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Market outlet choices for African Indigenous Vegetables (AIVs): a socio-economic analysis of farmers in Zambia

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Abstract

Agricultural research institutes in Sub-Sahara Africa have focused on establishing farmer groups that facilitate the commercial production and marketing of African Indigenous Vegetables (AIVs) to address food and nutritional security. With the freedom of selecting the choices of market outlets, we explored the factors such as farmers' characteristics, farm attributes, selling preferences, social relations, and other primary reasons that influence farmers' decision to choose a particular outlet to sell AIVs. A purposive random survey was conducted among the AIV farmers to understand the preferred market outlets for AIVs in Zambia. The results of the multinomial logit model indicate that male respondents are more likely to choose intermediary options to sell AIVs, particularly brokers and wholesalers. The rainfed farmers and those who receive primary income from farming activities are less likely to choose retailers and wholesalers to market their AIVs. Similarly, those who expect instant payment for their produce indicate that they are less likely to prefer retailers and brokers. Farmers who belong to the farmer's group exhibited a positive coefficient, meaning that they are more likely to choose intermediary options to sell their AIVs compared with the farmer-to-consumer direct sales option. However, good price, a positive momentum of AIVs price in the past, and processing activities were found to be insignificant determinants for market outlet choices when compared with farmer-to-consumer direct outlet option. Our findings could help to better cognize AIVs marketing channels and develop the intervention for new farmers to make an informed decision as to how best to market their AIVs.

Keywords: African Indigenous Vegetables (AIVs), African Traditional Vegetables, Farmers preference, Choice experiments, Decision-making, Profitability

Introduction

Small-scale farmers in developing countries have inadequate market opportunities to sell their farm products at a profitable price. Indigenous and traditional crops are comparatively less popular in the commercial market because of various reasons that include low levels of acceptability and access, limited market information, lack of processing technologies, intrinsically weak value chains and technologies to push the indigenous crops to the broader commercial markets (Mabhaudhi et al. 2019; Kasolo et al. 2018; Omotayo and Aremu 2020). Often the indigenous crops are considered underutilized

since these crops are generally harvested from wild populations that are probably considered weeds. However, indigenous vegetables have an advantage over staple crops, as they are well adapted to the local climatic conditions and tolerant to biotic and abiotic stresses (Weinberger and Lumpkin 2007). To drive the development agenda for the smallholder, a pervasive change of the farms from semi-subsistence, low input, low-productivity approaches to intensive, market-oriented approaches is needed (Olwande et al. 2015; Fischer and Qaim 2012).

In recent years, many Sub-Saharan African (SSA) countries have experienced considerable changes in agri-food sectors including demand and supply-side components. This transformation in the food system on the demand side is driven by dramatic changes in consumer preferences, tastes, and food choices (Vroegindewey et al. 2021; Tschirley et al. 2015; Udomkun et al. 2021). Although, the supply-side relies on productivity growth (Agamile et al. 2021; World Bank 2008; Barrett 2008; Alene et al. 2008) and improved access to markets (Fischer and Qaim 2012; Obi 2010; Chamberlin and Jayne 2013). Productivity growth involves upgrading technologies, dissemination, and adoption of high-yielding crop varieties. The productivity advancing technologies help to achieve marketable surpluses that lead to increased household income and livelihoods. This is referred to as the "agricultural productivity pathway" for the sustenance of agriculture and to eradicate poverty (Barrett 2008). Still, productivity growth alone is not enough to address the challenges encountered by farmers when marketing their agricultural produce (Obi 2010; Jagwe et al. 2010). The farmers in SSA have weak or nonexisting markets due to a lack of coordination among the community and high costs of transactions (Namonje Kapembwa et al. 2022; Obi 2010). Under this market situation, productivity enhancement technology provides only marketable surpluses but may not generate significant economic benefits for the farmers (Obi 2010; Jagwe et al. 2010; Minot and Ngigi 2004).

Further, contract farming has the potential to connect farmers to global markets and limit market channel choices. However, in SSA where contract enforcement is weak, inadequate institutional support and infrastructural developments are considered as major restrictions to smallholder farming than low productivity (Gerard et al. 2022; Namonje-Kapembwa et al. 2022; Alene et al. 2008; Pingali et al. 2005). Often, poor infrastructure and limited supporting services reduce the farmer's interest in market participation (O'Cass and Viet Ngo 2012; Fischer and Qaim 2012; Key et al. 2000; Omamo 1998). Smallholders are also excluded from emerging markets due to the enforcement of quality standards and modernization of procurement systems (Olwande et al. 2015; Okello et al. 2008). These challenges, combined with seasonal cash shortages, lack of produce handling facilities, and limited market information weaken farmers' position along the value chain in Sub-Saharan Africa (Vroegindewey et al. 2021; Pokhrel and Gopal 2007). Given this reality, researchers have recommended that addressing smallholder productivity growth must be coupled with measures to enhance market access for agricultural commodities (Fischer and Qaim 2012; Alene et al. 2008).

In Sub-Saharan Africa, several intervention projects have focused on productivity growth and market access in order to improve their food and nutritional security. For instance, research and development of indigenous vegetables have focused on eco-geographic assessment, collection, evaluation, and identification of promising germplasm

(Brindisi et al. 2020; Chadha et al. 2007; Dinssa et al. 2020) the nutritional and health contributions of AIVs (Mebelo et al. 2020; Somers et al. 2020) and strengthening the value chain (Govindasamy et al. 2020). Further, past studies indicate that most farmers would prefer to sell their produce in modern market outlets. In reality, this may not always be possible or even desirable (Blandon et al. 2009; Guo et al. 2007; Masakure and Henson 2005).

In this paper, we examine farmers' behaviour in decision-making related to market outlet choices for AIVs by using representative samples of the farmers in Zambia. Gaps in knowledge concerning AIVs to be addressed with outlet choices to promote and expand the market options for wider production, fair market operation, and necessary infrastructure developments. Against this background, this paper addresses these research gaps by analysing the factors that influence farmers to choose a particular outlet to market AIVs.

Methodology

Data

The baseline production survey for African Indigenous Vegetables (AIVs) was conducted in Lusaka and the Eastern provinces of Zambia. The AIV producers from a total of six districts from two provinces were interviewed: (1) Lusaka and Chongwe districts from Lusaka Province; and (2) Chipata, Lundazi, Katete, and Petauke districts from Eastern Province. The purposive random survey was conducted from 19 October 2015 to 6 November 2015. The study population included 50 producers from Lusaka Province and 250 from Eastern Province. These survey participants/producers grow African Indigenous Vegetables for home consumption, sale, or both. The survey participants were mostly farmers who belonged to cooperatives. Also, the purpose of the survey was explained to the farmers, and consent was obtained before collecting the information required for the survey. A purposive random survey was conducted by using a well-structured interview questionnaire to collect data on the production of AIVs. Local names of the indigenous vegetables were used during the survey to help farmers identify the vegetables. The survey was administered in English and also in the appropriate provincial native languages through face-to-face interview method. English, Soli, Bemba, Tonga, and Nyanja languages were used in Lusaka Province; and Tumbuka, Chewa, and Nsenga languages were used in the Eastern Province.

Empirical model

Producers choose various market outlets to sell their agricultural products in order to maximize their profits. However, selecting an appropriate market channel is not an easy task because there are different factors that influence market outlet choices. The choice experiment models were originally developed to analyse the preferences of consumers. However, they can also be used to analyse the preference of farmers as sellers (Roe et al. 2004; Blandon et al. 2009). Many studies have been conducted to reveal factors influencing marketing channel choice decisions. Multinomial probit/logit, multivariate probit/logit, conditional or mixed, or nested logit models are appropriate for analysing categorical choice-dependent variables. A study by Kifle et al. (2015), Atsbaha (2015), Bezabih et al. (2015), Bongiwe and Micah (2013), Roe et

al. (2004) attempted to determine factors influencing producers' market outlet choice using a multinomial logit model. However, Abate et al. (2019), Djalalou-Dine et al. (2015) and Shewaye (2016) employed a multivariate probit model to analyse factors affecting producers' market outlet choice.

Multinomial models are appropriate when individuals can choose only one outcome from among a set of mutually exclusive, collectively exhaustive alternatives (Tse 1987; Hensher et al. 2005; Seo and Mendelsohn 2008; Rossini et al. 2014; Arumugam et al. 2014; Lang and Shao 2019; Arumugam et al. 2018). Therefore, based on the empirical studies reviewed, multinomial logit regression was employed to decompose the factors contributing to the likelihood to choose a particular outlet among the available options to sell AIVs. The AIV producers were mapped into four marketing outlets: sales to consumers, brokers, retailers, and wholesale. The AIVs producing farmer i was able to choose from a set of alternatives ($j=1$, 2, 3, and 4) which provided a certain level of utility U_{ijt} from each alternative. This model was based on the principle that the farmer will choose an outlet that will maximize his/her utility. However, it is not possible to directly observe the utilities but the choice made by the farmer revealed which marketing outlet provides the greater utility (Greene 2012; Djalalou-Dine et al. 2015). Following random utility theory an individual's utility can be expressed as (Louviere et al. 2000; McFadden 1986):

$$U_{ijt} = V_{ijt} + \varepsilon_{ijt} \tag{1}$$

The MNL model for market outlets choice enumerates the relationship between the probability of choosing an option j ($j=1$, 2...) and a set of explanatory variables X (Hausman and McFadden 1984). This study assumed that each farmer faces a set of discrete, mutually exclusive options of market outlets. The utility maximization that ith AIVs grower attains alternative jth choice/option and tth situation is disintegrated into (1) a part labelled V_{jit} that is recognized (known part), and (2) an unknown part ε_{jit} which captures variations in choice due to within and between individual variance, omitted variables and measurement errors (Batsell and Louviere 1991) and which is treated as the error term.

The probability that ith farmer choose jth option over kth alternative and the situation/time t is equal to the probability that the utility of j is greater than (or equal to) the utility of k after evaluating all alternatives in a given choice of $k=1..j...K$ alternatives. This is given by,

$$\text{Prob}_{ijt} = \text{Prob}(U_{ijt} \geq U_{ikt}) \quad \forall k \in k = 1, \ldots, k;\ k \neq j. \tag{2}$$

The probability equation is,

$$\text{Prob}_{ijt} = \text{Prob}[(V_{ijt} + \varepsilon_{ijt}) \geq (V_{ik} + \varepsilon_{ik}) \quad \forall k \in k = 1, \ldots, k;\ k \neq j] \tag{3}$$

Reordering the equation with respect to utility maximization,

$$\text{Prob}_{ijt} = \text{Prob}[(\varepsilon_{ikt} - \varepsilon_{ijt}) \leq (V_{ijt} - V_{ikt}) \quad \forall k \in\ k = 1, \ldots, k;\ k \neq j] \tag{4}$$

The options of choice models arise with the assumed error structure of above ε_{jkt} (Dow and Enders 2004). If the εit's are independently and identically distributed

choosing *j*th option among alternatives *k*th and *i*th individuals with an extreme value distribution, the probability of farmers *i*th choosing alternative *j*th among *k*th is given by the multinomial logit (MNL) model:

$$p_{ijt} = \frac{\exp^{\beta_{ijt} v_{jt}}}{\sum_{k=1}^{j} e^{\beta_{ikt} v_{kt}}} \tag{5}$$

The MNL model parameters can be estimated by the maximum likelihood (ML) method using an iterative nonlinear optimization technique such as the Newton–Raphson Method. These estimates are consistent and asymptotically normal (CAN) under standard regularity conditions (McFadden 1986).

Assume that the MNL model utility function can be written linearly in its parameters: $U_{ij} = \beta 0 + \beta_1 V_{ij} + \varepsilon_{ij}$ Where U_{ij} = farmers maximum utility derived from alternative *j*.; $\beta 0$ = constant term; $\beta 1$ = parameter estimate; V_{ij} is a vector of observed variables relating to alternative *j*. With this background, the probabilities become.

The multinomial logit regression is formulated as:

$$\begin{aligned} &\textit{Market Outlet choices (Direct to Consumer; Brokers, Retailers, and Wholesale Market)} \\ &= \beta 0 + \beta 1\_\textit{Gender} + \beta 2\_\textit{Family\_Size} + \beta 3\_\textit{Acre} + \beta 4\_\textit{Good\_Price} \\ &\quad + \beta 5\_\textit{Home\_Consumption} + \beta 6\_\textit{Rainfed\_Farming} \\ &\quad + \beta 7\_\textit{Process\_Sell} + \beta 8\_\textit{Weekely\_visit} + \beta 9\_\textit{Price\_Awareness} \\ &\quad + \beta 10\_\textit{Paid\_immediately} + \beta 11\_\textit{Local\_Mkt} + \beta 12\_\textit{Info\_Price} \\ &\quad + \beta 13\_\textit{Farmers Group} + \beta 14\_\textit{Married\_RR} + \beta 15\_\textit{Age\_RR} \\ &\quad + \beta 16\_\textit{Upto\_Sec\_RR} + \beta 17\_\textit{Informal\_Edu\_RR} \\ &\quad + \beta 18\_\textit{Farming\_Primary} + \beta 19\_\textit{Save\_Money} + \varepsilon \end{aligned} \tag{6}$$

Results

The multinomial logit (MNL) model assumes that respondents have homogenous preferences. But in truth, the preferences may differ with respect to availability and situation. Four types of outlets were found to fit the market situation. In this model 71%, 17%, 7%, and 5% of the farmers prefer farmers to consumers' direct outlet options, wholesale markets, brokers, and retailers, respectively. The estimation results of the MNL model revealed the selected attributes, viz. farmer's characteristics, farm attributes, selling preference, social relations, and other primary reasons are the important determinants of an outlet choice by the farmers. The description of MNL model explanatory variables is presented in Table 1.

The estimated result of the model was satisfactory with a pseudo R^2 of 0.5596. A chi-square value *LR* chi^2 value 288.35 rejects the null hypothesis that the independent variables collectively do not contribute toward change in the dependent variable (*p* value of 0.000). From our estimated results, farmers will consider many attributes when he/she decide to choose a particular outlet to market their produce. Further, they rely on various sources including personal experiences for market information. Table 2 presents the results of the MNL model for selected attributes and the overall sample. The (1) individual characteristics significantly influence the farmer's decisions to choose a

Table 1 Description of explanatory variables

S. no.	Description	Levels	Per cent/mean
1	Grower characteristics	Gender—male	52%
		—female	48%
		Up to secondary school	68%
		Age above 50 years old	35%
		Married	80%
2	Farm characteristics	Average acreage	4.87
		Home consumption	69%
		Processing	28%
		Rainfed farming	44%
		Primary income from farming	82%
3	Selling preferences	Good price	40%
		Extra income	22%
		Weekly visit to nearest market	65%
		Paid immediately	87%
		Price increased in the past 5 years	62%
4	Social relations	Average family size	6.79
		Member of farming group	49%
		Participated AIVs training	92%
5	Other primary reasons for outlet choice	Price awareness before to sell	81%
		Informal education	74%
		Save money for unexpected expenses	74%

particular outlet to sell AIVs. For instance, male farmers are more likely to choose both brokers and wholesalers to sell their AIVs compared with farmers to consumers' direct sales option. However, married farmers are more likely to choose retailers and less likely to choose brokers, similarly, those who studied up to secondary school education are more likely to choose a wholesaler whereas those who are above 50 years old are less likely to choose wholesalers market compared with farmers to consumers' direct sales option. Further, (2) the farm attributes also considerably influence the farmer's decision to choose preferred outlets for AIVs. The estimated results denote that the acreage had a positive effect; thus, higher acreage levels lead to increases in the likelihood to choose both retailers and wholesalers as the market outlets for AIVs when compared with farmers to consumer's direct sales option. However, rainfed farmers are less likely to choose both retailers and wholesalers as preferred market outlets for AIVs. Farmers who grow indigenous vegetables for home consumption have a negative significant coefficient indicating that farmers are less likely to choose the wholesaler; also, those who receive primary income from farming are less likely to choose both brokers and wholesalers to market their AIVs when compared with farmers to consumers' direct sales option.

In addition to price and income, attributes related to the (3) selling preferences are found to be an important attribute to choose a particular outlet for agricultural produce. Our estimated results stated that the AIVs price was increased in the past 5 years and those who received good prices for AIVs were found to be an insignificant determinant for outlet choices when compared with farmers to consumers' direct outlet option. It denotes that farmers may not get a good price for AIVs in the different

Table 2 Multinomial logit model (MNL) coefficient of AIVs marketing outlets

S. no.	Description	Particulars	Brokers		Retailers		Wholesalers	
			Coef.	Std. err.	Coef.	Std. err.	Coef.	Std. err.
1.	Grower characteristics	Gender	1.844***	0.737	− 0.978	1.057	1.580***	0.675
		Upto_Sec_RR	0.637	0.682	− 1.274	1.094	1.505*	0.811
		Age_Above 50	0.462	0.705	0.503	1.008	− 2.280***	0.824
		Married_RR	− 1.246*	0.760	2.695*	1.650	− 0.263	0.938
2.	Farm attributes	Average Acreage	− 0.038	0.067	0.210**	0.111	0.250**	0.125
		Home_Consumption	− 0.840	0.721	− 0.448	1.157	− 2.240***	0.841
		Process_Sell	− 0.441	0.681	0.721	1.055	0.158	0.700
		Rainfed_Farming	− 0.956	0.725	− 3.254**	1.506	− 1.507*	0.839
		Primary Inc. Farming	0.109	1.068	− 2.771**	1.512	− 2.504***	1.006
3.	Selling preference	Good_Price	0.708	0.692	− 1.754	1.516	0.912	0.812
		Extra_Income	1.469**	0.717	1.035	1.067	0.962	0.732
		Weekely_Visit	0.003	0.643	1.442	1.169	2.228***	0.742
		Paid Immediately	− 1.535**	0.748	− 4.488***	1.290	− 1.316	0.830
		Price_ Increas_5Year	− 0.133	0.618	− 0.731	1.110	− 0.157	0.680
4.	Social relation	Ave. Family Size	− 0.114	0.127	0.223	0.220	− 0.059	0.125
		Farmers_Group	1.503**	0.698	3.848***	1.634	4.931***	1.301
		EX_Training	− 1.395*	0.774	0.570	1.604	− 1.163	1.225
5.	Other primary reasons for outlet choice	Price_Awareness	− 0.655	0.652	− 0.281	1.121	− 1.273*	0.698
		Informal_Edu_ RR	− 0.203	0.788	− 2.274*	1.411	0.008	0.871
		Save_ Money	− 0.698	0.617	1.077	1.404	0.093	0.713
		_cons	0.952	2.139	− 3.908	3.790	− 0.401	2.271
		Log-likelihood	− 113.443					
		Number of obs	297					
		LR chi2(60)	288.35					
		Prob > chi2	0.0000					
		Pseudo R2	0.5596					

***1%, **5% and *10% significant

market outlets. Further, paid immediately was found to be a negative and highly significant coefficient that indicates that farmers are less likely to prefer retailers and brokers when compared with farmers to consumers' direct sales option. On the other hand, those who are willing to sell AIVs for an extra income prefer to choose brokers, and those who visit a local market once a week prefer to choose a wholesale market to sell their AIVs when compared with farmers to consumers' direct sales option. Our results, however, demonstrate some evidence related to (4) social relations and their influence on the grower's decision to pick a market outlet to sell AIVs. The estimated results confirm that the farmer's group exhibited a positive coefficient, meaning that

they are more likely to choose brokers, retailers, and wholesalers to sell their AIVs, whereas those who attended extension training related to AIVs production and marketing are less likely to choose brokers compared with farmers to consumers direct market outlet option. Finally, (5) other primary reasons, viz. price awareness, informal education, and money-saving behaviour of the farmers are also considered important variables to choose a particular market outlet. Among these reasons, farmers who are aware of the AIVs market price are less likely to choose a wholesaler. Similarly, those who received informal education are less likely to choose brokers to sell their AIVs compared with farmers to consumers' direct market outlet option.

Discussion

In general, the male farmers prefer brokers and wholesalers to sell AIVs as compared with female counterparts because they are performing exceedingly well in bargaining, negotiating and enforcing the contract with brokers (Cunningham et al. 2008; Maina et al. 2012). However, women are observed to participate more in farmers to consumers' direct market outlet option as compared to their male counterparts because of the ability of women to sell in small quantities (Agamile et al. 2021; Cunningham et al. 2008; Maina et al. 2012). The age of the farmers, marital status, and level of education have a significant influence on choosing outlet options to sell AIVs. For instance, those who are above 50 years old are less likely to choose a wholesale market to sell their AIVs. This may be the reason that older people would prefer direct transactions like farm gate prices immediately offered by the broker. Also, they trust retailers and brokers because they may have developed a long-term relationship (Adegbola and Gardebroek 2007; Sall et al. 2000) unlike, young people who have longer planning horizons and might be more willing to take risks (Zegeye et al. 2001).

The farm attributes including acreage, home consumption, processing, rainfed farming, and received primary income from farm-based activities are significant influences on the outlet options when compared with farmers to consumers' direct sales option. In this case, AIV's marketable surpluses are generally less on small and marginal farms, and their proportions depend on the size of holding allocated to primary crops and AIVs (Abafe et al. 2021; Alene et al. 2008; Fischer and Qaim, 2012; O'Cass and Viet Ngo 2012). Hence, farmers preferred direct to consumers outlet option to sell small quantities (Cunningham et al. 2008).

Explaining the importance of selling preferences are upfront: Market outlet choices are primarily characterized by price awareness including processing, farm gate/current price, and movement of price over the period of time. Whereas profitable prices and positive price movements of AIVs over the time period were found to be insignificant determinants of the market choice. It denotes that farmers may not get a good price for AIVs because production and consumption of traditional vegetables in Sub-Sahara Africa remains low due to cultural values, human perceptions, and lack of consumer awareness about the benefits (Faber et al. 2010; Afari-Sefa et al. 2016; Vorster et al. 2007). Further, farmers prefer to receive cash immediately for their produce. So the farmers to consumers' direct market outlets choices are preferred by the farmers to sell AIVs and have many advantages including competitive pricing, direct contact with consumers to get a better understanding of them, and being able to freely experiment with new

products and gain their feedback. Likewise, farmers grow AIVs for additional income and they traded with brokers because they trust and may have formed a long-term relationship (Adegbola and Gardebroek 2007; Sall et al. 2000).

The social relation variables including average family size, farmers' group and extension training also influence the farmer's decision to pick an appropriate market outlet to sell their produce. The estimated results indicated that the farmer's group showed positive effects, meaning that farmer's group members prefer all the networks including brokers, retailers, and wholesaler options to sell their AIVs compared with farmers to consumers' direct outlet option. Social networks in which farmers are embedded or have purposefully created to support and help the farmers' innovation efforts by providing relevant knowledge and other resources (Abafe et al. 2021; Fadden and Gorman 2016; Klerkx et al. 2013; Hilkens et al. 2018; Van Rijn et al. 2012). Likewise, farmers who have attended extension training and received informal education may not prefer brokers to sell their produce. The training and informal education allow greater access to formal research-based knowledge, innovative experiences elsewhere, and financial resources (Ruiu et al. 2017; Saint Ville et al. 2016; Yu et al. 2013) including opening, diversifying forms of production, and business opportunities.

In our study, the original dataset was also used to quantify the farmers' preference for AIVs market outlets on the estimated marginal effects. Since the value of the coefficient can be directly interpreted in the above section, we, therefore, provide the marginal effects in the table form. Marginal effects that is, the change in predicted probability (per cent changes) of an outcome changes associated with changes in the explanatory variables (Table 3).

Table 3 Marginal effects of multinomial logit estimation of AIV outlets

S. no.	Description	Variable	Brokers	Retailers	Wholesalers
1.	Grower characteristics	Gender	8.35%	–	2.13%
		Upto_Sec_RR	–	–	1.71%
		Age_Above 50	–	–	− 2.75%
		Married_RR	− 7.85%	0.17%	–
2.	Farm attributes	Average Acreage	–	0.02%	0.35%
		Home_Consumption	–	–	− 5.38%
		Processing	Not significant		
		Rainfed_Farming	–	− 0.40%	− 1.99%
		Primary Inc. Farming	–	− 0.87%	− 9.15%
3.	Selling preference	Good Price	Not significant		
		Extra_Income	9.48%	–	–
		Weekely_Visit	–	–	2.66%
		Paid_Immediately	− 10.51%	− 4.23%	–
		Price_Increas_5Year	Not significant		
4.	Social relation	Average Family Size	Not significant		
		Farmers_Group	5.75%	0.59%	13.85%
		EX_Training	− 10.20%	–	–
5.	Other primary reasons for outlet choice	Price_Awareness	–	–	− 2.62%
		Informal_Edu_RR	–	− 0.50%	–
		Save money	Not significant		

Conclusion

We examined socio-economics factors that influence the farmer's decision to choose a particular marketing outlet to market AIVs. Our estimated MNL model results denote that individual characteristics, farm attributes, selling preferences, social relations, and others significantly influence the farmer's decisions to choose particular outlets to sell AIVs. The results revealed that male respondents are more likely to choose brokers and wholesalers to sell AIVs. Farmers, those who received primary income from farming activities, and rainfed farmers are less likely to choose retailers and wholesalers to market their AIVs. Likewise, those who expect immediate payment for their products are less likely to prefer retailers and brokers. The farmers who belong to the farmer's group observed a positive coefficient, indicating that they are more likely to choose intermediary options to sell their AIVs compared with the farmers-to-consumers direct sales option. However, good prices for AIVs, positive moments of price and processing-related variables were found to be insignificant determinants for AIVs outlet choices when compared with farmers to consumers' direct outlet option.

The processing and value addition activities are most important to get a good price for AIVs, however, they are found to be poorly developed in the marketing of AIVs in the SSA. This is true not only for AIVs but for horticultural crops, in general, as there is a lack of investment in horticultural crop processing in Africa (Lenné and Ward 2008). To create market opportunities for AIVs, it is important to change stakeholder perceptions and increase awareness of the health benefits of AIVs through community-based outreach, Information and Communication Technology (ICT)—enabled campaigns, and other educational programs with the support of international donors, local governments, NGOs, educational institutes and extension officers. Further, Farmers' producer organizations (FPO) and Public–Private Partnerships (PPP) along with the support of farmer groups can be created and thus could be considered a success in either linking farmers to the market, or opening up new marketing potentials including new product developments of AIVs. Such partnerships strengthen the member's knowledge and facilitate the exchange of information about market prices, demand, and market windows with other group members. Our findings could be used by the AIV farmers, consumers, marketers, and policymakers for a better understanding of farmer's preferences to sell AIVs through various channels and to develop the intervention training for new farmers and families so that they can make informed decisions as to how best to market their fresh produce.

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Author contributions

Conceptualization was contributed by SA and RG; methodology and software were contributed by SA; validation and project administration were contributed by JS, RG and EW; writing original draft preparation was contributed by SA; data curation, supervision, and visualization were contributed by EW, JS and RG; funding acquisition was contributed by JS, RG and EW. Improve the overall quality of the paper was contributed by BO. All authors have read and agreed to the published version of the manuscript.

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Availability of data and materials
The primary datasets used for the current study are available upon request.

Declarations

Competing interests
The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

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