AIV farmers who add value to their produce is still lacking. The different mechanism through which value is added to AIVs equally needs to be explored. The estimated average volume of AIVs handled annually in Kenya is 9,000 tonnes, with cash income earnings of about Ksh 80 million in informal markets and Ksh 150 million in formal markets (Muhanji et al., 2011). The volume handled is determined by the number of producers who supply the produce, the size of the plots, the production period/ season and production techniques employed by the suppliers. The impact of the socio-economic characteristics of AIV producers has not been considered as to how it affects the volume of AIV marketed throughout the year. The type of AIV marketed in either informal or formal markets or both needs to be specified.

Vertical market linkages that exist in agriculture

Vertical market linkages refer to market and non- market

relationships between firms operating at different levels of the value chain (Odunze, 2015). According to Pingali et al. (2019), Vertical market linkages are modes of exchange in which producers and buyers bypass existing marketing channels to assure the supply of quality agricultural goods, in demanded quality at a stipulated time. Vertical market linkages represent channels for the transfer of learning, information, and technical, financial, and business services from one firm to another along the chain (USAID, 2021). According to Uddin et al. (2010), vertical market linkages refer to how the structure of producers, processors and retailers are organized in the food supply chain so that each successive stage in the production, processing and marketing of a product is appropriately managed and interrelated. The nature of the relationships and the efficiency of the transactions among firms that are vertically linked in a value chain affect the competitiveness of the entire industry. However, the specific effect of vertical market linkages on the effectiveness of commercialization of AIVs in Kenya is not known. According to Odunze (2015), the relationships between buyers and their suppliers are often indicative of the larger economic order and closely related to the relative size and resources of each player. There are vertical market linkages between farmers and other market actors, traders, processors, agrifood companies, and retailers (Zhang, 2014). The most common forms of vertical market linkages according to Odunze (2015) include contract farming, production contracts and marketing contracts. Contract farming is a contractual arrangement between producers and buyers of a farm product. The contract can either be oral or written, and will specify one or more conditions of production and marketing of an agricultural product. A marketing contract is an agreement between a contractor and a grower that specifies some form of a price or pricing system and outlet ex ante. Production contracts are more extensive forms of coordination and typically include detailed production practices, inputs supplied by the contractor, specifications regarding the quantity and quality of a commodity and a price or pricing system. Contractors between AIV smallholder farmers may be with supermarkets, processors, or hotel, restaurant, and institutional buyers. Other forms of vertical linkages include franchising, strategic alliances, joint ventures, and full vertical integration (Hobbs and Young, 2000). The studies reviewed largely focus on high level vertical linkages such as joint ventures, alliances and franchises, there is need to understand the informal vertical linkages that exist within the AIV supply chain. A key issue to ponder about is which type of vertical market linkage is better for smallholder farmers on behalf of their interests while helping them to access markets (Zhang, 2014). Odunze (2015) argues that vertically linked farmers can access markets that were formerly out of reach for them. She added that vertical linkage is linked with increased incomes, reduction in the risk of price fluctuations,

opportunities for lending to farmers who would otherwise be ineligible for credit. Other advantages are timely provision of inputs and products to markets; managing the productivity of smallholder farmers; reducing their risk in the event of crop failure; improved awareness of the need for collective efforts for farmers' common good; and promotion of group and farmer association development. Vertical market linkages are equally associated with improved food security, which results from adoption of improved husbandry methods, improved access to extension advice and other technical assistance that would, otherwise, not be available to farmers under normal circumstances. Production contracts offer support such as the provision of credit, technical assistance and/or transportation. There is still need to understand extra benefits and support received by producers engaged in vertical linkages specifically focusing on AIVs.

Importance of vertical market linkages

Vertical market linkages in agriculture play a crucial role in ensuring the efficient functioning of the entire value chain, from production to consumption. The benefits of Vertical linkages has been experienced through lowering interest rate in the informal credit market and ensures better borrowing terms (Chaudhuri and Dwibedi 2014). Kibuchi (2017) reveal that vertical market linkages would enhance the sharing of information on market prices, consumer changes, thus reducing the need to inspect quality and enhance delivery of products on time in the quality and quantity desired. Young and Hobbs (2000) argue that vertical market linkages reduce transaction costs, uncertainty, and information asymmetry. Sharing of accurate and timely as well as relevant information reduces the need for buyers to monitor supplier deliveries and quality of inputs as well as reduce the need to enforce penalties in the case of lower quality inputs (Cuong et al., 2011). Vertical market linkage relationship is associated with improved product quality which ultimately rewards supplier involvement in quality (Hansman et al., 2020). Vertical relationships are important in moving knowledge and benefits down the chain chain (Korir, 2018). According to Pingali et al. (2019) vertically coordinated markets where the intermediaries are bypassed and transaction costs are reduced mitigate supply risks and establishment of grades and standards. According to Cuong et al. (2011) other key benefits of vertical market linkages agriculture include: Improved productivity through ensuring access to modern technology, inputs, and services such as credit, extension, and training which increase smallholder farmers' productivity and efficiency, leading to higher yields and better-quality produce. Another benefit is quality control which enables smallholder farmers and processors to ensure the raw materials meet the quality standards required for processing. Therefore, there is

need to understand how factors affecting commercialization are mitigated by an individual's participation in vertical linkages.

Challenges facing vertical market Linkages

While vertical markets linkages can offer many benefits, but they also come with several challenges (Kibuchi, 2017). Some of the key challenges facing vertical market linkages include: Information Asymmetry, this occurs when one party has more or better information than the other. This can be a challenge in vertical market linkages, as firms in different stages of the supply chain may have different levels of information about demand, pricing, and production costs (Kibuchi, 2017). This can lead to inefficiencies and misaligned incentives. Coordination is also another challenge between firms in different stages of the supply chain; each firm has its own goals, priorities, and strategies. This can create conflicts that need to be resolved to ensure smooth operations and optimal outcomes for all firms in the supply chain. Power Imbalances can also be a big challenge between firms in different stages of the supply chain. A large retailer may have more bargaining power than a small manufacturer, which can lead to unfair pricing or other practices. This can also affect innovation and investment decisions, as the more powerful firm may be able to dictate terms. Also risks and uncertainties can also be created by vertical markets linkages between firms in the supply chain. For example, a sudden increase in demand may lead to stockouts if the manufacturer is not able to ramp up production quickly enough. Similarly, a shift in consumer preferences or economic conditions can lead to changes in demand that can be difficult to predict (Mugwagwa et al., 2020). According to Sniazhko (2019), technological Change also poses challenges to firms, advance in technology can create challenges for vertical market linkages. The rise of e-commerce has disrupted traditional retail channels, forcing manufacturers and distributors to adapt to new ways of selling and distributing their products. Therefore, while vertical market linkages can offer many benefits, they also require careful management to ensure that they function effectively and efficiently for the benefits of smallholder farmers.

MATERIALS AND METHODS

Study area

The study was conducted in Kimilili and Kabuchai sub-counties which are in Bungoma County. Kimilili Sub-County is in rural with headquarters at Kimilili town with one of the largest open-air markets in Western region, the Kimilili old market. Kabuchai Sub County has the second largest open-air market in Kenya. Agriculture was the main economic activity in the area with cereals and traditional farming dominating. Bungoma County was chosen

for the study because about 52% of the people were engaged in agricultural production which provided 60% of all household incomes out of the total labor force of about 565,000 people (Thongrattana, 2012). Bungoma County is known to produce AIVs which are common household food and made a substantial contribution to the food security of rural people in Bungoma County. The practice of intercropping AIVs with other crops was done by over 61% of the female smallholder farmers in Bungoma County (Musotsi and Onyango, 2018) (Figure 1).

Study population and sampling

The determination of the sample size was following the proportionate sampling methodology specified as follows:

$$n = \frac{z^2 pq}{e^2} \quad (1)$$

Where: n = sample size, p= implied maximum possible variance q = 1-p, z = the standard value at a given confidence level ($\alpha = 0.05$), e = the acceptable error (precision). The study desired a 95% confidence level and 5% precision level with a z score of 1.96. In addition, the study assumed that p=0.5. The sample was determined as:

$$n = \frac{(1.96)^2 (0.5)(0.5)}{(0.05)^2} = 384 \quad (2)$$

The derived sample size for the study was 384 respondents.

Data collection and analysis

Primary data collection was done through observations and interviews using a semi-structured questionnaire which was to be administered to AIV smallholder farmers. Descriptive statistics was used to analyze for the vertical Market linkages that exist between smallholder AIV farmers and other actors will be identified. Frequencies, percentages, and standard deviation of various variables will be obtained. This helped in determining the most common linkages that exist, the nature of linkages that exist and the actors with whom smallholder AIV farmers are linked with. Inferential statistics including chi-square and t-test was used to determine the significance of the vertical market linkages that exist.

RESULTS AND DISCUSSION

This chapter presents the results and discussion information. It begins by giving brief information on the study socio-economic characteristics of the sampled unit, then the discussion about the vertical market linkages that exist between smallholder African Indigenous Vegetables (AIVs) farmers and other actors in Bungoma County. It proceeds to discuss the factors influencing the commercialization among Smallholder AIV farmers and the effect of vertical market linkages on the commercialization of AIVs in Bungoma County.

Descriptive statistics

This section provides an analysis of the descriptive

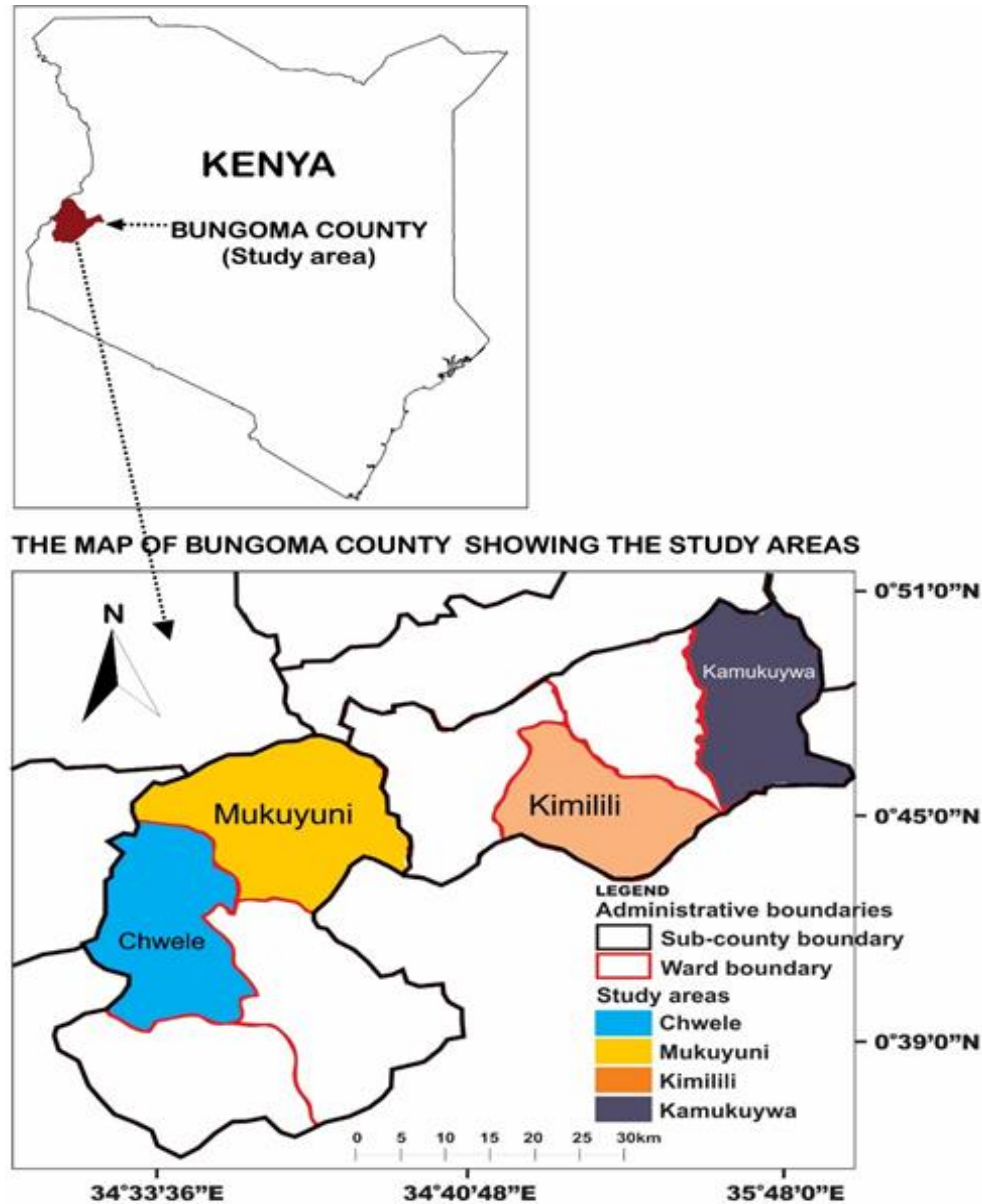


Figure 1. Map of the study area.
Source: Primary Data Collection (2023).

characteristics of the 384 households sampled.

Socioeconomic characteristics of respondents

The socioeconomic characteristics of the respondents are presented in Table 1. In relation to sex, majority (50.8%) of the AIV producers in Bungoma County are females while 49.2% are males. This can be attributed to the fact that AIV production requires small piece of land and since women have limited access to agricultural land, it becomes suitable for them. Men on the other hand largely prefer dealing with exotic vegetables and other

high-paying cash crops. This is consistent with findings from Musotsi and Onyango (2018) who reported that women in Kenya are more responsible for producing, preparing and cooking of AIVs. According to the IJRD (2021), over 70% of African Indigenous Vegetables are produced by women. The marital status of the respondents was categorized as married, single, widow/widower, and divorced. Results indicate that the majority (87.8%) of the respondents in Bungoma County are married. This implies that agriculture and food production in many African communities is often seen as a family affair, and this is attributed to the involvement of all generations and family members in the process. This

Table 1. Socioeconomic characteristics of the respondents.

Variable	Frequency	Percentage
Sex		
Male	189	49.2
Female	195	50.8
Marital status		
Married	337	87.8
Single	31	8.1
Widow/ widower	14	3.7
Divorced	2	0.5
Education level		
University	11	2.9
College/Tertiary	56	14.6
Secondary	191	49.7
Primary	124	32.3
No formal education	2	0.2
Access to land		
Own	310	80.7
Rented	24	6.3
Both	50	13

Source: Primary Data Collection (2023).

makes it possible for the household to collectively raise resources required for the production of AIVs as well as engage other household members such as spouses, children, and other family members as a source of labor. Riziki (2018) indicated that in African families set-up, the marital status of a household especially being married is highly ranked as the stability of households. According to Ngenoh et al. (2019), over 80% of smallholder, AIV farmers in Western Kenya are married. The level of education of the respondents was listed following this category: University, tertiary/college, Secondary school level, primary level, and no formal education. The results indicated that the majority of the respondents had attained secondary school level with 49.7% followed by 32.3% of the respondents who had primary level of education and lastly, 14.6% of the respondents had college/tertiary level of education, 2.9% of respondents had attained a bachelor's degree and 0.2% of the respondents had no formal education. The majority of AIV producers having secondary level education can be attributed to the increased demand for AIVs thus attracting high-profit margins compared to other vegetables and maize. The ability to comprehend market trends and profitable ventures compels secondary school levers to venture into AIV production. Contrary to this, Indeche et al. (2015) reported that 49.3 and 39.5% of the AIV producers in Kakamega County have primary and secondary level education respectively. The variation could be explained by the fact that the study in Kakamega only focused on only female AIV producers in

Kakamega. The same study noted that only 11.2% of the respondents did not have formal education. Land access by the respondents is represented into three categories, owned, rented, and both owned and rented. The results show that the majority (80.7%) of the respondents own the land on which they produce AIVs while 6.3% rent the land that is used for AIV production. The 13% of respondents both owned and rented land used for AIV production. The majority of respondents own land that is directly inherited from their parents while most of the women owned land due to their marriage to men who inherited land from their parents. This is consistent with findings from Govindasamy et al. (2020) who reported that over 59% of smallholder AIV farmers in Zambia own the land on which they produce AIVs. They noted that the majority of the farmers accessed land due to the communal nature of land ownership. Accessing land through renting was the least noted among AIV producers in Bungoma. This can be attributed to the economic constraints among smallholder farmers to rent land. According to Deininger et al. (2017), renting land in Sub-Saharan Africa is absent due to the land abundance and the popularity of subsistence farming.

African Indigenous Vegetables (AIVs) grown in Bungoma County

The African Indigenous Vegetables (AIVs) produced by smallholder farmers in Bungoma County are presented in

Table 2. African Indigenous Vegetables (AIVs) produced in Bungoma County.

AIVs grown	Percentage
Africa nightshade	73.9
Cowpeas	68.8
Vegetable amaranth	21.9
Spider plant	63.3
Jute mallow	34.4

Source: Primary Daa Collection (2023).

Table 2. African nightshade is the most commonly produced AIV at 73.9%, followed by cowpeas at 68.8%, spider plant at 63.3%, Jute mallow at 34.4%, and vegetable amaranth at 21.9%. African nightshade is the most commonly produced vegetable due to its popularity in many Kenyan communities, and it is often used in traditional dishes resulting to its high demand for the market making it more profitable for farmers to produce. Cowpea productions second level of importance is attributed to the fact that cowpeas is well adapted to the dry conditions in and it can tolerate drought better than many other crops since most of the AIVs are grown during the off-season period. Spider plant is the third most produced AIV because it is relatively easy to grow, and it can be cultivated in a variety of soil types and environmental conditions. This makes it a popular crop for smallholder farmers in the region and it is really accepted in the market leading to its price being high in the markets. Vegetable amaranth is the least produced AIV by 21.9% of smallholder farmers in Bungoma County. This is attributed to the fact that amaranth is common in every household and just a few smallholders produce them for commercialization. Amaranth vegetables are known as weed plants for they grow on themselves during the rainy season making it accessible to every household. Just a few stallholders have started expressing interest in its production because there is the introduction of other agricultural varieties that are good for diet in terms of vegetables and seeds that are crushed and prepared as porridge for infants.

Vertical market linkages that exist between smallholder AIVs farmers and other market actors

According to the study, vertical market linkage was used to refer to market relationships between smallholder AIV farmers and other market actors operating at different levels of the value chain. These linkages are important for the flow of goods, services, and information, as well as for the distribution of profits and risks along the value chain. Smallholder indigenous vegetable farmers are often vertically linked with other market actors in the markets. This is attributed to the fact that, through

linkages smallholder AIVs farmers are able to access the markets that they would have not been able to access before, and they are able to bargain for their products. Smallholder AIVs farmers get the markets information that helps them to maneuver in the markets via market linkages; through this, they can reduce the risks that would rise if they had not been vertically linked. The vertical market linkages that exist between smallholder AIVs and other market actors are presented in Table 3. The results in Table 3 indicate that smallholder AIV farmers are linked to market actors such as retailers, wholesalers, processors, and final consumers. The relationship between smallholder AIV farmers and the mentioned market actors were considered as vertical market linkages. Therefore, the vertical market linkages that exist include producer-retailer linkage, producer-wholesaler linkage, producer-retailer linkage and producer-final consumer linkage. The majority (98.7%) of AIV smallholder farmers are linked to final consumers thus the largest linkage that exist is producer-final consumer linkage. The final consumers linked to the AIV smallholder producers were friends, neighbours, relatives, fellow village members, schools and hospitals. The prominence of this vertical market linkage could be attributed to reduced distance to the market thus limiting the transaction costs involved in marketing. Final consumers equally prefer fresh AIVs which they can easily guarantee in case they buy directly from the farmgate. Additionally, the farmgate prices tend to be lower compared to market price of AIVs thus the preference by final consumers to deal directly with smallholder farmers. This is consistent with findings from Gido et al. (2016) and Jalang'o et al. (2016) who reported that the largest volumes of AIV sold by smallholder AIV farmers are sold through open air markets and farmgate to final consumers respectively. Additionally, Mwema and Crewett (2019) reported that smallholder AIV farmers in Kenya sell 75% of their produce to final consumers. Smallholder AIV farmers who have vertical market linkages with retailers are 352 translating to 91.7%. This implies that 91.7% smallholder have farmers are engaged in producer-retailer linkages which is the second most important vertical market linkage. The retailers that smallholder AIV farmers are linked to are mainly female market vendors (*mama mbogas*). Bungoma County has Chwele and Kimilili old markets which have numerous AIV market vendors who create demand for the AIVs produced by smallholder farmers. Besides, the streets of Kimilili town, Kamukuywa town, Mukuyuni and Kabuchai attract a variety of roadside retailers in the evening who handle numerous foodstuffs including indigenous vegetables. These vendors equally source AIVs from smallholder farmers within the study area. Since majority of the retailers are residents within the same communities, there is a long-term relationship that exist between smallholder farmers and retailers which makes it convenient for both parties to engage in a vertical market

Table 3. Actors who are vertically linked to smallholder AIV farmers.

Actors vertically linked to smallholder AIVs farmers	Frequency	Percentage
Retailers	352	91.7
Wholesalers	76	19.8
Processors	112	29.2
Final consumers	379	98.7

Source: Primary Data Collection (2023).

relationship. According to Minyattah et al. (2022), the second most important customers for AIVs produced by smallholder farmers are retailers.

The third most important actors linked to smallholder AIV farmers are processors at 29.2%. These actors buy AIVs for value-addition purposes. The only actors under this category who are linked to smallholder farmers are restaurants and hotels. Restaurants and hotels serve AIVs to their customers who treasure them as traditional staples. Besides, the Kenyan feeding culture involves eating indigenous vegetables as a side dish which creates demand by hotels and restaurants in order to meet the expectations of their customers. Thus, restaurants and hotels are compelled to engage in relationships with smallholder AIV farmers to provide a constant supply for their needs. However, only a few smallholder farmers sell to hotels and restaurants due to the constant quantities demanded that smallholders cannot constantly supply due to seasonality of production. Additionally, since smallholders only deal with restaurants and hotels within their sub counties, hotels and restaurants are fewer to accommodate all the smallholder farmers who are engaged in AIV production. According to Vivas et al. (2023), hotels and restaurants demand AIVs from smallholder farmers to meet the demand of customers who value traditional vegetables. Jalang'o et al. (2016) asserts that hotels and restaurants are just taking shape in rural areas of Kenya thus explaining why the proportion of smallholder AIV farmers linked with them is lower compared to retailers and final consumers. Results in Table 3 indicate that the least (19.8%) actors that smallholder AIV farmers are linked to are wholesalers. Therefore, the least linkage that exists between smallholder farmers and other actors is the producer-wholesaler linkage. Selling to wholesalers requires huge volumes of AIVs produced and prepared at regular intervals (daily or weekly) which most of the smallholder farmers cannot guarantee. Thus, wholesalers tend to rely on a few smallholder AIV farmers and other market actors to acquire the volumes that they require. According to Abebe et al. (2016), wholesalers in Ethiopia prefer to work with middlemen to guarantee minimum quantity and quality, and to reduce the cost of measuring quality since they tend to deal with high end markets. In addition, Senyolo et al. (2018) noted that there is no linkage and market relationship between smallholder

farmers and wholesalers in Limpompo province in South Africa which limit their important access points for smallholder farmers. The nature of vertical market linkages that exists between smallholder AIVs farmers and other market actors is presented in Table 4. The nature of vertical market linkages was categorized into formal, informal and both. the relationship between smallholder AIV farmers and retailers (producer-retailer linkage) was largely informal (94%). The same was observed across other vertical market linkages such as producer-final consumer (94.9%), producer-processor linkage (83.5%) and producer-wholesaler linkage (91.5%). Smallholder AIV farmers in Bungoma County assert that informality is time saving, less tedious and never binding to conditions that may have negative consequences on their livelihood. This is in line with findings from Mersha and Ayenew (2018) who noted that smallholder farmers in Ethiopia preferred informal transactions due to the limited understanding of procedures involved in formal transactions. The informality was largely observed in producer-final consumer linkage (94.9%) and least observed in producer-processor linkage (83.5%). Final consumers included friends, relatives and neighbours who are in constant communication and closer vicinity to the smallholder AIV farmers. Besides, these are people that they interact with on a daily basis thus having a higher degree of trust amongst them which does not necessitate formalizing the relationship. According to Anderson and Cuevas (2015), rural farming communities tend to have stronger concerns amongst themselves allowing them to adjust their terms and conditions incase unforeseen circumstances befall a colleague with whom they transact thus prevalence of informal relationships.

Formal vertical market linkages exist largely in producer-processor linkage (11.9%). The most important processors of AIVs in Bungoma County are hotels and restaurants who require constant supply at regular intervals and an assured quality of the produce supplied. According to Mbatha (2019), hotels and restaurants in Namibia transact with smallholder farmers formally to raise volumes constantly demanded by tourists while maintaining the quality of their services to their clients. This is followed by producer-wholesaler linkage (5.6%), producer-final consumer linkage (4.2%) and least observed in producer-retailer linkage (4%). Final

Table 4. The nature of vertical market linkages between smallholder AIV farmers and other market actors.

Nature of vertical market linkage	Producer-retailer		Producer-wholesaler		Producer-processors		Producer-final consumers	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Formal	14	4	4	5.6	13	11.9	16	4.2
Informal	332	94	65	91.5	91	83.5	358	94.9
Both	6	2	2.01	2.9	5	4.6	3	0.9

Source: Primary Data Collection (2023).

consumers formally linked to smallholder AIV farmers are schools and hospitals which require formal signing of contracts with smallholder farmers before supply of AIVs. This is because of the sensitivity of these institutions and their clients thus the need to guarantee quality. The main retailers that smallholders engage with are *mama mbogas* who always come and pick the AIVs directly from the garden after either a phone call or an informal talk during the market day or within their communities of residence. According to Research Solutions Africa (2015), majority of smallholder farmers and retailers (*mama mbogas*) in Kenya are less educated and thus do not have the capacity to organize contracts that formally bind their transactions.

CONCLUSION AND RECOMMENDATION

The study aimed to find the vertical market linkages that existed between smallholder AIV farmers and other actors in the markets, as well as the nature of the vertical market linkages. African nightshade was found to be the most commonly grown AIV, followed by cowpeas, spider plant, jute mallow and vegetable amaranth. African nightshade is the most commonly produced vegetable due to its popularity in many Kenyan communities, and it is often used in traditional dishes, resulting in a high demand for the market, making it profitable for farmers to produce. Smallholder AIV farmers were linked to market actors such as retailers, wholesalers, processors, and final consumers, which led to vertical market linkages such as producer-final consumer linkage, producer-retailer linkage, producer-processor linkage and producer-wholesaler linkage. The final consumers linked to smallholder AIV farmers included friends, neighbours, relatives, schools and hospitals. The relationship between smallholder AIV farmers and all the market actors is largely informal. To better integrate both the formal and informal vertical market linkages, and to allow the actors involved to collectively benefit from their participation in AIV production and marketing, it is necessary to establish a mechanism that cohesively this relationship. Organizing farmers into community-based organizations and associations can allow for easier access to formal market actors, such as wholesalers who source large quantities of AIVs at regular intervals.

Building up the capacity of smallholder AIV producers, through marketing, financial literacy training and value addition, can help to dramatically reduce the volume lost due to poor post-harvest handling. It will also contribute to an enhancement of the quality of AIVs supplied to various market actors.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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