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Determinants of Choice of Marketing Channels Among Smallholder Irrigated Tomato Farmers in the Kassena-Nankana Municipality of Ghana

Ganiu Issah[1*], Sylvester Nsobire Ayambila[2] and Dennis Sedem Ehiakpor[2]

[1]*Department of Mathematics, Ghana Education Service, Walewale, Ghana*
[2]*Department of Applied Economics, School of Economics, UDS, Tamale, Ghana*
**Corresponding Author: ganiuis2156@uds.ed.gh*

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ABSTRACT

The study analysed the determinants of the choice of marketing channels among smallholders' irrigated tomato farmers in Kassena-Nankana Municipality (KNM) of Upper East Region (UE/R), Ghana. Multi-stage sampling techniques were used to select 172 tomato farmers, and data was collected with the aid of semi-structured questionnaire during the 2017 farming season. The Haussmann test of independence of irrelevant alternatives (IIA) assumptions was used to test the validity of the channel choices of the model. Multicollinearity test was conducted and the variance inflation factor (VIF) showed no correlations between any of the independent variables. Multinomial logit model was used to analyse the determinants of choice of marketing channels. The analysis established that, the average size of irrigated farm land used was 0.92 acres, with 26.74% of farmers selling their produce to the wholesalers, 38.95 % to retailers, 20.93% to roadside traders and 13.37 % to consumers. Meanwhile, use of certified/improved seeds, Membership of Farmer Based Organization (FBO), farm size and access to market information significantly and positively influenced the choice of marketing channels. Whilst, age, education, gender, household size, labour cost and harvesting period negatively affected the choice of marketing channels. The study recommends creation of social media platforms or groups and mobile phone usage among tomato farmers to promotion market information on channel choices, awareness creation on certified/improved variety seeds usage, and promotion of strong cooperatives. Agricultural extension officers can take up the task in assisting farmers in the creation of social media platforms and link farmers up to tomato buying agents or groups.

INTRODUCTION

Tomato *(Lycopersicon esculentum)* is noted to have come from the Solanaceae family and is considered as one of the important vegetables crop in the world. The production of fresh tomato across the globe continue to increase. Notably, data from FAOSTAT (2020) established that, the global tomato production increased from 182,301,395 metric tonnes in 2017 to 186.821 million metric tonnes in 2020. According to Goodman (2015), the amount of tomato produced and marketed in Ghana each year stood at 510,000 metric tons. This can be attributed to the fact that, fresh tomato forms one of the most nutritious and vital components of most household food consumptions in the Upper East Region (UE/R) in particular and the country at large. It thus, serves as a supplementary source of minerals and vitamins in our diet. Tomato production equally serves as a source of employment and income generation to most smallholder irrigated tomato farmers in the UE/R who would have been unemployed especially during the dry season.

These dry season farmers have been empowered by, the construction of irrigation facilities such as Tono Dam in the Kassena-Nankana Municipality (KNM) and about 220 dugouts, dams and wells in the region (Food and Agriculture Organization, 2015). These is no doubt that these serve as an opportunity for smallholder's tomato farmers to continued venturing into tomato production in the

region, which will go a long way to meet the growing demand for tomato in the country. To this effect, the study of International Food Policy Research Institute (IFPRI), 2020 established that tomato production in the country is far lower than its demand and maintain that, 8,000 tons of fresh tomatoes is imported into the country annually to supplement domestic supply. The importation of tomato in to the country is causing unfavorable market competition in the country. This calls for the need for tomato farmers to devise appropriate marketing channels to reach out to the market.

Unfortunately, the choice of marketing channels for producers to adopt in order to yield maximum benefits is a challenge to the Ghanaian tomato farmers and especially the farmers in the study area. Meanwhile, the perishable nature of tomato also poses severe consequences to tomato farmers during and after harvesting. In this regard, the wholesalers (Market Queens) and retailers play a significant role in the tomato channel of distribution to get the commodity to the final consumer on one hand and dominates the management and control of the marketing system on the other. They achieved this by either influencing the price or quantity supply of the commodity in order to maximize profits. Hence, the wholesalers capitalize on the importation of tomato to offer farmers lower prices. Amikuzuno *et al.* (2015) established that, a considerable portion of the tomato supplied to the Ghanaian markets' is greatly regulated by the Market Queens at all times and emphasized that, during bumper harvest, smallholder tomato farmers have no option than to agree on any price offered them at the farm gate by the middlemen due to the perishable nature of the commodity. Again, Mamo and Degnet (2012) argued that, smallholder tomato farmers are dispersed, unorganized and unable to exploit available market channels choices and opportunities making it difficult to device proper bargaining power in negotiating for higher prices.

Different channel choices will result in different profits margins and cost to the farmers. For farmers to maximize their benefits, they have to make appropriate decisions regarding where to sell their produce. But, the perishability of tomato couple with the unorganized nature of tomato farmers and unorganized marketing system culminates in low producers' price. The low prices lead to low profit margins and unintended postharvest losses. This makes it problematic to enhance farmers' efforts to actively engage in the tomato marketing and channel choice decision and requires effective and efficient marketing channels. This is a setback to tomato farmers in their quest to realized higher revenue which need to be addressed. Besides, since tomato producers adopts different channel choice for the sale of their produce with the aim of yielding maximum profits, their households' decisions to choose the most appropriate channel choice would be affected by some factors.

There is very scanty documented approach on how to promote tomato farmers' information on the appropriate channel choice in literature in the Kassena-Nankana Municipality. Hence, identifying these factors affecting the choice of marketing channels is the cornerstone to reducing the information gaps between producers', traders and consumers. The knowledge of the variables affecting the choice of markets channel is of great importance in formulating policies in terms of tomato marketing, competitive pricing and higher profit margin. This study therefore sought to analyse the determinants of the choice of marketing channels among smallholders' irrigated tomato farmers in Kassena-Nankana Municipality (KNM). Specifically, the study assessed the choice of marketing channels of smallholders' irrigated tomato farmers of KNM of Upper East Region in Ghana, and analysed the determinants of the choice of marketing channels of smallholder irrigated tomato farmers of KNM in Ghana.

MATERIALS AND METHODS

Study Area

The study was carried out in the Kassena-Nankana Municipality (KNM) of Ghana. The Municipality shares boundary to the North with Burkina Faso, North East with Kassena-Nankana West District, to the South East with Bolgatanga Municipality and Bongo District, to the North West with Kassena-Nankana West District and to the South West by Builsa North and South Districts and the West Mamprusi Municipality in the North East Region. The Municipality has a total land size of 1,657 km square with 326 communities, which are predominantly farmers (GSS, 2014). The people in the Municipality are 'Kassenas and Nankanas' ethnic groups and the capital is called Navrongo. The Kassena-Nankana Municipality is also one of the top places where smallholder tomatoes' farming by irrigation is practiced in the Region. The Tono Dam is the major supply of water for vegetable production especially in the dry-season and some dug-outs and wells.

Sampling, Method of Data Collection and Analysis

Household survey was conducted using semi-structured questionnaire to collect primary data. The population consisted of all irrigated farmers who produced tomatoes in 2017 farming season in the Municipality. Multi-stage sampling technique was employed to collect primal data. Available data from Tono Irrigation Scheme revealed that, there are twenty (20) major tomato producing communities in the Municipality. Based on these and the assistance of an informant, ten (10) communities were randomly selected out of the twenty (20) communities through the method of balloting. Secondly, four (4) communities were selected purposively out of the ten (10) communities based on the magnitude of tomato cultivation in these areas and the supply of water through the Tono dam. Two communities were also purposively selected based on the existence of dugout wells that ensure constant supply of water throughout the season. In all, six (6) communities were considered for the study. These communities are: Korania, Bonia, Mayoro, and Gaani (ICOUR); Nayagnia and Doba (Dugout wells). Finally, twenty-seven (27) households of tomato famers were chosen from each of the six (6) communities which summed up to one hundred and seventy-two (172). Hence, a sample of 172 tomato-producing households/farmers were interviewed.

Sample Frame

Notably, the Population and Housing Census report revealed that, the total population of the Kassena-Nankana Municipality is 68,589 (Ghana Statistical Service, 2021). Out of these, 68% of the total population (68,589) in the KNM are engaged in agriculture. Hence, the sample frame was 46,641.

Sample Size

The basis for the selection of the sample size is evident in the study of Yamane (1967) who noted that, to make a research representative, the sample size is calculated using the formula;

$$n = \frac{N}{1+N(e^2)} \quad (1)$$

Where: N = Total number of farmers in the KNM; n = Sample size; e = 0.1 (10% confidence level); 1 = Constant of proportionality.

Therefore, using this sample size formula, the sample size is calculated as below;

$$n = \frac{46641}{1+(46641)\times(0.01)} = 99.8 = 100$$

However, to ensure that the study was more representative, a sample size of 172 tomato-producing households were used instead of the 100 according to the formula.

Data Collection

Data collection was carried out in December, 2017 in all the six (6) communities selected for the study. Data collection was done by the researcher and five (5) other people (teachers) trained by the researcher to assist in the collection of the data from the study area. The questionnaire was written and administered in English Language but sometimes, have to be translated in to Nankam or Kassem (the native languages) or Twi (Ashanti language) depending on the convenience of the respondent. This was necessary because, some of the farmers did not have formal education and hence could not understand English Language.

Data Analysis

The Haussmann Tests

The Haussmann tests of independence of irrelevant alternatives (IIA) assumptions was used to test the channel choices of the model. Consequently, the test fails to reject the null hypothesis of independence of the included market channels and established that, the multinomial logit model was correctly specified.

Table 1: Haussmann Tests of Independence of Irrelevant Alternatives

Omitted	Chi^2	Df	$P>chi^2$	Evidence
2	7.857	14	0.897	for H_0
3	9.212	14	0.817	for H_0

Ho: Odds (Outcome-J vs Outcome-K) are independent of other alternatives

The test of Multicollinearity

The test of Multicollinearity was equally conducted and the results of variance inflation factor (VIF) established that, there exist no correlations between any of the independent variables. The Multicollinearity test is presented in Table 2.

Table 2: Test for Multicollinearity among Explanatory Variables

Variable	Variance Inflation Factor (VIF)
Age	1.79
Education	1.92
Gender of farmer	1.94
Household size	1.84
FBO	1.92
Variety of tomato seeds used by farmer	1.63
Farm size	1.90
Labour Cost	1.55
Mean Market Distance	1.88
Credit access	1.87
Use of hired labour	1.55
Tomato harvest in December-January	1.58
Tomato harvested in January-February	1.38

Theoretical/Conceptual Framework

This section provides a framework of internal consistency of the study. The framework explains how tomato farmers in the Kassena-Nankana Municipality market their produce through various channel choices and the major factors influencing the choice of marketing channels they use. The major actors identified in the tomato industry of the Kassena-Nankana Municipality are the wholesalers, retailers, roadside traders and consumers. In the Kassena-Nankana Municipality, tomato farmers adopt different channels of selling their produce with the aim of making profits and at worse, minimizes losses. This is because, tomato is an important perishable commodity and the choice of channels to be adopted by smallholder tomato farmer in marketing his/her produce may possess some consequential effects on the profit margins ranging from low prices, postharvest losses, to low income. It is not surprising that, Ghana incurred tomato losses of about 20 to 65% of the national output in 2019 due to challenges of perishability, transportation and storage (MOFA, 2020). It is understandable however that, some tomato farmers will either sell their produce to, wholesalers' channel or retailers, or roadside traders or consumers channels. Besides, farmers could also choose multiple channel choices (selling to two or more actors) for the sale of their produce. This could take the form of; tomato producers to wholesalers, retailers and the final consumers; tomato producers to retailers and the final consumers. The producers direct to roadside traders and the final consumers; and tomato producers to the retailers, roadside traders and the final consumers.

There is a well-established linkage in the channel choice and profits/losses of tomato cultivation in the KNM of UE/R. This is because, farmer's choice of adopting a particular channel could yield higher revenue than another channel. Hence, Puozaa (2015) argued that, a well-functioning market is noted to be a factor that directly and indirectly affects the level of farm productivity as well as the amount of profitability in farming. This fact, no doubt, emphasizes the need to have an efficient agricultural market, as these market

channel choices will enable farmers' to efficiently sell their outputs in order to achieve higher margins profits.

Similarly, the efficient marketing channel systems of tomato by farmers will reduce the chances of tomato spoilage thereby reducing the losses of the smallholder tomato farmer since the commodity is perishable. Hence, the need to unearth the choice of market channel of the tomato farmer in the Municipality. Essentially, some socioeconomic, production and marketing factors could fundamentally be militating against the choice of market channels of the tomato farmer in the Municipality. When these factors are looked into, will help the researchers and other policy makers concerned to understand how the tomato farmers are being affected in their quest to have better marketing opportunities. Policy emanating from the research would be useful to government and non-governmental organizations in assisting Ghana's tomato industry to increase production and to meet the increasing demand of tomato in the country.

Methods of Data Analysis

The data was analyzed using STATA 13. The raw data was coded and entered into the Statistical Package for Social Sciences (SPSS 20) and cleaned data was afterwards exported to STATA 13 for analysis.

Descriptive Statistics

The socio-economic and demographic characteristics of data collated from the field was analyzed descriptively. Therefore, among the descriptive statistics used included, mean, standard deviation, minimum, maximum, percentages, and frequency. The results from these descriptive analyses of the data were presented in tables and chart.

Empirical Model

In analyzing the major factors affecting the channel choice decision of the smallholder's irrigated tomato farmers, multinomial choice (MNL) model with logistic distribution was used. This is because the marketing channels identified are unordered and not ordinal in nature. Hence, the researchers wanted to determine the effect of the explanatory variables, such as, production characteristics, household characteristics and marketing characteristics on the dependent variable (Market channels) in terms of the probability of smallholder tomato farmer choosing between the market channels in the tomato industry. According to Al-hassan *et al.* (2013), the Marginal utility model is given in equation 2;

$$U_j = X'\beta_j + e_j \quad and \quad U_k = X'\beta_k + e_k \qquad (2)$$

Where: U_j and U_k are the perceived utility of market channel j and k, respectively, X_i is a vector of explanatory variables influencing perceived desirability involving marketing channel, β_j and β_k are vector coefficients parameters of the exogenous variable X whilst e_j and e_k are error terms, assumed to be independently and identically distributed. If a household decides to use option j on *ith* market chain, it follows the perceived utility or benefit from option *j* which is greater than that of other options (*k*). This can be transformed as given in equation 3;

$$P_r(Y_i = 1) = \frac{e^{BjXi}}{\sum_{k=0}^{n} e^{BkXj}} \qquad (3)$$

We have to normalize the above equation to remove indeterminacy by assuming that β_0=0 which makes the estimated probability for multinomial model to be as given in equation 4;

$$P_r(Y_i = 1) = \frac{e^{BjXi}}{1 + \sum_{k=1}^{n} e^{BkXj}} \quad j = 0, 1, 2, \ldots \ldots J \qquad (4)$$

The channel choice of tomato producers are log-odds relative to the based category. So, we further drive the marginal effects to use for the interpretation of the results of explanatory variables on the dependent variables in terms of probabilities.

The marginal effect (the best and appropriate form of interpreting results) will measure the expected variation in terms of likelihood of any choice of marketing channel of tomato relative any unit change in the exogenous variables.

The above model is transformed as follows:

$$\mathrm{P_r}(Y_i = 1) = \frac{\mathrm{e}^{\mathrm{X}\beta(1)}}{\mathrm{e}^{\mathrm{X}\beta(1)} + \mathrm{e}^{\mathrm{X}\beta(2)} + \mathrm{e}^{\mathrm{X}\beta(3)}} \qquad (5)$$

$$\mathrm{P_r}(Y_i = 2) = \frac{\mathrm{e}^{\mathrm{X}\beta(2)}}{\mathrm{e}^{\mathrm{X}\beta(1)} + \mathrm{e}^{\mathrm{X}\beta(2)} + \mathrm{e}^{\mathrm{X}\beta(3)}} \qquad (6)$$

$$\mathrm{P_r}(Y_i = 3) = \frac{e^{X\beta(3)}}{e^{X\beta(1)} + e^{X\beta(2)} + e^{X\beta(3)}} \quad (7)$$

The model above as it stands, is not identified because there is more than one solution to $\beta(1)$, $\beta(2)$ and $\beta(3)$ that yields the same probabilities for, $Y = 1,\ Y = 2,\ Y = 3$

To make the model identified, we arbitrarily set one of the β coefficients to zero and it does not matter which one is set to zero (Al-hassan *et al.*, 2013). The remaining coefficients then measure the relative change to the base or reference group. The coefficients differ because they have different interpretations, but the predicted probabilities for Y=1, Y=2 and Y=3 will be the same. For example, if we set Y=1 as the benchmark or base outcome category, then we have;

$$\mathrm{P_r}(Y_i = 1) = \frac{1}{1 + e^{X\beta(2)} + e^{X\beta(3)}} \quad (8)$$

$$\mathrm{P_r}(Y_i = 2) = \frac{e^{X\beta(2)}}{1 + e^{X\beta(2)} + e^{X\beta(3)}} \quad (9)$$

$$\mathrm{P_r}(Y_i = 3) = \frac{e^{X\beta(3)}}{1 + e^{X\beta(2)} + e^{X\beta(3)}} \quad (10)$$

Further, with the multinomial logit, we interpret the marginal effects and not the signs of the coefficients. The variables of interest are, farmers' age, formal education, gender, household size, improved variety of tomato seeds, access to credit, use of hired labour, farm size in acres, harvesting period (December/January) and harvesting period (January/February).

Choice of Measurements of Explanatory Variables

The assessment of the choice of channel to be adopted depends on the household characteristics and other economic variables as presented in Table 3.

Table 3: Measurements of Explanatory Variables

Variable	Measurements	Mean
Age of household head	Years	40.3
Education	Dummy; 1=at least Basic Education and 0=otherwise	N/A N/A
Gender of farmer (household head)	Dummy; 1=Female and 0=Male	N/A
Household size	Number of persons	7.0
FBO Membership	Dunny; 1=Yes and 0=No	N/A
Variety of tomato seeds used by farmer (improve variety)	Dummy; 1=Yes and 0=No	N/A
Farm size	Acre	0.92
Labour Cost	Ghana Cedis	355.48
Mean Market Distance	Kilometers (km)	
Credit access	Dummy; 1=Yes and 0=No	N/A
Use of hired labour	Dummy; 1=Yes and 0=No	N/A
Tomato harvest in December-January	Dummy; 1=Yes and 0=No	N/A
Tomato harvested in January-February	Dummy; 1=Yes and 0=No	N/A
Access to market information	Dummy; 1=Yes and 0=No	N/A

RESULTS AND DISCUSSION

Socio-economic Characteristics of Tomato Producers in the Kassena-Nankana Municipality

The demographic characteristics and empirical analysis on the socio-economic factors affecting the channel choice of irrigated tomato farmers in Kassena-Nankana Municipality are presented in Table 4.

The descriptive analysis from Table 4 showed that, 88.4% of the farmers interviewed were household heads, with only 11.6% of them being non-household heads. In addition, the analysis of gender in Table 1 revealed that, majority (79.1%) of the respondents (farmers) were males, with only 20.9% being female. This is an indication of male-dominated occupation. As a result, we can infer that, there is higher level of perception of farming

to be a preserve activity for men within the KNM of the UE/R. Hence, the socio-cultural role under pinning northern Ghana custom as men being the breadwinners of the family is being reflected by the study. Another important variable in this study is age. This is because, age determines the quality and strength of the workforce as reported by Addo *et al.* (2015). The field survey result established the average age of a farmer to be 40 years. This implies that, on the average, KNM has a good active and potential manpower requirement for the tomato industry. Equally important variable is household size. Because, household size can determine the number of labour force available to a particular tomato farmer on the average. Analysis of the field survey revealed that, a mean value of seven (7.0) constituted the household size of the smallholder tomato farmers. Hence, most farmers in the study area have good number of labour force to support their farming activities. On the variable marriage, the results indicated that, majority (81.4%) of the tomato producers were married, with only 1.7% not married (single). Besides, 11.6% of the farmers are widows whilst, 5.2% are not married due to divorce. Overall, there is higher incidence of marriage among farmers interviewed in the KNM. The results, reinforces the sociocultural importance associated with marriage in northern Ghana, which may enable the small holder tomato farmer to give birth to more children needed for farm assistance. This is in accordance to Tetteh (2013) who established that, Smallholder tomato farming is labour intensive, and tends to use manual labour for virtually all production operations, thus emphasizing the important role of manual labour in carry out tomato farming activities. Out of the farmers' respondents interviewed, none had tertiary education with 32.0 % of them without any formal education. However, a proportion of 36.1% of the farmers had primary education, with 14.5% of them having JHS education while 17.4% of them had SHS/Vocational and Technical education. Notably, 68% of the farmers interviewed had some sought of formal education. This could lead to serious consequences in terms of productivity because, the farmers without formal education are unable read and understand instructions on the application of agricultural inputs. The woes of it all, illiterate farmers are reluctant in the adoption of appropriate agricultural skills and technology. This is in line with the findings of Addo *et al.* (2015) that the level of education can affect agricultural practices, adoption and application of innovation. The variable, FBO, revealed that, majority (81.1%) of the farmers do not belong to any organization with only 18.6% belonging to some sought of groups. Evidence from the field revealed that, most of the tomato farmers initially belonged to FBOs which were dissolved because, some of them had substituted tomato production which was formally their primary or major crop for other crops (pepper and okra) which commands high demand in the market. By inference, irrigated tomato farmers' lack the collective bargaining power to push for good prices for their produce in the study area which can lead to low profit margins and postharvest losses.

Table 4: Socio-economic Characteristics of Tomato Producers in KNM

Variables	Frequency	Percent (%)	Mean
Household Head			
Yes	152	88.4	
No	20	11.6	
Gender (%)			
Male	136	79.1	
Female	36	20.9	
Age (mean)	172		40.3
Household size (mean)	172		7.0
Marital Status (%)			
Married	140	81.4	
Single	3	1.7	
Educational Achievement			
None	55	32.0	
Primary	62	36.1	
JHS/MSLC	25	14.5	
SHS/Vocational/Technical	30	17.4	
Tertiary	0	0.0	

Marketing Channels of Irrigated Tomato Farming

The marketing channels adopted by irrigated tomato farmers in the in Kassena-Nankana Municipality (KNM) are presented in Figure 1.

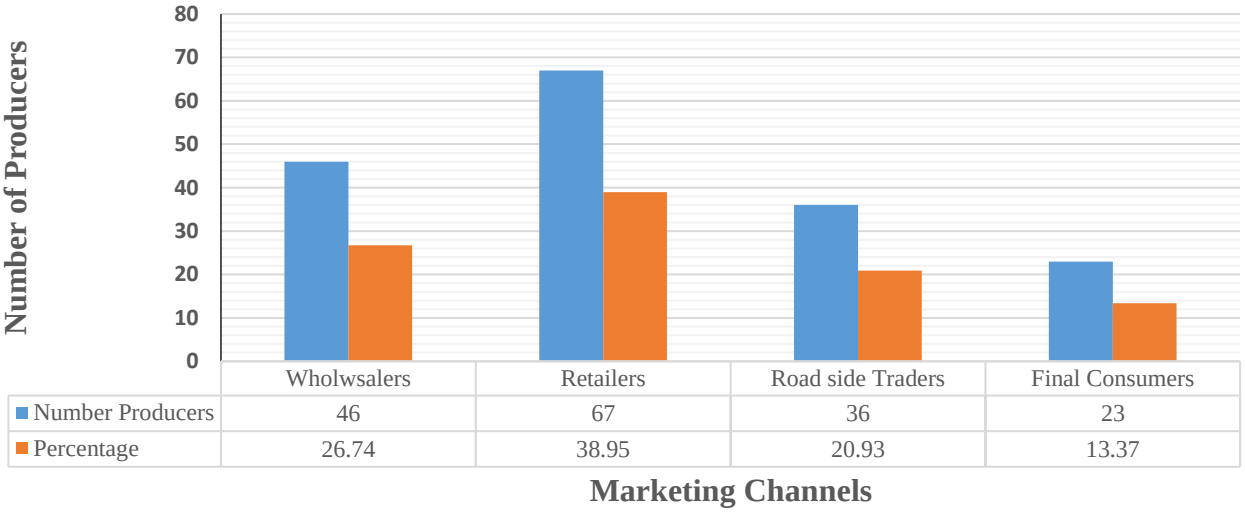

Figure 1: Relative Frequencies of Marketing Channels of Irrigated Tomato Producers in Kassena-Nankana Municipality

As presented in Figure 1, the descriptive analysis revealed that, majority (38.86 %) of the irrigated tomato farmers in KNM interviewed prefer selling through the retailers' marketing channel. This is in line with the findings of the study carried out by Bongiwe and Masuku's (2012) on the factors that determine the market channel choice of selling vegetables which found tomato farmers in choosing to supply their products to non-wholesalers at the expense of the wholesalers in the channel of distribution. The findings also agreed with Mebrat (2015), which found most tomato farmers selling their produce through the retailers' channel than others.

Yet, tomato farmers from the field/survey complained that, most tomato buyers (wholesalers) from southern Ghana (Market Queens) by-passed the Municipality to neighboring Burkina Faso for the purchase of the commodity, without restrictions at the border. As a result, the few (wholesalers) that remained patronizing tomato from the KNM dictates the price at the farm gate. This has made some farmers to also by-pass the few wholesalers buying from the Municipality to the retailers and roadside traders for the sale of their produce. This is in accordance with Donkoh *et al.* (2013) findings, which asserted that, Ghana's implementation of some economic and trade policies such as the interim Economic Partnership Agreement (EPA) in 2008and later signed the agreement on July 2014 has led to high importation of fresh tomato from Burkina Faso into the country. The results however, contradict the works of Amikuzono *et al.* 2015 that pointed out that, the wholesalers (Market Queens) monopolized the marketing systems and use their dominance to exploit the farmers in the region. This is because, at the time of the research, there existed no such monopoly, as farmers could sell their produce to buyers of their choice.

As presented in Figure 1, the study further brought to bear the wholesalers, as the second (26.53 %) channel choice of the distribution. According some farmers during the interview asserted that, some wholesalers claimed the quantity and quality of tomato in the Municipality is low. As a result, crosses to neighbouring Burkina Faso to purchase their tomato. The dwindling assertion of tomato production in the Municipality as maintained by the wholesalers was confirmed during the researcher's interactions with the Tono Irrigational Project/scheme Manager who noted that, some farmers were substituting tomato which previously is their primary production for rice, okra and pepper cultivation. Hence, contributed to the low production of tomato in the region. This was evident in farms of some communities such as Bonia, Korania, and Doba during the field survey. The analysis equally established that, a total of 20.78% of the producers sold their produce to the

third (roadside traders) channel choice of distribution of the tomato in the KNM, whilst consumers formed the fourth (13.83%) channel choice of the producers.

Multiple Channel Choice of Farmers in the Kassena-Nankana Municipality

The analysis of the farmers equally brought to bear other multiple choice of channels adopted by tomato farmers for their produce. Whilst some farmers preferred selling to only a single channel choice, some preferred double channels and others preferred multiple channel choices. Over all, the various multiple channel choices of marketing tomato emanated from the field survey by smallholder farmers are identified as follows:

1. Channel one (I): Producers → Retailers → Final Consumers.
2. Channel two (II): Producers → Wholesalers → Retailers → Final Consumers.
3. Channel three (III): Producers → Roadside traders' → Final Consumers.
4. Channel four (IV): Producers → Retailers → Roadside traders' → Final Consumers.

Channel one (I) illustrate the sale of tomato from producers to the retailers and from the retailers to the final consumers. On the other hand, channel two (II) represent the sale of tomato from producers to wholesalers through the retailers and to the final consumers. Channel three (III) explains the sale of tomato from the producers direct to the roadside traders and to the final consumers. Whilst, channel four (IV) is the sale of tomato from producers through the retailers to the roadside traders and to the final consumers. Evidence from the field survey revealed the emergence of roadside trading operations, within the retailers whom might purchase tomato from other retailers or wholesalers, or producers for onwards retail to the final consumer. Since the roadside traders are themselves retailers and purchases from other retailers for onward retailing, the study found it appropriate combining the channel three (III) and four (IV) choices for analysis.

Table 5: Choices of Combination of Marketing Channels in the KNM

Channel I Only		**Channel II Only**		**Channel III & IV Only**	
Channel Choice	Sample (%)	Choice of Channels	Sample (%)	Channel Choice	Sample (%)
Wholesalers only	8.1	Wholesalers – Retailers	20.9	Wholesalers-Retailers-Road Side Traders	10.5
Retailers only	20.9	Wholesalers - Roadside Traders	2.3	Wholesalers-Retailers-Final Consumers	0.6
Road Sider Traders only	1.2	Wholesalers-Final Consumers	3.5	Wholesale-Road-Final Consumers	3.5
Final Consumers only	0.0	Retailers-Roadside Traders	9.3	Retailers-Road Sider Traders-Final Consumers	5.2
		Retailers-Final Consumers	5.8	Wholesalers-Retailers-Road Side Traders-Final Consumers	1.7
		Road Side Traders - Final Consumers	6.4		
Sample (%)	30.2		48.3		21.5

The first column in Table 5, illustrates the percentage of farmers who adopted only one channel for the sale of their produce. The table revealed that overall, 30.2 % of the farmers adopted channel one for the sale of their produce. This consists of 8.1% of the farmers' produce sold to only wholesalers, 20.9% being sold to retailers only, 1.2% for roadside traders only and none sold to only consumers. This may be attributed to the fact that, some of the farmers have regular customers for the purchase of their produce.

Comparing the percentage values in table 5 to figure 1 above are not the same. Table 5 answers the question of the portion of farmers produce that went to only wholesalers, retailers only, roadside traders only and consumers only. Whilst figure 1 answers a general question; whether or not farmers sold part of their produce to the wholesalers, retailers, roadside traders and consumers. Due to

this, there are multiple responses arising as in figure 1 above. So, Figure 1 would necessarily record more responses than in table 5 (only wholesalers, retailers, roadside traders and consumers).

Further, the percentage of farmers that preferred channel two only in the second column of the table 5 revealed that, 48.3% of farmers marketed through channel two II choice. The various compositions are; 20.9% of the tomato farmers sold their tomato to both wholesalers and retailers, 2.3% sold to wholesalers and roadside traders, whilst about 3.5% was sold to wholesalers and consumers only. In addition, about 9.3% of the farmers adopted only retailers and roadside traders' channel, whilst 5.8% sold to only retailers and consumers' channel choice and 6.4% sold to the roadside traders and the final consumer. This came as no surprise as tomato is a perishable commodity, farmers whose tomato are ripe cannot postpone selling. As a result, sell to buyers who are available at that time.

Furthermore, the analysis in Table 5 equally brings to bear the combinations of three and four channels for marketing of tomato. The results revealed that, a total of 21.5 % of tomato farmers sold their produce to channel three. This percentage is made up of 10.5% of the farmers who choose the combination of wholesalers-retailers-roadside traders and final consumers only, whilst 0.6% of the farmers adopted the combinations of the wholesalers-retailers-final consumers' channel. In addition, about 3.5% of the farmers adopted the wholesalers-roadside traders-final consumers' channel, whilst, 5.2% adopted the retailers-roadside traders-final consumers and 1.7% sold through wholesalers-retailers-roadside traders-final consumers channel choice of distributions. The above analysis points to channel two (II) as best alternative for the marketing of tomato in the Kassena-Nankana Municipality.

Factors Determining the Choice of Marketing Channel of Tomato Farmers in KNM

The Multinomial Logit Model (MNL) was used to analyze the factors influencing the choice of marketing channels by smallholder tomato farmers in KNM. This is because, the parameter estimates of MNL model offered only the direction of effect of the explanatory variables on the dependent variable. The MNL model's estimation is statistically significant in explaining the choice of market channel by smallholders irrigated farmers. The results of the analysis are presented on Table 6.

Table 6: Empirical Determinants of Choice of Marketing Channels by Irrigated Tomato Producers in KNM in UE/R of Ghana

	Multinomial Logit Results		**Marginal Effects**			
Combination of marketing channels	**Channel II**	**Channel III**	**channel II**	**Channel III**		
Variable	Coefficient	Coefficient			Chan II Std. Err.	Chan III Std. Err.
Farmer's age in years	-0.0465	-0.192***	0.00587	-0.01855**	0.0493	0.0699
Farmer has formal education	-0.1270	-0.253***	-0.0029	-0.01986**	0.0817	0.0950
Gender of farmer-Male	-1.140	-0.852	-0.1253	-0.01708	0.697	0.867
Household size	-0.396***	-0.425**	-0.03456*	-002056	0.144	0.189
Farmer belongs to an FBO	-0.210	2.385***	-0.200801*	0.2857***	0.774	0.894
Used improved variety of tomato seeds	2.190***	2.399**	0.18745*	0.11943	0.847	1.089
Farm size in acres	3.240***	1.760*	0.40256***	-0.02656	0.858	0.958
Labour cost	-0.0209***	-0.010*	-0.00269***	0.000325	0.0053	0.0059
Access to market information	1.874**	-0.853	0.36368***	-0.22801***	0.741	0.815
Mean market distance	0.263	-0.426	0.07244**	-0.06678**	0.264	0.291
Farmer has received credit	0.0011	0.0022	0.00022	0.000177	0.0015	0.0015
Harvesting period Dec/Jan.	-4.250***	-2.944**	-0.4835***	-0.03737	1.227	1.423
Harvesting period Jan/Feb	-4.501***	-4.778***	-0.3960***	-0.22815*	1.359	1.556
Constant	9.532***	16.46***			3.275	4.117
Base Outcome: use of only one (I) marketing channel						
Number of observations	172			172		
LR $chi^2(26) = 119.00$						
Prob > chi^2=0.0000						
Log likelihood =-120.03864						
Pseudo R^2= 0.3314						

****, ** and * imply statistical significance at 1%, 5% and 10% respectively.*

The base outcome used for these estimations in Table 6 was channel one (1). The marginal effect estimates represent the probability of selling through only channel two (II) or channel three (III) relative to the base category. As a result, all the possible alternatives of tomato marketing channels in the KNM are compared to the base category, which is only channel one (I). In fact, the marginal effect of Multinomial Model analysis is superior to the estimated coefficients, as a result you have to choose the channel that best fit the model as the base category (Al-hassan *et al.,* 2013). The results of multinomial logit model in Table 6 revealed the Chi square value as 119.00, and it is statistically significant at 1% level. The result of the explanatory variables explains 33.14 % of total variation of market channel choice of tomato farmer in KNM. At 1% significant level, the hypothesis that, all the coefficients with the exception of the constant are zero is rejected by the test.

The results of marginal effect as presented in Table 6 revealed that, the age of the farmer has a negative effect on the probability of a farmer in KNM choosing channel three (III). The negative relationship indicates that, as the age of the farmer increases, the likelihood of selling to channel III decreases. Basically, as farmers age advances, they are less likely to sell through channel III by 1.855% relative to the base category. Hence, older famers are less likely to adopt selling their tomato to channel III as compared to younger farmers relative to the base category. Further, formal education of farmer is significant but with a negative effect on the choice of selling to channel three (III) relative to the base category. Statistically, an increase in the level of farmer's formal education, would lead to a corresponding decrease in the probability of selling to channel three (III) by 1.986% relative to the base category. This means that, farmers with formal education are less likely to sell their tomato to channel III relative to the basic category. Hence, educated tomato farmers are less likely to sell their produce through the three (III) channel as compared to illiterate farmers relative to the base category. This has met prior expectations and is in contradiction to Mamo and Degnet's (2012) study on the factors that influence the market channel choice of livestock marketing in rural Ethiopia among livestock producers. Their study found the variable, education, to be significant and has a positive effect on the producer's market channel choice decisions. Furthermore, household size is another important variable in the Table 5. The results of the marginal effect revealed that, household size was found to negatively affect household decision to sell to only channel two (II) of the marketing choices. As such, an increase in household's size by one person decreases the probability of a farmer's choice of selling through only channel two (II) by 3.456% relative to the base category (only channel one). Implying that, larger household's farmers are less likely to sell their produce through channel II as compared to smaller household's farmers relative to the base category.

More so, farmers belonging to FBO membership negatively affected the choice of channel two but, positively affected the choice of channel three/four. As a result, a farmer being a member of FBO probability of marketing his/her tomato through only channel two II choices decreases by 20.08%. In contrast, a reduction in FBO membership by one farmer will increase the probability of selling through the channel three (III) choice by 28.57%. This has contradicted the prior expectation of the researcher. The researcher expected that, famers with FBO are better organized and would be able to establish good relationship with a particular and regular customer base, for the purchase of their produce.

Equally important, the use of improved variety seeds is found to have a positive significance with only channel two choice of distribution relative to the based category. Statistically, an increase in the adoption of improved variety seeds will increase the likelihood of selling through only two channels by 18.745%. Evidence from the field revealed that, tomato fruits of the improved variety are more plump or bigger than the local variety. As such, preferred by most wholesalers than the local tomato variety. This has met the prior expectation of the researcher. The researcher expected that, famers with improved variety tomato will attract more customers than their counterparts with local variety tomato.

Another important economic variable is farm size, which measures the average land cultivated.

Farmers who have allocated more acres of land for tomato production would obtain more tomato than those with less allocation of land. Farm size significantly and positively affects household's decision to sell their produce to channel two markets choice only. Therefore, a one-acre increase in tomato farmer's farm size increases the probability of a farmer's position to sell through channel two choice of marketing by 40.256% relative to the base category. By implication, farmers that cultivate larger land sizes produces more quantities of tomato and choose to sell through channel two marketing choice as compared farmers with less farm size relative to the base category. This could be attributed to the fact that tomato farmers choose the nearest marketing channel in other to minimize their losses. This has met researcher's prior expectations and it is in accordance to Mebrat (2015) study on the factors that influence the market channel choice of tomato marketing in rural Ethiopia among tomato producers. His study found the variable, farm size, to have a significant and positive effect on the producer's market channel choice decisions.

More to the point, the cost of labour could affect tomato productivity and hence, affects the channel choice of producers. This is because, cost of labour increases cost of production and as such may decrease profits margin of the farmer. The results established cost of labour to be significant but negatively affecting the channel choice of the tomato producers on channel two (II). This implies that, one (1) Ghana cedi increase in the cost of labour will decrease the probability of marketing tomato through only two channel choice by 0.269% relative to the base category.

Again, access to market information is an incentive to farmer's decision of the channel choice decision. This steamed from the fact that, the smallholder tomato farmer is always aiming at making profits from his produce. The marginal effect of the access to market information significantly and positively affect the channel two but negatively affects the channel three (III) choices of the smallholder tomato farmer. The positive significance of the channel two implies that, an increase of access to market information increases the probability of the smallholder tomato farmer in selling their produce through the channel two choice by 0.364 as compared to those without market information relative to the based category. In contrast, the negative significance of access to market information on the channel three (III) indicates that, farmer's access to market information decreases the probability of selling through the channel III choice by 0.228 relative to the base category.

Additionally, distance to market is a disincentive to increased production due to the cost of transportation coupled with the challenges of perishability nature of tomato. The average distant from farm to market is found to be significant at both channel-two choice and channel three (III) choices. The marginal effect on the two channels is positive which means, as the distance between farm and market source increases by a kilometre, the probability of the tomato farmer selling through two channels increases by only 0.072. However, the negative significance on the channel three (III) choice indicates that, an increase in distance from the farm to market source by a kilometre, decreases the probability of the tomato farmer from selling through channel three (III) choices by 0.067 relative to the base category.

Equally, the variable harvesting period (December/January) describes the time at which some tomato farmers in the KNM harvest their tomato for sale (Amikuzono *et al.,* 2015). The December/January harvesting period has negatively affected the two channels choice. This means that, an increase in tomato harvest between December/January by an acre decreases the probability of the tomato farmer from selling through channel two (II) choices by 0.4835 as compared to those harvesting in January/February relative to the based category.

Finally, harvesting period (January/February) describes the time at which most tomato farmers in the KNM and some Burkina Faso harvest their crop for sale (Amikuzono *et al.,* 2015). This variable is equally significant but negatively affects both the two and three (III) channel choice relative to the based category. This negative significance implies that, an increase in tomato harvest between January/February by a crate decreases the probability of the tomato farmer

from selling through channels two and three choice by 0.396 and 0.228 respectively relative to the based category.

CONCLUSION

The study analysed the current marketing channels and determining factors on smallholder irrigated tomato farming in the Kassena-Nankana Municipality (KNM). Semi-structured questionnaire was used to collect primary data through household survey during the 2017 farming season. Besides, the descriptive analysis established that, smallholder tomato farmers adopts different channels of marketing their produce in the KNM. Whereas majority of the farmers preferred selling through the retailer's channel of distribution, others preferred the wholesalers and some to the roadside traders in marketing of their produce. In view of the above, the study concludes that, the choice of selling through channel two (II) is comparatively the best alternative for the sale of tomato which will potentially, yield higher profits to the tomato farmers in the Municipality.

The multinomial logit model analysis on the determinants of the choice of marketing channel established that, use of improved variety seeds, farm size, FBO and access to market information greatly and positively influenced the choice of marketing channel. With age, education, gender, household size, cost of labor and harvesting period negatively affected the choice of marketing channels. Which means producers are accruing higher income from the retailers for which reason, they prefer selling to the retailers over the wholesalers' channel. In this regard, it is imperative to promote market information, use of certified seeds, FBO membership and increase farm size among smallholder tomato farmers.

The study recommended the promotion of market information through the creation of social media platforms or groups and mobile phone calls usage among tomato farmers. Awareness on market prices at different markets and at different times can help farmers to identify the best market channel choice decision for their produce. Agricultural extension officers can take up the task in assisting farmers in the creation of these platforms and link them up to tomato buying companies or groups in the country.

Besides, there is the need to promote farmers' awareness on the use of certified/improve variety instead of local variety seeds. This will enable farmers to command higher price and higher profits for their produce. Farmers with FBO membership can share the experience with their counterparts. Through this means they would be able to compete with imported tomato in the market.

Government policy on youth and agricultural policy initiative could target tomato farmers in providing assistance/motivations to young graduates and existing farmers in the region to promote tomato production, by providing subsidized inputs and credit facility to those irrigated tomato farmers in the municipality.

CONFLICT OF INTEREST

The authors have declared that there is no conflict of interest regarding the publication of the paper.

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