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African indigenous vegetable marketing: examining the influence of socio-economic factors and market patterns in Tanzania

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ABSTRACT

While most studies on African Indigenous Vegetables (AIV) focused on their nutritional values, household income and consumer attitudes, little has been documented on their marketing patterns. This study examines the influence of socio-economic factors and market patterns on AIV marketing among smallholder farmers in Arusha Tanzania. The study applied a cross-sectional design, in which a structured questionnaire was adopted to capture information from 288 sampled AIV producers. The Cobb Douglas (Double Log) regression model was employed during data analysis. Findings indicate that smallholder farmers' marital status, education level, and household size are positively and significantly influencing the marketing of these vegetables. Also, a positive and significant effect of smallholder farmers' trade experience, marketing infrastructure, AIV varieties, marketing information and market channel was observed. The findings of this study extend the application of market orientation theory and resource-based theory in the context of AIV marketing. This study provides a marketing framework for policymakers and smallholder vegetable farmers on better marketing strategies for active involvement in vegetable markets. This study contributes to the body of knowledge on the need for policy reforms to enhance AIV marketing patterns in developing economies. Also, the findings of this study have both practical and policy implications.

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1. Introduction

African indigenous vegetables (AIV)¹ are food products that have been cultivated, collected and consumed in African-sub Sahara over the past 100 years. These traditional African vegetables have continued gaining prominence due to their economic, health, nutritional and environmental benefits (Kansiime, Karanja, et al., 2018; Kansiime, Ochieng, et al., 2018; Kazungu & Nyagango, 2020; Krause et al., 2019; Mphafi et al., 2019; Mworira, 2021). They constitute 1,000 different edible species of leafy and fruits which are economy, an easily accessible source of vitamins, minerals, also a good supplement of protein and calories (Muhanji et al., 2011; Oyedele & Adenegan, 2017; Senyolo et al., 2018). Also, these vegetables are resistant to drought, diseases and pests (Chepkoech et al., 2018; Luoh et al., 2014; Mabhaudhi et al., 2022) and therefore are extremely important in reducing food insecurity in deprived rural and urban settings (Sharma et al., 2021). They are valued as major sources of energy, primary foods and micro-nutrients in poor societies (Senyolo et al., 2018; Zulu, 2022). Further, these vegetables are sold in local, regional, and international markets, thus, they function as a source of household income, and poverty alleviation (Amfo & Ali, 2020; Musotsi et al., 2017; Weinberger & Lumpkin, 2013).

Smallholder farmers' socio-economic characteristics are important determinants influencing marketing decisions related to these vegetables. For instance, gender is considered an important component of the effective market of African vegetables. Studies by Mabhaudhi et al. (2022), Kimambo (2016) and Lenné

and Ward (2011) have noted that women are more involved in production and marketing than their male counterparts. This gender difference in vegetable marketing is attributed to factors such as high adaptive capacities and access to some human and social capital by female farmers (Chepkoech et al., 2020) and the presence of agriculture programmes that are aiming at promoting women's participation in farming project like the AIV seed start-up kits (Kansiime, Karanja, et al., 2018). Also, household size dictates family labour which reduces some costs related to the production of AIV and thereby promotes its effective marketing (Mwema & Crewett, 2019). Other determinants of smallholder African indigenous vegetable farmers' active participation in markets include farmers' age, education, farm size, type of seeds used and quantity produced (Lotter et al., 2014; Mwaura et al., 2014; Mwema & Crewett, 2019; Mworira, 2021; Ngenoh et al., 2019).

Performance of AIV in these markets is a function of several marketing patterns. These patterns take the form of production, pricing, promotional, and distribution strategies. Product-based patterns prioritize the adoption of demand-driven and time-scheduled farming methods aimed at meeting consumer requirements, emphasizing the improvement of farming practices. Thus, smallholder farmers require knowledge of AIV varieties, enhanced agricultural production technologies, production scale, and evolving farming methods and market trends (Amfo & Ali, 2020). Price-based strategies for these vegetables are very critical in determining market trends. Vegetable prices are usually higher in urban markets than in rural markets. This according to Matsane and Oyekale (2014) and Hassan et al. (2012) is caused by the lowly dissemination of vegetable market information, increased marketing margins and costs by the brokers, transportation and other marketing charges. Promotional-based strategies are also very critical to vegetable marketing as they enhance market information and AIV consumption patterns. Through promotional strategies, consumers are rich in information about the prominence of these vegetables in their diets and therefore increasing their eagerness to pay higher prices (Senyolo et al., 2014). Likely, better promotion strategies and incentives encourage more supermarkets to sell vegetables and increase their availability, thus enhancing market choice among urban dwellers (Gido et al., 2016). Distribution-based strategies are largely dictated by marketing channels by ensuring that consumers can conveniently access vegetables through retail outlets, while also providing ample market information (Hassan et al., 2012; Ayanwale et al., 2011).

The markets for these vegetables are grouped into five distinct market chains, each exhibiting different characteristics. The classification of these markets primarily relies on factors such as location, trader type, and product availability. These markets according to Osano (2010) in Kazungu and Nyagango (2020) are classified into four categories. Firstly, there are local village markets, typically situated alongside roads and close to villages. These markets are predominantly run by women and children, offering a limited selection of products with unreliable supply. Secondly, regional markets are found in district capitals and regional centres. These markets attract small, medium, and large traders, providing a varied supply ranging from low to large quantities and offering a broader range of products. Thirdly, national markets are primarily dominated by large traders, ensuring a reliable supply of vegetables. Lastly, there are supermarkets located in major cities. These supermarkets feature both local and foreign traders and offer a consistent and dependable supply of vegetables.

These vegetables have proven to have growing demand which is caused by several factors, which include increased awareness of their nutritive benefits and improved food security. Likely, the alkaline, salty, coral soils in which these vegetables grow offer a protective effect against non-communicable diseases such as diabetes and hypertension, which have experienced a significant surge in prevalence over the years. Additional factors contributing to increased demand include the growing potential in major supermarkets and green grocery stores, as well as a rise in consumers' willingness and ability to pay for high-quality processed AIV products. Also, these traditional vegetables are cheap, environmentally friendly, and potential sources of minerals (like Iron and Calcium), vitamins (such as A, B and C), protein and calories (Kansiime, Karanja, et al., 2018; Kazungu and Nyagango, 2020; Mabhaudhi et al., 2022; Mphafi et al., 2019; Muhanji et al., 2011; Senyolo et al., 2018).

Despite the growing demand for AIV, smallholder vegetable farmers in Tanzania exhibit low participation in vegetable marketing, with only a limited number of households involved in selling vegetables. This unfavourable trend can be attributed to various marketing challenges that impede the effective engagement of smallholder farmers in vegetable marketing, not only in Tanzania but also across much of sub-Saharan Africa (Matemu, 2022; Mwangi & Crewett, 2019; Sangija et al., 2021). These challenges

encompass limited access to market information, inadequate market infrastructure, weak bargaining power, insufficient physical resources, lack of marketing skills, limited access to financial resources and human capital, as well as inadequate processing capacity and scarce training in handling and processing techniques for these vegetables (Barrett et al., 2012; Govindasamy et al., 2020; Kazungu & Nyagango, 2020; Musebe et al., 2017). This study, therefore, profiles the socio-economic characteristics of small-holder AIV growers and determinants of AIV marketing in Arusha, Tanzania.

2. Theoretical foundation

Several theories and models have been used to expound the marketing of farm produce. Nevertheless, in this study, the Market orientation theory (MOT) and resource-based view (RBV) have been used in conjunction with each other. According to Kohli and Jaworski (1990), market orientation entails gathering market information from both current and potential customers, disseminating this information across departments, and prompting appropriate responses. An understanding of market orientation is very important as it influences a producer's performance, level of strategic orientation, relationship quality, and customer retention (Gheysari et al., 2012). According to Na et al. (2019), greater market orientation leads to increased enhancements in the producer's competence, customer satisfaction, innovation, selection and implementation of competitive strategies, customer response, and product/service quality. Thus, producers with high market orientation are expected to improve their ability to develop products and services and positively influence their technical and managerial innovations than others. Market orientation theory suggests that producers should focus on meeting the needs of their target markets to be successful. In the context of indigenous vegetable production and marketing, this theory might be used to guide decisions about which indigenous vegetables to produce, how to package and label them, and how to market them to different consumer segments. The market orientation theory suggests that small-holder farmers who have been in the AIV trade for a long time and with AIV varieties are more likely to develop effective marketing strategies that enable them to understand and meet their customers' needs and want. These farmers can do so by being customer-focused and by adapting their products and services to meet the changing needs and preferences of their target markets. Therefore, this marketing approach can lead to higher customer satisfaction, increased sales, and improved profitability among AIV farmers.

Resource-Based View Theory suggests that a firm's resources and capabilities are the primary drivers of its competitive advantage (Ismail, 2022b). According to Penrose's theory from 1959, RBV holds the belief that a company can gain a competitive edge and differentiate itself from its rivals by possessing valuable, uncommon, and distinctive assets. Generally, the RBV is based on the principle that a producer's success is largely determined by resource ownership (Barney, 1991; Penrose, 1959). In the context of AIV marketing, this theory can be used to analyse and develop marketing strategies based on the firm's resources and capabilities, such as production capacity, product quality, marketing infrastructure, and access to market information and channels.

The RBV suggests that AIV's marketing capabilities among smallholder farmers can be strengthened through access to marketing resources such as marketing infrastructure (e.g. storage and transportation), marketing information (e.g. pricing, market trends and consumer preferences), and marketing channels (e.g. distribution networks) (Kariuki et al., 2020; Ogunleye & Adebayo, 2022).

Whereas the RBV maintains that wider resources lead to superior market performance variations among AIV smallholder farmers, the MOT considers how marketing resources are pooled for market performance transformations. Thus, merely having access to resources is inadequate to explain the differences in sustainability outcomes among AIV smallholder farmers. Vegetable farmers should therefore be able to access and effectively utilise these resources and marketing strategies for sustainable market-oriented results. The viability and practicability of this from the marketing of AIV can only be achieved if competencies related to action are present. Therefore, smallholder AIV farmers need to possess a range of competencies, including trade experience, farm and market knowledge (e.g. AIV varieties, market information, channel members and market infrastructure), to improve their productivity, market participation, and livelihoods. The presence of such competencies will also enable AIV smallholder farmers to maximize the potential of their resources and respond promptly to the demands of target markets in a deliberate and organized manner. The stream

of these two theories proposes that smallholder AIV farmers with good market orientation and resource endowment are more likely to perform well in the market. Assuming appropriate market orientations of AIV smallholder farmers is believed to be crucial for achieving market competitiveness, which can subsequently enhance sustainability. Therefore, smallholder farmers in the AIV sector who possess such competencies are thought to be better positioned for competitive advantage compared to those who lack sufficient competencies in the form of market orientations and resources.

3. Literature review and hypotheses development

3.1. Smallholder farmers' socio-economic factors

Studies on smallholder farmers' socio-economic factors are vital for the advancement of knowledge and development of the marketing of African Indigenous vegetables. Farmers with a higher level of education may be better equipped to understand market dynamics and make informed decisions regarding the pricing, packaging, and distribution of their produce (Arumugam et al., 2022; Khapayi & Celliers, 2016). Gender can play a role in marketing strategies as female farmers may face additional barriers such as limited access to markets and fewer opportunities for networking and training. Farm size can also have an impact on marketing strategies, whereas small farms may have limited resources for marketing, larger farms may have more resources but may face additional challenges such as increased competition (Arumugam et al., 2022; Endris et al., 2020; Okoboi & Nakelse, 2019).

Studies by Arumugam et al., (2022) and Chepkoech et al., (2020) propose that smallholder farmer's marital status could have a positive effect on AIV marketing. Marital status can influence a farmer's access to resources, social networks, and decision-making power, which could all impact their ability to effectively market their produce. For example, married farmers are more likely to have large household sizes which may lead to greater access to resources such as labour and capital that could help them to increase production and improve the quality of their AIV (Mwema & Crewett, 2019). Additionally, married farmers may have more extensive social networks, which could provide them with more opportunities for marketing and selling their produce. Finally, married farmers may be more likely to make joint decisions with their spouses, which could result in more effective marketing strategies. However, it is important to note that the impact of marital status on AIV marketing could vary depending on the cultural context and specific circumstances of the farmer. Therefore, more research would be needed to fully understand the relationship between marital status and AIV marketing.

Smallholder farmers' household size could potentially have a positive effect on AIV marketing, but it would depend on several factors. A larger household size could provide additional labour for farming activities, which could increase the productivity and efficiency of the farm (Mwema & Crewett, 2019). This could result in higher yields and better-quality AIV, which could be marketed at a higher price. Moreover, a larger household size could also mean a larger customer base. The farmers could sell their AIV to the members of their household, and also to the extended family and friends who are part of their social network. This could lead to a more reliable customer base, as well as word-of-mouth advertising that could help to increase the popularity of the AIV and bring in new customers. However, it is important to note that the positive effect of household size on AIV marketing would also depend on the availability of resources to support the larger household. For example, if there is no enough land, water, or other resources to support a larger household, it could result in lower productivity and lower quality AIV. Additionally, if the larger household is facing poverty or food insecurity, they may not have the resources to invest in marketing their AIV effectively. Therefore, while household size could potentially have a positive effect on AIV marketing, it is just one of many factors that would need to be considered when developing marketing strategies for smallholder farmers.

Thus, smallholder farmers' socio-economic factors can have a significant impact on the marketing of African Indigenous vegetables. And so, it is essential to consider these factors when developing marketing strategies to ensure that they are effective and sustainable. Therefore, given that, smallholder farmers' socio-economic factors such as age, marital status, level of education, household and farm size enhance AIV marketing. Thus, it can be hypothesized that:

- H₁: Smallholder farmer's age has a significant positive effect on AIV marketing
- H₂: Smallholder farmer's marital status has a significant positive effect on AIV marketing
- H₃: Smallholder farmer's education level has a significant positive effect on AIV marketing
- H₄: Smallholder farmer's household size has a significant positive effect on AIV marketing
- H₅: Smallholder farmer's farm size has a significant positive effect on AIV marketing

3.2. AIV marketing patterns

A well-functioning set of marketing patterns facilitate the marketing of AIV while enabling excellent use of marketing strategies among AIV producers and therefore increasing their marketing capabilities. Smallholder farmer's trading experience could potentially have a positive effect on AIV marketing (Minyattah et al., 2022). Farmers with trading experience are likely to have better market knowledge, negotiation skills, and market connections, which can help them to achieve better prices for their AIV and increase their sales volume. Trading experience can also provide farmers with a better understanding of market demand, which can help them to tailor their AIV production to meet market needs. Moreover, farmers with trading experience may be more adept at identifying new market opportunities and adapting their marketing strategies accordingly. They may also be more familiar with the requirements of different market channels, such as regulatory requirements, packaging standards, or quality certifications, which can help them to access new markets and sell their AIV at a higher price (Musebe et al., 2017).

Marketing infrastructure can play a critical role in facilitating vegetable marketing by smallholder farmers (Matsane & Oyekale, 2014). Marketing infrastructure includes a range of physical, institutional, and regulatory factors that affect the flow of AIV from producers to consumers. These factors can include proximity to the markets, transportation systems, storage facilities, market information systems, market regulations, and market institutions (Khapayi & Celliers, 2016; Mustafiz et al., 2021). Having a well-developed marketing infrastructure can have a significant positive effect on AIV marketing for smallholder farmers. For example, good transportation systems can help to reduce transportation costs, increase the speed and reliability of AIV delivery, and expand the geographical reach of the market. Storage facilities can help to ensure that AIVs are kept fresh and of high quality, even when there is a surplus of production. Overall, a well-developed marketing infrastructure can provide smallholder farmers with the necessary support and resources to market their vegetables effectively and efficiently (Matsane & Oyekale, 2014). However, it is important to note that the specific marketing infrastructure requirements can vary depending on the local context, market demand, and farmers' resources and preferences. Therefore, it is important to assess the local marketing infrastructure and develop tailored marketing strategies that are appropriate for smallholder farmers and their local context.

The production of a variety of AIV can have a significant positive effect on AIV marketing for smallholder farmers. Offering a range of AIV varieties can help farmers to meet the diverse needs and preferences of consumers and cater to different market segments. This can help to increase demand and improve marketability for AIV. Producing a variety of AIV can also help farmers to reduce their production risks and increase their resilience to changing market conditions. By producing different AIVs, farmers can spread their production risks across multiple crops, reducing the impact of market fluctuations or crop failures on their income. This can help to stabilize their income and increase their profitability over the long term. Furthermore, producing a variety of AIVs can also help to diversify the sources of income for smallholder farmers. By offering different AIVs, farmers can access different markets and buyers, increasing their sales volume and revenue streams. This can also help to reduce their reliance on a single crop or market, which can be vulnerable to external shocks or price volatility. Moreover, producing a variety of AIV can also help to increase the nutritional value of the local diet. The AIVs are often rich in essential nutrients such as vitamins, minerals, and antioxidants, and consuming a variety of AIVs can help to improve the overall health and well-being of local communities.

Access to market information can have a significant positive effect on the marketing of AIV by smallholder farmers. Market information refers to timely and relevant information about market trends, prices, demand, and supply that can help farmers make informed decisions about what to produce and how to market their farm products (Nyagango et al., 2023). Market information can provide farmers with timely and accurate information about market trends, prices, and demand, helping them to make informed decisions about what to produce and how to market their vegetables (Matsane & Oyekale, 2014). Access to market information can also help smallholder farmers to identify market opportunities, determine the best time to sell their AIV and negotiate better prices with buyers. Farmers with access to market information can also adjust their production strategies to meet changing market demand, such as by producing AIV with higher quality standards or in larger quantities (Krause et al., 2019; Weinberger & Lumpkin, 2013). This can help them to respond more effectively to market conditions and increase their competitiveness in the market. Moreover, access to market information can also help farmers to identify potential market risks, such as changes in consumer preferences, price volatility, or market disruptions. By being aware of these risks, farmers can develop contingency plans and adapt their marketing strategies to minimize the impact of these risks on their income and livelihoods. Furthermore, access to market information can also help to promote transparency and fairness in market transactions. When farmers have access to information about market prices and demand, they are better able to negotiate with buyers and avoid exploitation or unfair practices.

Access to market channels can have a significant positive effect on the marketing of AIV by smallholder farmers (Arumugam et al., 2022). Market channels refer to the different channels through which AIV are sold and distributed to consumers, such as wholesalers, retailers, supermarkets, and local markets. Having access to a variety of market channels can help smallholder farmers to reach a larger number of consumers and increase their sales volume (Ngenoh et al., 2019). For example, selling AIV through supermarkets or online platforms can help farmers access urban markets and reach consumers who may be willing to pay higher prices for their products. At the same time, selling AIV through local markets can help farmers to reach low-income consumers who may have limited access to supermarkets or other formal market channels. Moreover, having access to a variety of market channels can also help to reduce market risks and increase market competitiveness. By selling AIV through multiple market channels, farmers can spread their market risks across different channels and reduce their dependence on a single market or buyer. This can help to increase their bargaining power and enable them to negotiate better prices and terms of trade with buyers. Furthermore, having access to market channels can also help to promote innovation and value addition in the AIV sector. For example, by selling AIV through supermarkets or other formal market channels, farmers may be required to meet certain quality and packaging standards, which can encourage them to invest in better production practices and improve the quality of their products. Similarly, by selling AIV directly to consumers through online platforms, farmers can add value to their products by providing information about their farming practices, nutritional value, and recipe ideas.

Therefore, from these theoretical foundations, it can be deduced that experienced farmers with access to marketing infrastructures, market information and proper market channels can significantly participate well in the AIV market. Thus, it is reasonable to hypothesize that:

H₆: Smallholder farmer's trading experience has a significant positive effect on AIV marketing

H₇: Marketing infrastructure has a significant positive effect on AIV marketing

H₈: Production of AIV varieties has a significant positive effect on AIV marketing

H₉: Access to market information has a significant positive effect on AIV marketing

H₁₀: Access to market channels has a significant positive effect on AIV marketing

From the reviewed literature and hypotheses developed, this study suggested a conceptual model grounded in the marketing orientation theory and resource-based view. The proposed model in [Figure 1](#) proposes that both socio-economic factors (i.e. smallholder farmer's age, marital status, education level, household size and farm size) and marketing patterns (e.g. smallholder's farmers trading experience, marketing infrastructure, AIV varieties, access to market information and market channels) will lead to better



Figure 1. Conceptual model: domains of socio-economic factors and marketing patterns.

participation in the AIV marketing by smallholder farmers. Likely, all the suggested relationships among variables of the study result in the development of hypotheses H_1 to H_{10} as presented in [Figure 1](#).

4. Study methodologies

4.1. Area of study

This study was conducted in the Arusha region, Tanzania. Arusha was selected because of its long time history of agricultural production especially vegetable and the presence of a substantial number of small-scale farmers who engage themselves in vegetable production as their livelihood strategy. The 2012 National Sample Census of Agriculture identified that the number of small-scale farmers in the Arusha region was 205,547 out of which 37,985 were involved in growing indigenous vegetables.

4.2. Research design and sampling

A cross-sectional research design was adopted in this study to determine the factors behind the marketing of these vegetables in Tanzania. Generally, cross-sectional design encompasses gathering data from a random population sample at a specific point in time (Ismail, [2022b](#)). The study population consisted

of small-scale farmers engaging in producing indigenous vegetables on farm sizes not more than 3.5 acres. A total of 28 smallholder vegetable farmers were randomly selected to pilot the questionnaire in Moshi before actual fieldwork. The randomized lottery method was used to identify 288 AIV smallholder farmers as sampled respondents across villages in the study area. Data were collected from smallholder farmers in Arusha with the use of a structured questionnaire.

4.3. Data analysis techniques

Data used were gathered on socio-economic factors (i.e. age, gender, marital affairs, education, farm size and membership in farmers' groups/associations) and market characteristics (trading experience, varieties of indigenous vegetable planted, marketing infrastructure, market information and marketing channel) respectively. Data gathered were analysed by using the Double Log i.e. the Cobb-Douglas regression model which applied the generalised Cobb-Douglas production function in Equation 1:

$$Y_d = b_0 X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} e_i^u \quad (1)$$

The generalised Cobb-Douglas production function was then transformed into the linearized double log form in Equation 2 to be solved by using the least squares method:

$$\text{Log}Y = \log f(\text{AG, TE, MI, MS, FS, ED, VA, HS, MC, MI}_{nf}) + e_i. \quad (2)$$

where Y = AIV harvest (kg/ha); AG = Age of smallholder AIV farmer (in years); TE = Trade experience (in years); MI = Market infrastructure (distance to market in Km); MS = Marital status (1 = Single, 2 = Married, 3 = Divorced, 4 = Widowed); FS = Farm size (in acres); ED = Education level (number of years spent in schooling); VA = Variety of AIV (number of varieties); HS = Household size (number of household members); MC = Marketing channel (1 = through wholesalers, 2 = retailers, 3 = supermarkets, 4 = local markets, 5 = farm gate); MI_{nf} = Market information (1 = access timely information on market trends, 0 = do not); e_i = error term.

Test of hypotheses

The hypotheses were tested using t -values at significance levels of 1%, 5%, and 10%. As a general rule, if the t -value of the sample exceeds the critical value of t (i.e. 2.581 for a 99% confidence interval, 2.05 for a 95% confidence interval, and 1.65 for a 90% confidence level), we accept the alternative hypothesis. Otherwise, we reject the alternative hypothesis.

5. Results and discussion

5.1. Profile of smallholder farmers

The study sought to establish a brief background information about the indigenous vegetable smallholder farmers. The study looked at farmers' demographic characteristics focusing on their age, gender, farm location and farm size.

5.1.1. Age of smallholder farmers

Descriptive results in Figure 2 reveal that about two-thirds of farmers are between the ages of 20 and 40. This gives evidence of increasing involvement in farming activities by the youths as income generating activity than the elders. These findings are supported by Amfo and Ali (2020) and Chepkoech et al. (2020) that, a large proportion of African indigenous vegetable farmers comprise people aged between the age group of 20 and 40 years. This age category constitutes a substantial group of the country's labour force with a potential to make major contributions to the growth of the agricultural sector in Tanzania. Farmers of this age group have wide experience in vegetable production and farming practices (Kimambo, 2016). Other reasons for the involvement of this age category include low

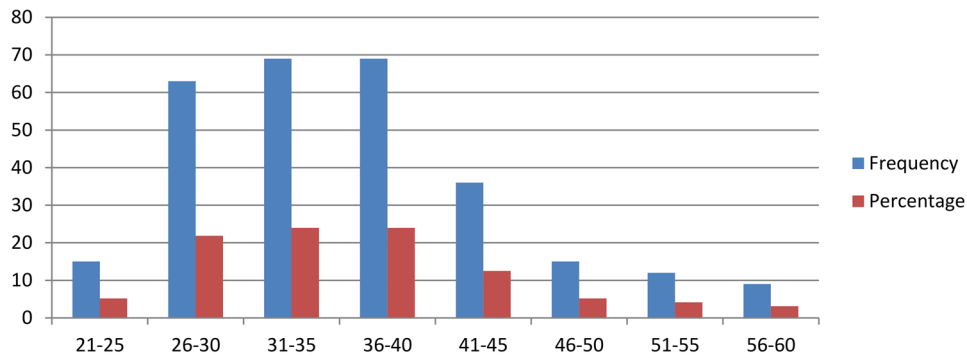


Figure 2. Age of respondents.

Table 1. Gender of respondents.

Gender category	Frequency	Percent (%)
Female	153	53.1
Male	135	46.9
Total	288	100.0

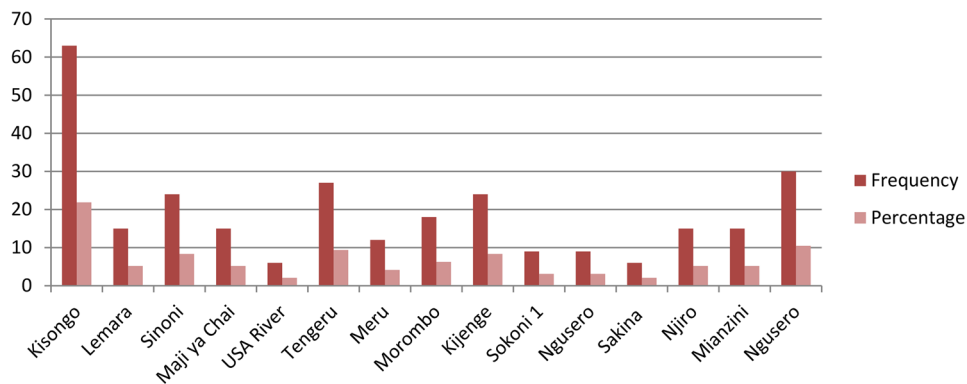


Figure 3. Locations of respondents.

level of education among the rural producers and insufficiency of formal employment opportunities and access to capital for off-farm trading activities in urban areas (Lotter et al., 2014; Muhanji et al., 2011). Nevertheless, there is a need to promote the involvement of more youths in the marketing of these indigenous vegetables. This will be a milestone in promoting food security, nutritional status and incomes of farmers.

5.1.2. Gender of smallholder farmers

This study established the gender distribution of these vegetable smallholder farmers. Findings in Table 1 reveal that out of 288 sampled vegetable farmers, 53.1% were female and males were also 46.9%. This shows that the two genders were adequately represented in the study and that both genders participate well in the marketing of these vegetable with slight domination of females. The involvement of women in marketing indigenous vegetable is subject to their daily household responsibilities whereas, their male counterparts are subjected to activities related to farming and other responsibilities other than their day-to-day household activities. These results are supported by the observation by Mabhaudhi et al. (2022), Lenné and Ward (2011) and Kansime et al. (2018) who contended that women dominate vegetable production and marketing when compared to their male counterparts. A study by Chepkoech et al. (2020) identified that women's great involvement in farmers' networks and favourable access to extension services as the factors behind their high involvement in marketing of these vegetables.

5.2. Location of AIV smallholder farmers

The study results in Figure 3 shows that most of the AIV smallholder farmers are based in Kisongo which carries 21.87% of the respondents, followed by Ngusero (10.49%), Tengeru (9.37%), Sinoni (8.33%), Morombo (6.25%), Lemara (5.2%), Maji ya Chai (5.20%), USA River (2.08%), Meru (4.16%), Kijenge (8.33%), Njiro (5.2%), Sokoni (3.12%), Ngusero (3.12%), Sakina (2.08%) and Mianzini (5.2%). It means that most of these vegetable smallholder farmers are found in the outskirts of Arusha and are coming from the listed places because of the nature of the soil and the availability of farms for agricultural activities. The outskirts of large cities have the advantage of easy access to irrigation among the small-scale African indigenous vegetable growers which facilitates the production of these vegetable (Mwangi & Crewett, 2019). Also, these are areas located very close to the urban centres with increasing urban populations with potential markets for indigenous vegetable which are characterised by good market infrastructure and diffusion of grocers and supermarkets (Musebe et al., 2017).

5.2.1. Size of the farm

Findings in Table 2 indicate that over 88% of smallholders own less than two acres of farmland. Thus, most of these vegetable smallholders have a small plot of land used for the cultivation of varieties such as Amaranths, Nightshade and Swiss chard. This variable affects the effective participation of smallholders in indigenous vegetable markets in the sense that the smallness of the farm size hinders production capacity while an increase in the farm size may lead to higher production and so the probability for a high degree of farmers' participation in vegetable marketing. These results corroborate the observation by Mwaura et al. (2014) who identified that farm size is one of the significant predictors of vegetable farmers' active involvement in markets.

5.3. Multicollinearity test

Variance Inflation Factor (VIF) analysis was used to check the degree of multicollinearity of the predictor variables in the model. Both VIF and tolerance statistics show the possibility of one predictor having a strong linear relationship with other predictors (s) (Field, 2013). Results in Table 3 indicate that the VIF results vary between 2.36 and 5.78 with a mean VIF equal to 3.709 which is less than 10. The results for the estimated Tolerance value (1/VIF) range between 0.17 and 0.42. The result confirms the absence of the problem of multicollinearity as all the VIF values for all the predictors are not more than 10 (i.e. the

Table 2. Farm size (acres).

Size of the farm category	Frequency	Percent (%)
0.5	9	3.1
1	255	88.5
2	15	5.2
3	3	1.0
4	6	2.1
Total	288	100.0

Table 3. Test of multicollinearity.

Variable	VIF	1/VIF
Age of smallholder farmer	3.57	0.28
Trade experience	3.24	0.31
Market infrastructure	3.95	0.25
Marital status	2.36	0.42
Farm size	5.78	0.17
Education level	2.61	0.38
Variety of AIVs	3.42	0.29
Household size	3.13	0.32
Marketing information	4.66	0.21
Marketing channel	4.37	0.23
Mean VIF	3.709	

Table 4. Determinants of AIVs marketing among smallholder farmers.

Variable	Coefficient	Standard error	t-Value
Age of smallholder farmer	-0.3482	0.7455	-0.4671
Trading experience	0.3267	0.1241	2.63255***
Market infrastructure	1.07648	0.6013	1.7903*
Marital status	0.8341	0.2126	3.9233**
Farm size	0.3217	0.2254	1.4272
Education level	2.3355	0.2231	10.4683***
Variety of AIVs	1.0780	0.1716	6.2821*
Household size	1.1008	0.1920	5.733***
Marketing information	0.9232	0.1743	5.2966*
Market channel	0.4926	0.2370	2.07848*
Const.	2.0604	1.2839	1.6048
R	0.8786		
R-square	0.772		
Adjusted R-square	0.759		
No. of observations	288		

***, ** and *, Significant at 1%, 5% and 10% level of Probability.

critical value). The result is similar to Chikobola (2016) who reported a VIF of less than 10. This suggests that individual variables incorporated in the model were not correlated.

5.4. Inferential analysis

Results in Table 4, show the determinants of marketing of these vegetable among smallholder farmers in Arusha, Tanzania. The first hypothesised relationship is on the effect of smallholder farmers' age on AIV marketing. Results confirm a negative and insignificant relationship between smallholder farmers' age on AIV marketing [$\beta = -0.3482$, $t = -0.4671$]. Hence, hypothesis one (H_1) is not accepted and this implies that the probability of smallholder farmer's age decreases with AIV marketing by 0.7455 times. This is against the literature by Maspaitella et al., (2018) and Endris et al. (2020) who found a positive and significant relationship between farmers' age and vegetable marketing. The common practice is, if there is indeed a positive and significant relationship between farmers' age and vegetable marketing, it may suggest that older farmers have more experience and knowledge in marketing their produce. They may have established networks of buyers and sellers and may have developed marketing strategies that are more effective than those used by younger farmers. Additionally, older farmers may have more resources and capital available to invest in marketing their produce, such as through the use of technology or hiring marketing professionals (Endris et al., 2020). They may also have more established reputations in their communities, which can lead to increased demand for their products.

The second relationship is on the influence of smallholder farmers' marital status on AIV marketing. The results in Table 4 reveal a positive and significant relationship [$\beta=0.8341$, $t=3.9233$] at 10% level of significance. Thus hypothesis two (H_2) is accepted and it is concluded that smallholder farmers' marital status has a positive effect on AIV marketing. This implies that the probability of smallholder farmers' marital status increases with AIV marketing by 0.2126 times. Thus, married smallholder farmers are more likely to perform well in AIV marketing. This corroborates with findings by Mwema and Crewett (2019) who observed that married farmers are likely to have large family size and this contributes to family labour and thus assist in the production and marketing of AIVs. From these findings, married smallholder farmers are more likely to perform well in AIV marketing. This may be attributed to factors such as the specific context of the farming system, cultural norms, and individual characteristics of the farmers involved. It should be noted that being married may provide smallholder farmers with access to additional labour, resources, and support from their spouses, which could potentially increase their productivity and overall success in agricultural activities, including AIV marketing.

The third relationship is on the effect of smallholder farmers' education on AIV marketing. Results in Table 4 revealed that the farmer's level of education was highly significant [$\beta=2.3355$, $t=10.4683$] at a 1% level of significance. It is anticipated that as smallholder farmers' level of education increases, they tend to produce and market more to traders and consumers. Nevertheless, this contradicts with prior beliefs and results of similar research by Krause et al. (2019) and Neven et al. (2011), which established

that smallholder vegetable farmers with more knowledge are anticipated to have a good understanding of the entire production process, marketing strategies, supply requirements and price negotiations are more likely to perform well in the market. This calls for interventions by training and research institutions like World Vegetable Center and HORTI-Tengeru, TAHA and SIDO to be highly involved in building smallholder farmers' capacity in areas of production and marketing as emphasized by Musebe et al. (2017).

The fourth relationship is on the influence of smallholder farmers' household size on AIV marketing. Results in Table 4 reveal a positive and significant relationship [$\beta=1.1008$, $t=5.733$] at a 1% level of significance. Thus hypothesis four (H_4) is accepted and it is concluded that smallholder farmer's household size has a positive effect on AIV marketing. This means that a unit increase in smallholder farmers' household size increases the probability of participating in AIV marketing by 0.1920 times (Table 4). This suggests that smallholder farmers with large family sizes, family labour could be used to lessen some operational costs. This is supported by Mwema and Crewett (2019) who revealed that household size has positive marginal effects on the commercialisation of AIV. The size of a smallholder farmer's household can influence their participation and performance in AIV marketing. Larger households may have more labour available to contribute to production and marketing activities, which can increase the volume of goods produced and marketed. Additionally, larger households may have more diverse skills and knowledge, which can enable them to engage in multiple stages of the value chain and access more profitable markets. On the other hand, larger households may also face greater constraints in terms of resources and labour allocation, which could limit their ability to engage in AIV marketing.

The fifth relationship is on the influence of smallholder farmers' farm size on AIV marketing. Results indicate a positive and insignificant relationship between smallholder farmers' farm size on AIV marketing [$\beta=0.3217$, $t=1.4272$] at a 1% level of significance. Hence, hypothesis one (H_5) is not accepted and this implies that the probability of smallholder farmer's farm size decreases with AIV marketing by 0.2254 times. This is against pieces of literature by Endris et al. (2020) and Okoboi and Nakelse, (2019) who found a positive and significant relationship between farmers' age and vegetable marketing. The result further contradicts the common expectation that the larger the size of the farm would result in more vegetables being produced for sale. It is very common that smallholder farmers' farm size can also influence their participation and performance in AIV marketing. Generally, farmers with larger farm sizes may have greater economies of scale in production, which can lead to lower production costs and higher profits. Furthermore, older farmers may have more established networks and relationships with traders and buyers, which can provide them with better market information and access to market opportunities. Additionally, larger farms may be better equipped to comply with market standards and regulations, such as those related to quality and food safety, which can enable them to access more lucrative markets. Herein, the hypothesised relationship was found to be insignificant due to the fact that a large number of farmers (see Table 2) have small farms and even those with larger farms face greater constraints in terms of access to credit, inputs, and labour, which could limit their ability to engage in AIV marketing.

The sixth relationship is on the influence of smallholder farmers' trading experience on AIV marketing. The results in Table 4 show a positive and significant relationship [$\beta=0.3267$, $t=2.63255$] at a 1% level of significance. Hypothesis 6 is therefore accepted and a conclusion made is, that smallholder farmer's trading experience is positively influencing participation in AIV marketing. This means that an increased unit in trade experience increases the probability of participating in AIV marketing by 0.1241 times. This means that farmers with more trading experience may have a better understanding of market dynamics, including price fluctuations, buyer preferences, and market requirements. This knowledge can enable them to make better market decisions, negotiate prices, and access more profitable markets. Furthermore, trading experience can help farmers establish and maintain relationships with buyers, traders, and other market actors, which can increase their access to market information and opportunities. Farmers with trading experience may also have more established networks of suppliers, input providers, and other support services, which can enhance their production and marketing capabilities (Agrawal, 2022; Mgale, & Yunxian, 2020).

The seventh relationship is on the influence of marketing infrastructure on AIV marketing. The coefficient of market infrastructure was positive and significant [$\beta=1.07648$, $t=1.7903$] at a 10% level of significance. This suggests that a unit rise in access to market infrastructure will lead to 0.6013 participation in AIV marketing. This observation is supported by Mphafi et al. (2019) who revealed that infrastructure

increases significantly participation in informal markets by AIV farmers. Likely, Ismail (2022a) and Oyedele and Adenegan (2017) emphasized the need to strengthen infrastructures to promote the marketing of farm produce. It should be noted that strengthening agricultural infrastructure such as physical infrastructure like transportation, storage, processing facilities, financial services and market information systems is crucial for promoting the marketing of farm produce in developing economies (Khapayi & Celliers, 2016; Mustafiz et al., 2021).

The eighth hypothesised relationship is on the influence of AIV varieties on AIV marketing. The results in Table 4 show that the variety of AIV planted in farming were significant [$\beta=1.0780$, $t=6.2821$] at a 10% level of significance. This implies that one becomes more productive with experience and varieties of plants, and thereby performs well in the marketplace. This contradicts the observation by Chepkoech et al. (2018) and Oyedele and Adenegan (2017) on the need for the availability of varieties of quality, affordable and resistant AIV seeds for increased yield and quantities produced.

The ninth and tenth hypothesised relationships were on the influence of market information and market channel on AIV marketing. Results in Table 4 show that, both market information and market channel were also found to be positive and significant [$t=5.2966$, $\beta=0.9232$; $t=2.07848$, $\beta=0.4926$] at a 10% level of significance. This implies that with access to market information (on prices, customer characteristics and behaviours, farm inputs) and market channels and market infrastructure facilities, producers of these vegetables would participate and perform well in the marketplace. This finding is supported by Krause et al. (2019) and Weinberger and Lumpkin (2013) who established that access to marketing information is vital for the marketing of AIV as it increases gains and reduces household poverty levels. Also, access to marketing information is a crucial factor for the successful marketing of farm products, especially for smallholder farmers in developing countries as it also allows them to make informed decisions on pricing, timing, and quality of their products, which can significantly impact their profits and market success (Arumugam et al., 2022; Matsane, & Oyekale, 2014; Nyagango et al., 2023). Additionally, the strong correlation between the independent variables (socio-economic domains and marketing patterns) and AIV marketing (dependent variable) is evidenced by the significant R value of 0.8786. Furthermore, the results presented in Table 4 indicate that the independent variables accounted for 77.2 percent ($R^2 = 0.772$) of the variation in the dependent variable.

6. Contribution to literature

This study added to the body of literature by underlining the determinants of AIV marketing with a focus on socio-economic factors and market patterns. In addition, an interactive marketing framework for policymakers and AIV smallholder farmers on better marketing strategies and relationships among marketing patterns is developed. Finally, the study reveals several methodological and contextual gaps which are substantial to advance an essential research agenda for forthcoming research.

7. Study implications, conclusion and recommendations

There are several practical implications drawn from this study. It is confirmed that market infrastructure, marital status, farming experience, education level, household size, variety of these vegetables, marketing channel and information constituted the main aspects that determined its marketing pattern. Therefore, farmers who are well educated are able to prepare better marketing strategies than the traditional market suppliers and thereby participate well and supply in vegetable markets. Thus, policies have to be reformed and targeted at promoting literacy amongst AIV smallholder farmers. Secondly, households with a greater number of individuals ought to be stimulated to make effective use of household labour in marketing AIV and capitalize on their comparative advantage over other economic projects in an attempt to improve households' economies in the study area. Thirdly, the findings on marketing factors reveal that market infrastructure, market information, market channels and farm size are positively and significantly influencing the marketing of these vegetables. Hence, smallholder vegetable farmers must increase their ability to use large-scale farms with better marketing strategies and patterns for increased production of African indigenous vegetable potentials and active participation in vegetable markets.

Based on the information provided, we can conclude that there is a positive and significant relationship between the level of education, marital status, and household size of smallholder farmers and their engagement in AIV marketing. This implies that smallholder farmers who have larger households and are married are more likely to engage in AIV marketing. This may be due to their access to more resources, such as labour and land, which can enable them to produce and sell more products. Additionally, being married may provide them with greater social and economic support, which can also contribute to their success in the marketplace.

Also from the study findings, it is concluded that smallholder farmers with trade experience, access to market information, use of AIV varieties, and diversified market channels have a positive and significant relationship with their engagement in AIV marketing. This suggests that these marketing patterns can enhance smallholder farmers' market competitiveness, improve their ability to adapt to market changes and increase their profitability. The positive relationship between trade experience and AIV marketing suggests that farmers who have experience in trading commodities may be better able to negotiate prices, identify market opportunities, and develop relationships with buyers. Access to market information, on the other hand, can help farmers make informed decisions about what to produce when to produce, and where to sell their products. The use of AIV varieties can also improve farmers' productivity and product quality, which can result in higher market prices. Lastly, diversified market channels can provide farmers with greater market access, reducing their reliance on a single buyer or market. This can help farmers reduce price risks, improve market competitiveness, and increase their bargaining power.

This study also recommends the need to come up with policy reforms which will enhance literacy among vegetable smallholder farmers is highly recommended in this study. This will strengthen farmers' access to market information and therefore sell these vegetables profitably. Furthermore, farmers have to be frequently trained on the variety of AIV with high market demand. In addition, families with a greater number of individuals should be sensitised to make effective use of household labour to enhance marketing of these vegetables and capitalize on their comparative advantage over other economic projects in an attempt to improve households' economies in the study area. The study also recommends a holistic marketing framework for policymakers and actors in these vegetables on designing better marketing institutions and strategies for strengthened participation in vegetable markets among small-scale farmers actively engaging in AIV in Tanzania and other developing economies.

8. Study limitations and further studies

This study examined the determinants of African indigenous vegetable marketing among smallholder farmers in Arusha Tanzania, while applying quantitative approaches. Forthcoming research may adopt a qualitative approach to surface a wide perspective of this subject matter. Furthermore, this study used small-scale vegetable farmers as sampled respondents. Other studies can use vegetable brokers and agents to find out how actors in other nodes of vegetable value chains are involved in the marketing system for the sustainability of food systems in developing economies. Further research may also be necessary to determine the factors that contribute to successful AIV marketing among smallholder farmers. Finally, longitudinal methods can be used in future to understand changes in the variables used in the current study over time.

Note

1. These vegetable includes: Amaranth leaf (*Mchicha*), Nightshade leaf (*Mnavu*), African eggplant (*Nyanya chungu*), Cassava leaf (*Kisamvu*), Ipomea leaf (*Matembele*) Ethiopian mustard leaf (*Sukuma wiki*), Okra (*Bamia*), Cowpea leaf (*Kunde*), Squash leaf (*Maboga*), and Spiderflower leaf (*Mgagani*) (Kazungu & Nyagango, 2020; Mworio, 2021; Weinberger & Pichop, 2009;). [The italicized AIV names are in the *Swahili language*, which is commonly used in the East, Central and some parts of Southern Africa].

Disclosure statement

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