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DETERMINANTS OF MARKET OUTLET CHOICE AMONG SMALLHOLDER IRISH POTATO FARMERS IN KINANGOP SUB-COUNTY, NYANDARUA COUNTY, KENYA

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ABSTRACT
The market outlet choice is among the key decisions in every farming household since the outlet chosen determines the profits accrued to the individual household. However, smallholder Irish potato farmers face challenges reaching their preferred outlets in Kenya. The research therefore, examined the determinants of market outlet choice among smallholder Irish potato farmers. A descriptive research design was employed to collect cross-sectional data on the year 2022 crop season from sampled 241 smallholder Irish potato growers. Smallholder Irish potato farmers were identified through cluster sampling and interviewed using a semi-structured pretested questionnaire. A multivariate probit model was used to investigate the determinants of market choices. The study revealed that 92.95% of smallholder Irish potato farmers sold their produce to brokers. The likelihood of smallholder farmers choosing the brokers was significantly influenced by land size, market distance, and phone access. Selecting the local market was significantly influenced by land size, gender, information access, market distance, extension, and phone access. The likelihood of choosing urban markets was significantly influenced by age, information, and phone access. The probability of selecting the contracts was influenced significantly by age, market distance, information, credit and phone access, and primary occupation. Therefore, the study recommends agricultural extension agents disseminate relevant information to smallholder Irish potato farmers to facilitate informed decisions when selling their produce.
Keywords: Market outlet choice; Market determinants; Irish potato; Irish potato farmers; Multivariate probit model.

INTRODUCTION

Irish potato is the world's third essential diet crop behind wheat and rice, contributing significantly to rural welfare and food security (Jo et al., 2022). Statistics reveal that over 1.3 billion people worldwide consume the crop, with production shifting in developing nations, especially East Africa and Asian countries (Gikundi et al., 2023; Karya Kate et al., 2019). The growth in production results from population growth and increased demand for processed Irish potato, including chips and crisps (Wakaba et al., 2022). Irish potato is a staple diet amongst other crops in Kenya, Uganda, Tanzania, and Rwanda (Wangithi et al., 2023). The crop is Kenya's second most important agricultural produce behind maize, and smallholder farmers dominate production (Orare et al., 2020). The crop's high productivity per unit of land and faster maturity period (<120 days) place the crop in a good position in alleviating poverty and improving the livelihoods among smallholder rural farmers in the county (Saleh & Awolola, 2022). However, the productivity of the crop in Kenya is still low (10 t/ha) compared to the ideal 30 t/ha but higher compared to African countries like Uganda, producing 7 t/ha (Chepkoech, 2022; Isaac, 2023). The low yields result from inadequate access to production inputs, financial support, advanced technology, and information asymmetry, especially between the farmers and markets as a result of the existence of brokers (intermediaries) (Nambafu et al., 2023; Wakaba et al., 2022; Kwambai et al., 2022).

Market outlet choice is among the fundamental decisions smallholder Irish potato farmers are faced with when selling their produce; weighing the costs and benefits that can be derived from that market to select the utility-maximizing market outlet (Ketema & Lika, 2023; Anthony et al., 2021). In Kinangop sub-county, Irish potato is the major crop and has emerged as the primary source of employment and income for most farmers in the area (Okaka et al., 2020; Wakaba et al., 2022). However, despite the crop's importance, the market outlet choice among smallholder farmers remains a critical, challenging decision. Literature reveals that most smallholder farmers sell potato to brokers, resulting in low produce prices (Kwambai et al., 2022). Therefore, understanding the market outlet choice determinants among the smallholder farmers in Kinangop sub-county to better their income becomes a serious concern. The process of Irish potato marketing and production is featured by seasonality that affects farmers' and producers' behaviors, inadequate linkage among the players in the market, information asymmetry, lack of storage infrastructure resulting in farmers selling their produce immediately after harvesting, leading to low prices, and poor coordination between the potato farmers to strengthen their bargaining power (Kuradusenge et al., 2023; Sakadzo et al., 2020; Wauters et al., 2022). Therefore, a responsive, efficient, and integrated market structure is vital in resolving market challenges through the optimum allocation of resources and making markets efficient (Bijmolt et al., 2021).

Among the factors that have been documented to influence smallholder farmers' decisions on the market outlet choice include age, gender, education level, household size, information access, transaction cost, extension service access, and market distance, among others (Abate et al., 2019; Mohammed-Kassaw et al., 2019; Endris et al., 2020; Mwembe et al., 2021; Chekol & Mazengia, 2022). In Kinangop sub-county, smallholder Irish potato farmers sell Irish potato in different market outlets to maximize the utility derived from the market or returns. Despite the situation, little has been done about the factors influencing the farmers' decisions on the market outlet. Consequently, a literature gap exists concerning the factors determining Irish potato smallholder farmers' market outlet choice in Kinangop sub-county. The study was therefore designed to analyze the determinants of market outlet decisions among Irish potato smallholder farmers in Kinangop sub-county using a Multivariate probit model.

STUDY METHODOLOGY

The research was conducted in the Kinangop sub-county of Nyandarua County, Kenya. The sub-county has eight wards, including Magumu, Nyakio, Njabini, Githabai, Engineer, North Kinangop, Gathara and Murungaro. The area lies between longitude 36^0 42' and 36^0 25' East and a latitude 0^0 32' and 0^0 50' South, at an elevation of 2667.11m. Farming is the predominant economic activity in the area, with milk and Irish potato being the first and second leading produce, respectively. The main crop is Irish potato, with the potential to increase production and marketing. The sub-county leads in Irish potato production in Nyandarua County (Kenya's top Irish potato producer).

Face-to-face interviews were conducted using a piloted semi-structured questionnaire to facilitate a systematic explanation of the questionnaire to smallholder Irish potato farmers. Ten percent of the sample size (25 farmers) were randomly selected from Kipipiri sub-county to pretest the questionnaire, which facilitated the adjustment of the questionnaire and check the questionnaire's validity and reliability. The respondents were informed of the study's objectives before the interviews to ensure the respondents participated voluntarily. Additionally, the study sought clearance from Chuka university ethics committee and obtained a license from the National Commission of Science, Technology and Innovation. A cluster sampling method was utilized to randomly select 241 Irish potato growers in the study area where Kothari (2004) sampling formula was utilized.

Econometrics analysis and descriptive statistics were employed to meet the study's specific objectives. Percentages, mean, frequencies and standard deviations were used in descriptive statistics, while a multivariate probit model was utilized for econometric analysis.

Multivariate probit model specifications

Smallholder Irish potato farmers (f) would select selling Irish potato to either brokers, local, urban, or contract market outlets. An individual farmer could select one market outlet (m) to sell Irish potato or select a combination of two or more outlets and, therefore, be faced with a problem of multiple choices. Based on the principle that smallholder Irish potato farmers could select one market outlet or combine the outlets to maximize utility, the study utilized a multivariate probit model to examine the aspects determining the market outlet decisions by Irish potato smallholder growers in Kinangop sub-county. The model showed the impact of a group of causal factors on the market outlet choice decisions and interactions among latent disturbances and the association between the choice of market outlet. The multivariate probit model was the best model utilized to measure Irish potato farmers' market outlet decision differences and jointly determine correlated binary results, given the likelihood of concurrent market outlet selection and correlations between the market outlet selection decisions. The binary equation of the dependent variables is specified in Equation 1.

$$A_{fm} = \alpha_m x_{fm} + \varepsilon_{fm} \quad (1)$$

where; A_{fm} represents the unobservable latent variable of the selected market outlet (Brokers, local market, urban market, or contract) by the f^{th} Irish potato farmer ($f = 1,2,3, \ldots, n$). α_m=*k*1* for vector parameters to be determined. ε_{fm} Are residual terms with a normal distribution, zero mean, and covariance matrix M (equation 4). Matrix M has one value on the main diagonal of the correlated outlets. Thus, the selection of the utility-maximizing market outlet m by Irish potato farmer f is A_{fm}. The choice of Irish potato smallholder farmer f to sell in the preferred market outlet m is $m(A_{fm} = 1)$ or otherwise $m(A_{fm} = 0)$ as given in equation 2.

$$A_{fm} = \begin{cases} 1 \text{ if } A_{fm} = x\beta_{fm} + \varepsilon_{fm} \geq 0 \Leftrightarrow x_{fm} \geq -\varepsilon_{fm} \\ 0 \text{ if } A_{fm} = x\beta_{fm} + \varepsilon_{fm} < 0 \Leftrightarrow x_{fm} < -\varepsilon_{fm} \end{cases} \quad (2)$$

The decision to select a market outlet relies on the selection of other outlets, and the choice decisions could be influenced by a similar set of explanatory variables, creating a system of econometric equations (Equation 3).

$$\begin{aligned} A_1^* &= x_1\alpha_1 + \varepsilon_{fm1} & A_1 &= 1 \text{ if } A_1^* \text{ is } > 0,\ A_1^* = 0 \text{ otherwise} \\ A_2^* &= x_2\alpha_2 + \varepsilon_{fm2} & A_2 &= 1 \text{ if } A_2^* \text{ is } > 0,\ A_2^* = 0 \text{ otherwise} \\ A_3^* &= x_3\alpha_3 + \varepsilon_{fm3} & A_3 &= 1 \text{ if } A_3^* \text{ is } > 0,\ A_3^* = 0 \text{ otherwise} \\ A_4^* &= x_4\alpha_4 + \varepsilon_{fm4} & A_4 &= 1 \text{ if } A_4^* \text{ is } > 0,\ A_4^* = 0 \text{ otherwise} \end{aligned} \tag{3}$$

where; A_1 , A_2, A_3, A_4 are brokers, local, urban, and contract market outlets, α^1 were estimated parameters, and ε are normally distributed error terms with a variance value of one and a zero mean. If ρ_{fm} Signifies the correlation between the market outlets, then symmetric matrix M can be estimated as in equation 4.

$$(\varepsilon_{fm1}, \varepsilon_{fm2}, \varepsilon_{fm3}, \varepsilon_{fm4}) \sim N\{(0), \begin{pmatrix} 1 & \rho_{12} & \rho_{13} & \rho_{14} \\ \rho_{21} & 1 & \rho_{23} & \rho_{24} \\ \rho_{31} & \rho_{32} & 1 & \rho_{34} \\ \rho_{41} & \rho_{42} & \rho_{43} & 1 \end{pmatrix}\} \tag{4}$$

RESULTS AND DISCUSSIONS

Preliminary Test

Test for multicollinearity

Before running the Multivariate probit model, an ordinary least-squire regression was run to check the presence of multicollinearity using the VIF (Variance inflation factor) command. VIF measured the degree of multicollinearity in the regression model by estimating an index that estimated the increase in the regression variance of the coefficient s estimated. The calculated VIF value was low (Table 1) when compared to the critical value (<10). Therefore, the null hypothesis that multicollinearity was absent among the explanatory variables was accepted. The variables were therefore, fit to be used for analysis.

Table 9: VIF and 1/ VIF results

Variable	VIF	1/VIF
Experience	2.00	0.499
Household age	1.85	0.542
Education years	1.42	0.704
Land under Irish potato	1.30	0.769
Credit access	1.30	0.772
Phone access	1.26	0.797
Group membership	1.18	0.846
Market distance	1.18	0.848
Extension access	1.17	0.856
Main occupation	1.16	0.866
Information access	1.15	0.871
Household size	1.13	0.883
Household head gender	1.05	0.957
Mean VIF	1.320	

Source: Field survey, (2023)

Test for heteroskedasticity

The Breusch-Pagan test was employed to evaluate heteroskedasticity between the dependent and independent variables. Breusch-Pagan / Cook-Weisberg test for heteroskedasticity.

Ho: Constant
variance
Variables:
fitted values of
e^2
chi2(1) = 567.63
Prob > chi2 = 0.000

The computed p-value was found to be 0.000, indicating the test was significant, thus rejecting the null hypothesis; there is constant variance. The findings implied unequal variance in the residuals across the explanatory variables; hence, heteroskedasticity was present. Therefore, robust standard errors (RSE) were utilized to correct the heteroskedasticity.

Social-economic and institutional characteristics of sampled smallholder Irish potato farmers

Smallholder farmers' social economic, and institutional characteristics play a relevant role when smallholder farmers make market outlet choice decisions. Table 2 reflects the description of Irish potato smallholder farmers. The farmers in the study had an average age of 46 years, indicating that most farmers are at life productive stage. The mean education years of the farmer was approximately 10 years. The education status of an individual farmer is perceived to be an important factor as it can determine the readiness of the farmers to reject or accept the innovation and technologies to advance their decisions in market outlet selection. The sampled households in Kinangop sub-county had three persons, on average, who were very resourceful in providing labor for the households to minimize the production costs. The findings revealed that Irish potato farmers in the study had a good farming experience of approximately 14 years, reflecting farmers' ability to make sound decisions to maximize their profitability. Land utilized for Irish potato production and distance to the market was approximately 0.92 acres and 28 km, respectively. The findings implied that most of the farmers are far from the markets, which could impact the choice of the market outlet to reduce the

transaction costs.

Table 10: Summary of descriptive results

Variable	Obs	Mean	Std. Dev.	Min	Max
Household head age (years)	241	46.100	12.040	20	75
Education years	241	9.593	3.913	0	16
Household size	241	3.747	1.758	1	10
Experience (years)	241	13.913	10.641	1	50
Land under Irish potato (acres)	241	.9217	.8235	0.125	5
Market distance (km)	241	28.071	16.768	0.5	60
Gender	241	.6141	.4882	0	1
Information access	241	.2780	.4491	0	1
Extension access	241	.1826	.3872	0	1
Phone access	241	.8548	.3538	0	1
Group member	241	.2614	.4404	0	1
Credit access	241	.1784	.3841	0	1
Main occupation	241	.7676	.4263	0	1

Source: Field survey, (2023)

The findings showed that most farming households (61.41%) were male-headed, implying that men are considered decision-makers among farming households in Kinangop sub-county. However, only 27.8% of smallholder producers had access to market information, implying asymmetric information between the farmers and the buyers. According to Table 2, farming households with extension services and credit access were 18.26% and 17.84%, respectively. These implied low access to extension and credit among the smallholder farmers, which can influence farmers' productivity and market outlet decisions. Farming households with access to phone were 85.48%, implying farmers can easily communicate with the buyers when selling Irish potato. Moreover, farming households belonging to a farmer group were 26.14%, implying that farmers do not engage in collective actions that can facilitate better decision-making and economies of scale to enhance their profits. From the findings, agriculture can be concluded as the main economic activity in the study area, as 76.35% of the sampled households depended on agriculture as the major source of income.

Main market outlets among smallholder Irish potato farmers

The major market outlets used by smallholder Irish potato farmers in Kinangop sub-county were brokers, local, urban, and through contracts (Table 5). Most smallholder farmers (92.95%) sold their Irish potato to brokers. The findings reveal that Irish potato marketing is cartel led by brokers who function as intermediaries connecting the smallholder farmers and the market. Irish potato smallholder farmers could have preferred selling their Irish potato to brokers at the farm gates due to factors such as the avoidance of transaction costs and marketing risks when selling in other market outlets. Additionally, the farmers could have the immediate need for cash to cater for their daily expenses, preferring the most immediate and convenient market outlets. However, the brokers usually exploit smallholder farmers, especially through pricing, due to information asymmetry between the farmers and the market and brokers' experience and knowledge in marketing Irish potato. The situation results in brokers attaining higher profits from the produce compared to farmers. Similar findings were reported by van der Lee et al. (2020), where potato growers in Kenya experienced limited market participation resulting from high transaction costs.

Table 11: Market outlet results

Market outlets	Frequency	Percent
Brokers	224	92.95
Local market	11	4.56

Urban market	5	2.07
Contract	4	1.66
Total	264	101.24

Source: Field survey, (2023)

Determinants of market outlet choice among smallholder Irish potato farmers

The Wald χ^2 (52) test =258.35 was statistically significant ($p<0.01$), which implied the subset model coefficients were jointly significant. The findings further showed the model fits the research sensibly as the informative power of the causal variables in the model is satisfactory (Table 4).

Table 12: Correlation matrix

	ρ1	ρ2	ρ2	ρ4
ρ1	1.000			
ρ2	-0.637***	1.000		
	0.000			
ρ3	-0.415***	-0.032	1.000	
	0.000	0.623		
ρ4	-0.472***	-0.028	-0.019	1.000
	0.000	0.661	0.770	
Number of observations				241
# draws				5
Wald chi2 (52)				285.35
Log-likelihood				-93.54
Prob > chi2				0.0000***

Note *** significant at 1%

Source: Field survey, (2023)

The values ρ_1, ρ_2, ρ_3 and ρ_4 represents the brokers, local, urban, and contract markets, respectively. The correlation between brokers and contract markets (ρ41), urban markets and brokers (ρ31), and local markets and brokers (ρ21), were statistically significant at 1% level. The results reveal a negative and significant correlation between the market outlets. When smallholder farmers sold to brokers, the probability of selecting local, urban, and contract outlets decreased by 63.7%, 41.5%, and 47.2%, respectively, when farmers sold Irish potato to brokers (Table 4).

According to the results from the Multivariate probit model, the likelihood of smallholder farmers deciding to sell through the brokers was significantly influenced by Irish potato land, market distance, and phone access at 1% significant level. Selling through the local market was significantly influenced by the land under Irish potato and gender at 5%, information access and distance to the market at 1%, and extension and phone access at 10% significant levels. The likelihood of choosing urban markets was significantly influenced by age and information access at 1%, whereas phone access was significant at 5%. The probability of selling through the contracts was significantly influenced by the decision maker's age and access to credit at 1%, and market distance, information access, phone access, and household's main occupation at 5%.

The age of the household decision maker had a significant ($p<0.01$) positive and negative impact on smallholder farmers selling through urban and contract markets, respectively. The findings implied that an additional year by household decision-makers increased the likelihood of smallholder Irish potato farmers selling through the urban markets by 6.5%. However, an additional age by the household decision-maker decreased the probability of selling through the contract outlets by 20%, ceteris paribus. The positive

correlation suggests that older decision-makers could be more inclined to engage in urban market transactions, potentially due to experience, market knowledge, or preference for direct sales. However, the negative correlation between age and contract markets could result from older people preferring traditional methods, being reluctant to enter formal contracts, or having greater comfort with unstructured market outlets. Similar findings were reported by Mwembe et al. (2021), where age negatively influenced smallholder farmers selling their produce at the farm gates. However, Kassaw et al. (2019) reported that younger farmers were more likely to sell their tomatoes to wholesalers.

Land utilized for Irish potato production, either rented or individually owned, significantly ($p<0.01$) and positively influenced the likelihood of selling through the brokers and negatively through local markets. Therefore, an increase in land utilized for Irish potato production per season resulted in farmers foregoing selling through the local market and brokers. These results indicated that an additional one acre of land utilized for Irish potato production increased the likelihood of selling through the brokers by 73.2% while decreasing the likelihood of selling through the local market by 178.5% ceteris paribus. These findings implied that as the land acreage of Irish potato increased, higher yields were realized from the land utilized. Smallholder farmers having large sizes of land could have foregone selling to local and other market outlets and therefore, sold to brokers to avoid higher transportation costs associated with transporting Irish potato to the market. The poor roads and information asymmetry existing between the market and the farmers could also have caused farmers to prefer brokers as they were readily available. Chekol and Mazengia (2022) revealed land under garlic significantly influenced market outlet choice of retailed market. However, Endris et al. (2020) stated land had a significant negative impact on vegetable producers selling to consumer markets.

Market distance positively and significantly ($p<0.01$) influenced the likelihood of selling through brokers and negatively through local ($p<0.01$) and contract market outlets ($p<0.1$). Smallholder Irish potato producers residing far from the marketplaces would struggle to sell their potato to market options other than brokers. When other factors are held constant, an additional distance to the marketplace by one kilometer increased the chance of smallholder farmers selling Irish potato to brokers by 2.9%. On the other hand, a one-kilometer increase in distance reduced the likelihood of selecting local and contract market outlets by 5.6% and 104.01%, respectively. Smallholder Irish potato farmers could forego selling Irish potato to the urban markets due to long market distance and poor roads in the study area, which could result in high transportation costs. Due to increased market distance, information asymmetry between the market buyers and the smallholder farmers could also exist. Therefore, farmers could prefer choosing brokers since they are available at the farm-gate, and selling to them was convenient even though the prices were low. These findings
concur with studies by Abate et al. (2019); Wosene et al. (2018), where market distance was reported to have a significant and negative influence on pepper and teff farmers' choice of consumer market outlets.

Gender of the household negatively and significantly ($p<0.05$) influenced smallholder Irish potato farmers' choice of the local market. The results implied households headed by males were more likely not to sell Irish potato to the local markets compared to their female counterparts. Households headed by males decreased the Likelihood of selling through local market outlets by 105.3%. Male households could be perceived as having market information due to diverse opportunities and social networks. They hence could have preferred high-valued outlets such as the urban markets or contracts to maximize their returns. Studies by Kaimba et al. (2020) reported farmers' age had a significant and positive effect on baobab pulp farmers choosing rural and urban wholesalers in Kenya.

Information access had an influence on smallholder farmers' decision to sell through the four market outlets. Information access significantly and negatively influenced smallholder farmers choosing to sell Irish potato to brokers and contract at 1% and 5%, respectively. Information access significantly ($p<0.01$) and positively influenced farmers' choice of urban and local market outlets. These findings implied that farmers with market information access increased the likelihood of choosing urban and local markets by 132.8% and 210.0% respectively, when other factors were constant. The probability of selecting local markets was higher than urban markets when farmers accessed market information.

Table 13: Multivariate probit model results

	Brokers	Local market	Urban market	Contracts

Variables	Coef.	S. E	R	Coef.	S. E	R	Coef.	S. E	R	Coef.	S. E	R
Household Age	0.0220	.0156	0	-0.006	.0235	0	0.065	.0182***	0	-0.2004	.0674***	0
Education years	-0.0363	.0411	0	-0.0715	.0533	0	-0.0190	.0487	0	-0.0557	.0807	0
Household size	-0.0090	.0721	0	-0.1485	.0945	0	0.1243	.1124	0	0.0959	.1349	0
Experience	-0.0258	.0206	0	0.0396	.0230	0	-0.0063	.0201	0	-0.0286	.0531	0
Land size	0.7316	.2771***	0	-1.7854	.7978**	0	0.0154	.1849	0	0.0099	.0168	0
Market distance	0.0293	.0088***	0	-0.0556	.0142***	0	0.0058	.0110	0	-1.0408	.5604*	0
Gender	0.4408	.2831	0	-1.0532	.4911**	0	0.0188	.3026	0	0.0525	.2400	0
Information access	-1.0103	.2630***	0	2.0104	.4592***	0	1.3282	.2892***	0	-1.4015	.5938**	0
Extension access	0.0381	.4144	0	-0.8348	.4825**	0	0.0891	.5462	0	-1.1545	.0846	1
Phone access	0.9318	.3783**	0	-1.2248	.6328*	0	-0.7376	.3294**	0	-1.7602	.7881**	0
Group membership	-0.4291	.4029	0	0.5168	.4790	0	0.2563	.4935	0	-0.0577	.6501	0
Credit access	-0.4281	.4171	0	0.0908	.5122	0	0.5073	.5781	0	2.4794	.7957***	0
Main occupation	-0.2021	.3709	0	-1.0551	.6409	0	0.0789	.4612	0	-1.2256	.5281***	0

Note ***<0.01, **<0.05, *<0.1, the figures in parenthesis represents the standard error. Source: Field survey, (2023).

Access to market information could facilitate informed decisions among smallholder farmers as the farmers can compare the costs and benefits of each market outlet before choosing where to sell. The benefits derived from the
local and urban markets can be greater than those for brokers and contract markets. Smallholder farmers could have realized better output prices and means of marketing their Irish potato to the urban and local markets to maximize their profits. The likelihood of choosing the local market was greater than that of the urban market, and it could result from long distances to the urban markets that give rise to high transportation costs. The probability of smallholder farmers choosing brokers and contract markets decreased by 101.0% and 140.2%. Contract markets have standards and regulations of the quality and quantity farmers must follow in production and marketing. Farmers could avoid the process that might require large investments. Contract farming also has uncertainties and risks; therefore, farmers could have preferred other market outlets. Farmers' probability of choosing brokers decreased due to access to market information, as farmers could be exploited by brokers. The study findings agree with that of Kiprop et al. (2020), who reported information cost significantly influenced Indigenous chicken producers selling to brokers.

Access to extension services negatively and significantly ($p<0.05$) influenced the probability of smallholder farmers choosing the local market. The likelihood of smallholder farmers selecting local markets decreased by 48.3%. Because of accessing extension services, smallholder farmers accessing extension services could have had a good market orientation, skills, and information obtained through extension training. Farmers could, therefore, compare the benefits of the alternative market outlets when having market information. Smallholder farmers could have preferred local markets as it could be the profit-maximizing outlet as the farmers minimized the costs involved in transactions like transportation costs. Similarly, Anthony et al. (2021) found extension service access to significantly influence smallholder rice farmers in Nigeria selling at the local market.

Credit access positively and significantly ($p<0.01$) affected the likelihood of smallholder Irish potato farmers

choosing contract market outlets. These findings showed credit access among farmers increased the likelihood of farmers selling through contracts by 247.9%. In most situations, contract farming necessitates large expenditures from producers to enable them to purchase inputs and resources as stipulated by the contractor to achieve the desired quantity and quality. Credit access, therefore, can facilitate smallholder farmers' implementation of the required specifications. Smallholder farmers with access to financing could be motivated to pick contracts as market outlets since contracts have more consistent pricing. Similarly, access to credit significantly influenced poultry farmers to choose contract farming as a market outlet in Ghana (Oppong-Kyeremeh et al., 2022).

Access to phone was hypothesized to increase the smallholder farmers' probability of selling at the urban and local markets. However, the results indicated phone access significantly ($p<0.05$) and positively influenced the choice of brokers as the market outlet. Access to the phone had a significant negative impact on the local market at 10% urban and contract markets at 5%. The findings implied that access to phone increased the likelihood of smallholder farmers selling Irish potato through the brokers by 93.2%. However, the probability of selling through local, urban, and contract market outlets reduced by 122.5%, 73.78%, and 176.0%, respectively, ceteris paribus. The probability of selling Irish potato to the contract market was higher than local and urban markets. These implied that access to phone negatively impacted selling to the contract market with a greater margin than the local and urban market outlets. These could have resulted from the role played by phone in producing and marketing agricultural produce. With access to phone, smallholder Irish potato farmers can access market information on the prevailing market prices in different alternative market outlets that farmers have. Despite access to phone easing communication between the farmers and the markets, farmers could have preferred selling their produce through the brokers to avoid the risks associated with local, urban, and contract market outlets. Findings agree with those of Obayelu et al. (2023); Subramanian et al. (2022), where mobile phones were found to ease communication between buyers and the farmers.

The household's main occupation significantly ($p<0.01$) and positively influenced smallholder farmers' selection of contract market outlet. The findings implied smallholder farmers who practiced agriculture as their main occupation had a higher probability of choosing contracts as the market outlet. The likelihood of Irish potato farmers choosing contract market outlets increased by 122.6%, ceteris paribus for farmers who had agriculture as the main occupation. These findings can be justified as contracts provided advantages to farmers, including agreed stable prices before production (Staritz et al., 2022). Smallholder farmers who, therefore, had agriculture as the primary income source could choose contract farming to have a continuous planned flow of income and reduce the uncertainties that arise during Irish potato marketing. The findings align with Nazifi & Hussaini (2021) in Nigeria, who reported farmers who primarily depended on maize for income were likely to participate in contracts.

CONCLUSION

The study examined market outlet choice determinants among Irish potato smallholder growers in Kinangop sub- county, Kenya. Most farmers preferred selling Irish potato at the farm gate to brokers as it was an available and convenient market outlet to use and to avoid high transaction costs and risks associated with selling produce to the markets. The findings revealed the decision of smallholder farmers to sell through the brokers was positively influenced by Irish potato land, market distance, phone, and information access, which influenced farmers selling to brokers negatively. Irish potato land, market distance, gender, extension service, and phone access significantly influenced selling to the local market negatively, while access to information positively influenced selling to the local market. The urban market was significantly influenced by age and information access positively, whereas phone access was influenced negatively. Contract market decisions were influenced by occupation and credit access negatively, and age, market distance, information, and phone access influenced the contract market negatively. Land utilized for Irish potato production, market distance, information, and phone access are essential factors smallholder farmers consider when deciding where to sell their Irish potato. Famers receiving market information sought to market their Irish potato in high-value markets to maximize their returns. However, the increase in land, distance, and access to the phone resulted in smallholder Irish potato farmers selling their produce to brokers.

RECOMMENDATIONS

Smallholder Irish potato farmers should be encouraged to form active production and marketing farmer

groups to foster collective marketing, increase their bargaining power, minimize transaction costs, and eradicate brokers who exploit smallholder farmers. The government should support smallholder Irish potato farmers by establishing non- profit public marketing agents in the study area to substitute the intermediaries, connect Irish potato producers to the appropriate markets, and reduce market information asymmetry between the farmers and buyers. The government should also provide extension services through training and improve infrastructure to facilitate easier marketing among Irish potato producers, particularly those in rural regions.

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REFERENCES

Abate, T. M., Mekie, T. M., & Dessie, A. B. (2019). Determinants of market outlet choices by smallholder teff farmers in Dera district, South Gondar Zone, Amhara National Regional State, Ethiopia: a multivariate probit approach. *Journal of Economic Structures*, *8*(1). https://doi.org/10.1186/s40008-019-0167-x

Anthony, L., Alabi, O. O., Ebukiba, E. S., & Gamba, V. (2021). Factors Influencing Output of Rice Produced and Choice of Marketing Outlets Among Smallholder Farming Households, Abuja, Nigeria. *Sarhad Journal of Agriculture*, *37*(1), 262–277. https://doi.org/10.17582/journal.sja/2021/37.1.262.277

Bijmolt, T. H. A., Broekhuis, M., de Leeuw, S., Hirche, C., Rooderkerk, R. P., Sousa, R., & Zhu, S. X. (2021). Challenges at the marketing–operations interface in omni-channel retail environments. *Journal of Business Research*, *122*, 864–874. https://doi.org/10.1016/j.jbusres.2019.11.034

Chekol, F., & Mazengia, T. (2022). Determinants of Garlic Producers Market Outlet Choices in Goncha Siso Enese District, Northwest Ethiopia: A Multivariate Probit Regression Analysis. *Advances in Agriculture*, *2022*. https://doi.org/10.1155/2022/6719106

Chepkoech, B. (2022). Socio-Demographic Characteristics and Potato Production Practices of Smallholder Potato Farmers in Molo Sub-County, Kenya. *East African Scholars Journal of Agriculture and Life Sciences*, *5*(6), 112–122. https://doi.org/10.36349/easjals.2022.v05i06.004

Endris, E., Haji, J., & Tegegne, B. (2020). Factors Affecting Vegetable Producers Market Outlet Choice in Habru District, North Wollo Zone, Ethiopia. *European Business & Management*, *6*(1), 1. https://doi.org/10.11648/j.ebm.20200601.11

Gikundi, E. N., Buzera, A. K., Orina, I. N., & Sila, D. N. (2023). Storability of Irish Potato (Solanum tuberosum L.) Varieties Grown in Kenya, Under Different Storage Conditions. *Potato Research*, *66*(1), 137–158. https://doi.org/10.1007/s11540-022-09575-8

Helena Oppong-Kyeremeh, Richard Kwasi Bannor, & Ernest Darkwah Yeboah. (2022). Contract farming as a marketing strategy to improve poultry agribusiness in Ghana. *International Journal of Value Chain Management*, *13*(4), 360–382.

Isaac, S. (2023). Formulation and Evaluation of Paracetamol Tablets using Solanum Tuberosum Starch as A Disintegrant. *Newport International Journal of Biological and Applied Sciences (NIJBAS) Volume 3 Issue 2 2023*

Jo, K. R., Cho, S., Cho, J. H., Park, H. J., Choi, J. G., Park, Y. E., & Cho, K. S. (2022). Analysis of genetic diversity and population structure among cultivated potato clones from Korea and global breeding programs. *Scientific Reports*, *12*(1). https://doi.org/10.1038/s41598-022-12874-2

Kaimba, G. K., Muendo, K. M., & Mithöfer, D. (2020). Marketing of baobab pulp in Kenya: Collectors' choice of rural versus urban markets. In *African Journal of Agricultural and Resource Economics* (Vol. 15).

Karya Kate Nanbol, & Otsanjugu Aku Timothy Namo. (2019). The Contribution of Root and Tuber Crops to Food Security: A Review. *Journal of Agricultural Science and Technology B*, *9*(4). https://doi.org/10.17265/2161- 6264/2019.04.001

Ketema, S., & Lika, T. (2023). Determinants of market outlet choice by smallholder wheat producers in Arsi Zone of Oromia National Regional State, Ethiopia. *Cogent Food and Agriculture*, *9*(1). https://doi.org/10.1080/23311932.2022.2163578

Kiprop, E. K., Okinda, C., Akter, A., & Geng, X. (2020). Factors influencing marketing channel choices for

improved indigenous chicken farmers: insights from Baringo, Kenya. *British Food Journal*, *122*(12), 3797–3813. https://doi.org/10.1108/BFJ-11-2019-0841

Kothari, C. R. (2004). *Research methodology: Methods and techniques* (Second edition). New age international publishers.

Kuradusenge, M., Hitimana, E., Hanyurwimfura, D., Rukundo, P., Mtonga, K., Mukasine, A., Uwitonze, C., Ngabonziza, J., & Uwamahoro, A. (2023). Crop Yield Prediction Using Machine Learning Models: Case of Irish Potato and Maize. *Agriculture (Switzerland)*, *13*(1). https://doi.org/10.3390/agriculture13010225

Kwambai, T. K., Struik, P. C., Griffin, D., Stack, L., Rono, S., Nyongesa, M., Brophy, C., & Gorman, M. (2022). Understanding Potato Production Practices in North-Western Kenya through Surveys: An Important Key to Improving Production. *Potato Research*. https://doi.org/10.1007/s11540-022-09599-0

Mohammed Kassaw, H., Birhane, Z., & Alemayehu, G. (2019). Determinants of market outlet choice decision of tomato producers in Fogera woreda, South Gonder zone, Ethiopia. *Cogent Food and Agriculture*, *5*(1). https://doi.org/10.1080/23311932.2019.1709394

Mwembe, A. M., Owuor, G., Langat, J., & Mshenga, P. (2021). Factors affecting market outlet choice of agroforestry- based mango producers in Kwale and Kilifi counties, Kenya: The application of the Multivariate Probit model. *Cogent Food and Agriculture*, *7*(1). https://doi.org/10.1080/23311932.2021.1936367

Nazifi, B., & Hussaini, Y. I. (n.d.). Determinants Of Participation in Contract Farming Among Smallholder Maize Farmers in North-Western Nigeria. *Acta Sci. Pol. Agricultura*, *20*(4), 147–160. https://doi.org/10.37660/aspagr.2021.20.4.2

Obayelu, A. E., Afolami, C. A., Folorunso, O., Adebayo, A. M., & Ashimolowo, O. R. (2023). Impact of adoption of mobile-based Information Communication Technologies on production efficiencies among smallholder farmers in the southwest of Nigeria. In *Trop. Agric. (Trinidad)* (Vol. 100, Issue 1).

Okaka, F. O., Omondi, P., Ndegwa, B. W., Okaka, F., & Omondi, P. P. (2020). Irish Potato Production in Relation to Climate Change and Variability in Ndaragwa Agro-Ecological Zone in Nyandarua County. Kenya. *Issue 3 Ser. I*, *13*, 27–35. https://doi.org/10.9790/2380-1303012735

Ronald Orare, N., Moturi, J., J Ochieng, J. J., & Gowland, J. (2020). Effectiveness of Agricultural Training Centers' Curriculum in Promoting Adoption of Agricultural Technologies: Evidence from Small-Scale Potato Farmers in Nyandarua County, Kenya. *International Journal of Innovations in Educational Methods*, *9*(1). www.panafricanjournal.org

Sakadzo, N., Mavugara, J., & Musara, A. (2020). A Critical Review of Value Chain for Irish Potato in Zimbabwe with Specific Regards to the Economic Policy: A Review. *Agricultural Science*, *2*(2), p42. https://doi.org/10.30560/as.v2n2p42

Saleh, A., & Awolola, J. O. (2022). Determination of design-related properties of selected Irish potato varieties.

Nigerian Journal of Basic and Applied Sciences, *30*(1), 36–40. https://doi.org/10.4314/njbas.v30i1.5

Scolastica, N. N., Hillary, B., & Kenneth, W. S. (2023). Vertical market linkages between smallholder African

indigenous vegetable farmers and other market actors in Bungoma County. *Journal of Development and Agricultural Economics*, *15*(1), 26–36. https://doi.org/10.5897/JDAE2023.1380

Staritz, C., Tröster, B., Grumiller, J., & Maile, F. (2022). Price-Setting Power in Global Value Chains: The Cases of Price Stabilisation in the Cocoa Sectors in Côte d'Ivoire and Ghana. *European Journal of Development Research*. https://doi.org/10.1057/s41287-022-00543-z

Subramanian, K., Bozzola, M., & Nugent, A. (n.d.). *Give to AgEcon Search The role of ICT adoption in promoting livelihoods in Eastern Africa: Evidence from Uganda*. http://ageconsearch.umn.edu

van der Lee, J., Oosting, S., Klerkx, L., Opinya, F., & Bebe, B. O. (2020). Effects of proximity to markets on dairy farming intensity and market participation in Kenya and Ethiopia. *Agricultural Systems*, *184*. https://doi.org/10.1016/j.agsy.2020.102891

Wakaba, D., Ateka, J., Mbeche, R., & Oyugi, L. (2022). Determinants of Irish potato (Solanum tuberosum) commercialization and market participation by farmers in Nyandarua County, Kenya. *Journal of Agriculture and Food Research*, *10*. https://doi.org/10.1016/j.jafr.2022.100382

Wangithi, C. M., Nyangaresi, A. M., Srinivasulu, R., Moyo, M., Muzhingi, T., & Kawarazuka, N. (2023). Consumer willingness to pay a premium for orange-fleshed sweet potato puree products: a gender-responsive evidence from Becker–DeGroot–Marschak experimental auction among low- and middle-income consumers in selected regions of Nairobi, Kenya. *Frontiers in Sustainable Food Systems*, *7*.

https://doi.org/10.3389/fsufs.2023.1114468
Wauters, P., Naziri, D., Turinawe, A., Akello, R., & Parker, M. L. (2022). Economic Analysis of Alternative Ware Potato Storage Technologies in Uganda. *American Journal of Potato Research*, *99*(3), 217–228. https://doi.org/10.1007/s12230-022-09874-3
Wosene, G., Ketema, M., & Ademe, A. (2018). Factors affecting market outlet choices of pepper producers in Wonberma district, Northwest Ethiopia: multivariate probit approach. *Cogent Food and Agriculture*, *4*(1). https://doi.org/10.1080/23311932.2018.1558497