## Factors Affecting Tomato Market Outlet Choice Decisions in West Gojjam Zone, Amhara National Regional State of Ethiopia

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**Abstract:** Most importantly, vegetable crops are an important source for food security, income generation as well as creating jobs for many job seekers. More remarkably, tomato is one of the essential ingredients for stews as well as cash crops for many smallholder producers to alleviate poverty especially in the developing world just like Ethiopia. Vegetable crops in general and tomato in particular need an appropriate market outlet choice decision because of its perishability nature of the crop. Hence, this study was aimed to identify tomato market channels and determinants of market outlet choices of tomato producers. A multi-stage random sampling procedure was applied. Data were collected from both primary (280 tomato producers) and secondary sources. Both descriptive and inferential statistics were applied to analyze the collected data and generate valuable information. Eleven major tomato market channels were identified in the study areas. Information is an important resource for running the business effectively and efficiently. However, the information was scanty in the study area which only accessing 43.57% from the total respondents. Of the total tomato producer, 21.43% of them were used motor pump technology for irrigation purpose. The result of the correlation matrix indicated that correlation between collector market outlet with retailer market outlet and wholesale market outlet with consumer market outlet indicates a non-competitive relationship. This model shows significant and positive correlation between the choice of retailer and collector outlets and between wholesaler and consumer outlet. It was indicated that producers use retailer outlet as a substitute for collector outlet and use consumer outlet as a substitute for wholesaler market outlet. Multivariate probit model results indicated that family size, total livestock owned, yield, post-harvest loss, market information, current market price, extension frequency, off-farm income and motor pump owned significantly influenced market outlet choice for tomato producers in the study areas. Extension service helps to the producers to provide important market information as well as production technology. The mean extension contact with producer is two times per month during the production season which is less as compared to the transmission of information and technologies demanded by producers. Therefore, this study recommended that capacitating farmers via extension education and introducing tomato post- harvest reduction technology would help farmers to select lucrative market outlet choices as well as accessing valuable and timely information is a paramount important for the tomato production and marketing development.

**Keywords: Tomato,** **Market outlet choice, Multivariate, Probit Model, West Gojjam**

1. **Introduction**

The growth of agricultural sector in Ethiopia is a major contributor to overall economic growth and remarkable occurrence for Africa, which lags in agricultural production globally and increasingly dependent on imported staple foods to feed its population (Jayne *et al*., 2013).

Ethiopia possess different agroecological zone which is suitable to produces different varieties of vegetable crops via commercial and small-scale farm. However, the production and cultivation of vegetables varies few plants in the backyards for home consumption up to a large-scale production for domestic and export market (Zylberberg, 2014). The most common and widely grown vegetable on the land is the cultivated tomato (Lycopersicon esculuntum Mill). Its significance in Ethiopia is growing at the moment. More than any other vegetable, it is widely accepted and widely used in a variety of dishes as raw, fried, or processed items (Lema, 2002).

Although tomato can improve the livelihood of rural farmers, studies have shown that the full potential of the crop has been under exploited because of many challenges. For instance, most farming in Nigeria (as well as most African countries) is rain feed because of lack of effective irrigation system (Adenuga *et al*., 2013). The incidence of pests and disease, low quality and insufficient quantity of tomato produced and competition from foreign imports are also some constraints hampering the production of tomato in Africa (Robinson and Kolavalli, 2010).

Post-harvest challenges are other challenges faced by producers, processors, distributers, retailers as well as exporters in handling the produces after it has been harvested until it gets to the final consumer. Post-harvest challenge in tomato production can be on farm challenge includes inappropriate harvesting period, excessive field heats and lack of on-farm storage facilities and inappropriate packaging material and off-farm challenges includes lack of access to road, inappropriate mode of transport, lack of processing factories, inappropriate retail packaging and lack of reliable market (Isaac, 2015).

Tomatoes are more appealing to Ethiopian farmers than other vegetables because they can be harvested multiple times, resulting in a high profit per unit area. It is a valuable cash crop for small-scale farmers, as well as a source of jobs in the production and processing industries. In addition, tomato is an important vegetable crop in Amhara region. In the region, the total cultivated land and productions were 1,074.46 hectare and 90,947.68 quintal (CSA, 2017). The study areas were well known district in tomato production due to its favorable Agro-ecology. As Bureau of Agriculture reported, in 2016/17 production season total production of tomato in Bure Zuria Woreda, North Mecha Woreda and Jabitehinan Woreda were estimated to be 38640, 74336 and 46000 quintals on 121, 232 and 144 hectares of land, respectively.

Marketing information regarding to tomato marketing is useful for assisting farmers with crop preparation prior to planting and selling surplus produce. Inadequate consumer outlets and a lack of price awareness are two factors affecting agricultural commercialization, according to Jaleta (2007). Poor product handling and packaging, as well as poor pricing mechanisms and knowledge asymmetry, all have an effect on the marketing of horticultural crops (Emana and Gebremedhin, 2007).

Farmers can better manage their production to match market demand, harvest at the most lucrative time, choose which market to sell their produce, and negotiate on an equal footing with traders by using improved knowledge and marketing facilities (CIAT, 2004). One of the most pressing development issues, according to MoA and ILRI (2013), is improving poor smallholder farmers' ability to enter markets and actively engaging them. Farmers and traders who do not completely rely on their vegetable business for a steady income, according to Xaba and Masuku (2012), frequently sell their produce at almost any price offered because the vegetable market is disorganized.

Vegetables such as tomato and onion, according to Hailu and Fana (2017), attract a high price but are subject to high price volatility. The current market situation and production planning do not suit the nature of vegetable products, where farmers received extremely low prices, especially for onion and tomato, at the producer and trader levels. Furthermore, using a multinomial logit regression model, determinants of market outlet choices were established, revealing that family size, education level, farmer styles, market access, and credit access all influenced vegetable farmers' outlet choices.

Despite the seasonality of production, the perishability of the product and the price fluctuations, the farmer in the study areas were faced with the marketing problem and unable to meet the ever-growing tomato market demand in the study areas. So, market problems existed in the study areas would determine market outlet choice decision of tomato producers. Therefore, this study, motivated to be filled the knowledge gap by clarifying underpinning drivers of market outlet choices among smallholder farmers in the selected woredas using a multivariate probit model analysis.

# Research Methodology

* 1. **Description of the Study Area**

The study was conducted in the selected woreda (Bure Zuria, North Mecha and Jabitehinan) of West Gojjam Zone of Amhara National Regional State. According to the Amhara regional bureau of finance and economic development, the total population of West Gojjam in 2018 was estimated to be 2,641,240 from which 1,301,353 are male and 1,339,887 females. From the total population 85.30% lives in rural areas and 14.70% in urban centers. Urban population were 388,204 from these 182,267 were males and 205,937 were females. West Gojjam Zone also had with a total of 2,253,035 rural households of which 1,119,086 were males and 1,133,950 were females (BoFED, 2018).

## Source and Data Requirements

The study was used both primary and secondary source of data. Qualitative and quantitative type of data from primary data sources were collected using two types of questionnaire, one from producers and the other from traders. Data collection was made with local trained enumerators. These, local enumerators were recruited and trained to administer the interview under close supervision of the researchers. During the personal interview, primary data were focused on key demographic, institutional and socio-economic factors affecting market outlet choice of tomato producers. A checklist was also used to guide the informal discussion conducted to generate data that could not be collected from individual interviews (focus group discussion a size of 10 participants within a group). The interview schedules were first pre-tested using non-sample respondents before actual data collection and amendments were made accordingly.

## Sampling Techniques and Sample Size

To select a representative tomato producing households a multi-stage random sampling procedure were applied. In the first stage, three major tomato producing Woreda found in West Gojjam Zone were selected purposively based on production potential of information obtained from the Zone and Woreda office of Agriculture. In the second stage, two kebele in each Woreda (Denbun and Weynma Ambaye from Bure Zuria; Abasem and Jimmat from Jabitehinan and Enguty and Enamrt from North Mecha)) were selected randomly. In the third stage using probability proportional to size technique, potential producers of tomato were selected from each selected sample Kebeles. Then a total of 280 sample tomato producers were randomly selected from the Six kebeles (Table 1). The total population of the three district is estimated to be 690,986 (BoFED, 2018).

Table 1: Distribution of households in the Six kebeles

|  |  |  |  |
| --- | --- | --- | --- |
| **No.** | **Woreda** | **Total number of tomato producers in each kebeles** | **Sample size** |
| 1. | Bure Zuria | 512 | 109 |
| 2. | Jabitehnan | 392 | 84 |
| 3. | North Mecha | 500 | 87 |
|  | Total | 1404 | 280 |

Source: Woreda Office of Agriculture and Rural Development, 2018

## Methods of Data Analysis

Descriptive statistics and econometric analysis were used to analyze the data obtained from tomato market chain actors to address each specific objective.

## Descriptive analysis

Descriptive analysis of data mainly uses percentage, mean and standard deviation to examine the descriptive result of the variable hypothesized. It was employed in the process of examining and describing producers’ socioeconomic characteristics.

## Econometric analysis

Econometric analysis was used to estimate the causal relationship between the dependent variable and regressors. It is pertinent to understand the effect of different regressors on the tomato market outlet choice. Hence, model specifications for market outlet choice decision are presented as follows.

**Modeling market outlet choice of tomato producer**: The goal of market outlet choice decision is to explain the effects of the independent variables on the probability of choosing between different market outlets in tomato market. According to Gujarati (2003), to estimate the effect of explanatory variables on dependent variable involving multiple choices with unordered response categories, multinomial probit or logit model is required as a function of the explanatory variables.

The producers’ selection of market outlet depends on the amount of utility obtained from alternative market outlets. The possible outcome of market outlet choice can be modeled following random utility formulation. A Market outlet which has greater level of expected utility as compared to other market outlet is supposed to be chosen by the farmer (Masten and Saussier, 2002). Random utility model (RUM) was used to analysis the producers’ market outlet choice. The utility function to be fitted to the "no-yes" type of data should be of a threshold type. It is appropriate for modeling discrete choice decisions such as market outlet choices. Econometric models such as multivariate probit/logit, multinomial probit/logit, conditional or mixed, or nested logit are useful models for analysis of categorical choice dependent variables. A number of studies have been done that have revealed factors influencing market outlet choice decisions. Different scholars have been used multivariate probit model to analyze determinants of market outlet choice. For instance, Kassa et al (2017), Efa and Tura (2018), Fakery et al (2017), Addisu (2017), Shewaye (2016), Takele *et al.,* (2017), and Taye et al (2017) were used multinomial logit model in an attempt to determine factors affecting producers’ market outlet choice. On the other hand, Sultan *et al., (*2017), Berhanu *et al*., (2013) Bongiwe and Micah (2013), Atsbaha (2015), Emana et al. (2015) and Kifle *et al.*, (2015) were used multinomial logit model in an attempt to determine factors affecting producers’ market outlet choice. Multinomial models are appropriate when individuals can choose only one outcome from among the set of mutually exclusive, collectively exhaustive alternatives. However, in this study, producers’ market outlet choice is not mutually exclusive, considering the possibility of simultaneous choices of outlets and the potential correlations among these market outlet choice decisions. Therefore, multivariate probit model was adopted for this study to estimate several correlated binary outcomes jointly because it simultaneously captures the influence of the set of explanatory variables on each of the different outlet choices, while allowing for the potential correlations between unobserved disturbances, as well as the relationships between the choices of different market outlets (Greene, 2012).

Consider the ith farm households (i=1, 2… N), facing a decision problem on whether or not to choose available market outlets. Let V0 represent the utility expected to obtain by the farmer who chooses Kth market outlet and Vk represent the actual utility of farmer to choose the Kth market outlet: where K denotes different market outlets in the study area. The farmer decides to choose the Kth market outlet if Y\*ik = V\*ik –V0 >0. The net benefit that the farmer derives from choosing a market outlet is a latent variable determined by observed explanatory variable (Xi) and the error term which represent an observed utility (ei):

Yik\* = *Bk*Xik + *ei* (K= Y1, Y2, Y3, Y4…)                  (1)

Where, *Bk* is vector of parameter. K represents different level of utility from different market outlet (Yi). Using the indicator function, the unobserved preferences in equation (7) translates into the observed binary outcome equation for each choice as follows:

$Yik=\left\{\begin{array}{c}1 if , \&Yik\*>0\\0 otherwise\end{array}\right. (K=Y1, Y2, Y3, Y4…)$ (2)

In multivariate model, where the choice of several market outlets is possible, the error terms jointly follow a multivariate normal distribution (MVN) with a mean of zero and variance–covariance matrix V has values of 1 on the leading diagonal and correlation 𝝆jk = 𝝆kj as off- diagonal element where (*µy1, µy2, µy3, µy4)* MVN ~ (0, Ω) and the symmetric variance-

covariance matrix Ω is given by:-

1 𝜌𝑦1𝑦2 𝜌𝑦1𝑦3 𝜌𝑦1𝑦4

𝜌𝑦2𝑦1 1 𝜌𝑦2𝑦3 𝜌𝑦2𝑦4

𝜌𝑦3𝑦1 𝜌𝑦3𝑦2 1 𝜌𝑦3𝑦4

𝜌𝑦4𝑦1 𝜌𝑦4𝑦2 𝜌𝑦4𝑦3 1

 Ω = (3)

Off-diagonal elements in the variance - covariance matrix represent the unobserved correlation between the stochastic components of the different types of outlets. This assumption means that equation (3) will generate MVP models that jointly represent a decision to choose a particular market outlet. This specification with non-zero off-diagonal elements allows for correlation across error terms of several latent equations, which represents unobserved characteristics that affect the choice of alternative outlets. Therefore, this study examined the determinant factors of market outlet choice on interdependence market outlets (wholesalers, retailers, rural collectors and consumers). Following the form used by Cappellari and Jenkins (2003), the log-likelihood function associated with a sample outcome is then given by;

$$L=\sum\_{i=0}^{n}⍵lnΦi\left( µi, Ω\right) (4) $$

Where ⍵ is an optional weight for observation i---N and Φ is the multivariate standard normal distribution with arguments µi and Ω, where µi can be denoted as :

$$μi= \left(Ki1β1Xi1, Ki2β2Xi2, Ki3β3Xi3, Ki4β4Xi4\right), while Ωik= 1 for J = K and$$

$$Ωjk= KijKikρjk for J=K, K=1, 2, 3…with Kik=2yik-1 for each i, k=1,….4 (6) $$

Matrix $ $Ω has constituent elements Ωjk. Therefore, we can use multivariate probit model to study farmers joint decision to market outlet choices.

# RESULT AND DISCUSSION

* 1. **Descriptive Result**

Education is an important tool that plays great role for tomato producers in selecting appropriate market outlet choices. Educated farmers could also have access to acquire and process information and enable them to evaluate their decisions, plan and conduct their businesses with confidence (Zhou., 2008). Table 2 indicate that the mean year of schooling for sample household were three years.

The tropical livestock unit (TLU) per household was estimated to determine the livestock holdings of survey respondents. In the study area, tomato growers had an average livestock holding of 5.36 TLU, which influenced their choice of alternative market outlets. It is a farmer's secondary source of income, food, and traction power for tomato cultivation. As a result, households with greater livestock holdings are better off.

In the three Woreda, the average farming experience of the total survey respondents was 4.36 years. It is thought that as farming experience increases, so does the likelihood of finding and embracing agricultural technologies and market knowledge in order to run a profitable tomato business.

Table 2: Demographic and socio-economic characteristics of sample households

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Bure (N = 109)** | **Jabitehnan (N = 84)** | **N/Mecha (N = 87)** | **Total (N = 280)** |
|  | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** |
| Year of schooling | 2.6 | 2.9 | 3.27 | 3.11 | 3.6 | 2.6 | 3.13 | 2.9 |
| TLU | 5.09 | 2.2 | 5.1 | 1.90 | 5.9 | 2.4 | 5.36 | 2.23 |
| Farmingexperience | 4.75 | 3.63 | 3.4 | 1.94 | 4.6 | 2.8 | 4.36 | 2.98 |
| Off-farmIncome | 12548. | 8950.9 | 13164.4 | 9198.4 | 22348.8 | 18038.1 | 15679.9 | 13156.3 |

Source: Own computation from survey result, 2019

The respondents depend on a variety of income-generating methods, with grain production being their primary source of income. Vegetable output is also regarded as the second most important source of income in Bure, Jabitehinan, and North Mecha Woredas. Off-farm income amounted to 15679.9 Birr per year on average.

## Access to institutional service of sampled households

Farmers would be better able to sell their surplus tomatoes and select profitable market outlets if they had accurate market information on the current market situation. According to the survey results, in Bure, Jabitehinan, and North Mecha Woreda, respectively, 29.4%, 45.2 percent, and 59.8% of the sampled households had access to market knowledge from various sources.

Despite the fact that access to market information is one of the most important factors in running a successful tomato business, only 43.57 percent of respondents in the study area were able to obtain it.

Furthermore, tomato producers are discouraged by the perishability of tomato products on the one hand, and the regular price fluctuations on the other. As a result, providing actors with up-to-date tomato market knowledge is a great way to enable tomato value chain actors to increase tomato production and marketing's contribution to economic growth.

Table 3: Access to institutional services

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Item** | **Bure** **(N =109)** | **Jabitehinan (N = 84)** | **N/Mecha (N = 87)** | **Total (N = 280)** |  |
|  | **Freq** | **%** | **Freq** | **%** | **Freq** | **%** | **Freq** | **%** | **χ2/fisher ’s exact test** |
| market information | Yes | 32 | 29.4 | 38 | 45.2 | 52 | 59.8 | 122 | 43.57 |  |
| No | 77 | 70.6 | 46 | 54.8 | 35 | 40.2 | 158 | 56.43 |  |

Source: Own computation from survey result, 2019 0.900 χ2

Agricultural extension program, by farmers training centers (FTCs), also plays an important role in determining the best business outlets. Extension services also help farmers enhance their ability to introduce new and improved technologies such as crop varieties, animal breeds, tools, pesticides, and practices by improving their abilities and knowledge (Abraham, 2012). According to Table 6, the mean extension contact of sample household was about 2.57 times per month.

Table 4: Mean extension contact of tomato producers per month

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variables**  |  | **Mea n** | **SD** | **Mea n** | **SD** | **Mea n** | **SD** | **Mea n** | **SD** |
| Extension contacts |  | 2.65 | 1.42 | 2.27 | 1.14 | 2.77 | 1.36 | 2.57 | 1.33 |

Source: Own computation from survey result, 2019

## Marketing channels of tomato

## The marketing channel, according to Mendoza (1995), is the series of intermediaries by which the entire commodity passes from the point of origin to the point of consumption. The aim of marketing channel analysis is to gain a comprehensive understanding of the movement of products and services from point of origin to point of destination. Despite the fact that the tomato marketing channel is diverse and multifaceted, 11 main tomato marketing channels have been established. The following is the quantity purchased and sold flow of tomato product during the 2018 production season:

* + - 1. Producers             Consumers 5.3% (16395.55)
			2. Producers            Retailers            Consumers 11.65% (36038.13)
			3. Producers         Rural collectors          Retailers        Consumers 2.79% (8621.62)
			4. Producers            wholesalers            Retailers             Consumers 33.20% (102696.39)
			5. Producers            Wholesalers            Processors         Consumers 13.11% (40563.21)
			6. Producers              Retailers           Processors          Consumers 5.66% (17510.35)
			7. Producers           Wholesalers          Retailers          Processors          Consumers 16.13% (49898.54)
			8. Producers              Rural collectors          Wholesalers         Processors        Consumers 2.27% (7021.81)
			9. Producers         Rural collectors          Wholesalers        Retailers        Consumers 5.75% (17777.54)
			10. Producers          Rural collectors       Retailers          Processors            Consumers 1.35% (4189.08)
			11. Producers Rural collectors Wholesalers retailers Processors consumers

2.79% (8637.83)

Figure 1: tomato market channels

When all value chain participants are reasonably compensated for their value addition contributions, the marketing channel is considered to be the greatest. It is self-evident that when it comes to unfair benefit distributions in marketing channels, the shortest marketing channel is the best for minimizing unfair benefit distributions, while the longest marketing channels are the least efficient. The most important concept to remember is that the longest marketing platforms are not always the best. Since, regardless of value addition and ownership transfer, such marketing channels can be the best in terms of value addition and product delivery to the consumer at the right location and at the right time. As a result, the best channel for this study is determined by the value. As a result, the best channel for tomato product flow in this study is the first channel, which runs from producer to customer, and this type of product or knowledge flow is known as direct marketing. The highest volume of tomato transactions, on the other hand, came from the fourth marketing channel, since wholesalers have more working capital and can buy tomatoes in bulk.

Producers (309,350kg)

Retailers

Rural collectors

Wholesalers

Consumers

5.3%

14.95%

62.44%

17.3%

72.3%

27.7%

79%

67.3%

Processors

21%

32.7%%

100%

Source: Own Sketch from the survey results, 2019

Figure 2: Tomato products market channels

* 1. **Econometric Results**
		1. **Factors affecting smallholder tomato producers market outlet choices**

The multivariate Probit model was used to account for the anticipated multivariate interdependence of collectors', buyers', retailers', and wholesalers' range of specific market outlets (Table 5). The Wald test was used to verify the model's fitness, and the results show that the data is statistically significant at the 1% stage, indicating that the subsets of coefficients are different from zero and jointly significant, and the independent variable used in the model is justifiable. Furthermore, the model’s likelihood ratio test (21 = 31 = 32 = 42 = 43 = 41 = 0) is significant at 1%. As a result, the researcher rejects the null hypothesis that all (Rho) values are equal to 0, implying that the model's goodness-of-fit decisions to select these market outlets are interdependent. As a result, a multivariate probit model is suitable for determining factors affecting market outlet selection. Furthermore, the probability ratio statistics revealed variations in farmer activity when it came to market outlet selection.

The ρ values (ρij) show the degree of correlation between market outlet selections. The results of the simulated maximum likelihood estimate indicated that there was a positive and statistically significant interdependence between farmers' choice of market outlet for retailer and collectors, implying that the ρ31 (correlation between collector and retailer choice) was positively and statistically significant.

The study also revealed that wholesale market outlet with consumer market outlet is positively and statistically significant at 1 percent level of significance. Therefore, correlation between collector market outlet with retail market outlet and wholesale market outlet with consumer market outlet suggests a non-competitive relationship.

The marginal success probability for each equation (market channel decision) is shown in Table 5. When compared to the likelihood of selecting consumer market outlets (89 percent), retail market outlets (90 percent), and wholesaler market outlets (50 percent), the likelihood of selecting collectors is comparatively low (27 percent). Farmers were not interested in selling their goods to collector market outlets, even though it meant lowering marketing costs, because collectors preferred to buy tomato products at a low price by persuading them of the current market situation.

Households are more likely to succeed in jointly choosing four market outlets than they are in jointly failing four market outlets. Households are 16 percent more likely to choose all four channels at the same time, although they are almost 1 percent less likely to do so.

Table 5: Overall fitness, probabilities and correlation matrix of the market outlets from the MVP model

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **Market outlets** |  |  |
| **Variables** | **Collectors** | **Consumers** | **Retailers** | **Wholesales** |
| Predicted probability | 0.27 | 0.89 | 0.90 | 0.50 |
| Joint probability(success) |  |  |  | 0.16 |
| Joint probability(failure) |  |  |  | 0.01 |
| Number of simulation (draws) |  |  |  | 100 |
| Observation |  |  |  | 280 |
| Log likelihood |  |  |  | -391.14 |
| Wald χ2(44) |  |  |  | 184.53 |
| Prob > χ2 |  |  |  | 0.00\*\*\* |
|  | **𝝆1** | **𝝆2** | **𝝆3** | **𝝆4** |
| 𝝆1 | 1.00 |  |  |  |
| **𝝆2** | 0.109 (0.21) | 1.00 |  |  |
| **𝝆3** | 0.00\*\*\*(0.17) | 0.38(0.24) | 1.00 |  |
| **𝝆4** | 0.78(0.13) | 0.006\*\*\*(0.19) | 0.16(0.19) | 1.00 |
| Likelihood ratio test of | 𝝆21 = 𝝆31 = 𝝆41= | 𝝆32 = 𝝆42 = 𝝆43 =0  |  |  |
|  |  | χ2 = 29.37 |  |  |
|  |  | Prob > χ2 = 0.00 |  |  |

Note: \*\*\* and \*\* indicate statistical significance at 1 and 5%, respectively. ρ1 = wholesalers, ρ2= retailers, ρ3= local collectors and ρ4=Consumers.

Parenthesis in the disturbance term correlation matrix showed the robust standard error (RSE). Source: Own computation from survey result, 2019.

Table 6 shows that certain variables were significant in more than one market outlet, while other variable was significant in just one market outlet, based on the results of the multivariate probit (MVP) model. Five of the fourteen explanatory variables in the model had a significant impact on rural collector’s market outlets, consumer outlets, and wholesaler outlets, while five variables had a significant impact on retailer outlets.

Table 6: Determinants of market outlet choice (Multivariate probit model result)

|  |
| --- |
| **Market outlet** |
| **Variables** | **Rural collectors** | **Consumers** |  | **Retailers** |  | **Wholesalers** |
|  | **Coef** | **RSE** | **Coef** | **RSE** | **Coef** | **RSE** | **Coef** | **RSE** |
| QUANT\_SOLD | .000598 | .0003993 | .0011005 | .000699 | -.000114 | .00062 | .000 | .000 |
| FAM\_SIZE | .137852\*\*\* | .0525103 | .1343382\* | .071791 | .17119\*\* | .07209 | -.019 | .048 |
| EDU | -.0205489 | .0367035 | -.022383 | .046926 | -.0347949 | .04614 | .002 | .035 |
| DIS\_MKT | -.0044532 | .0061659 | -.0073723 | .008428 | -.0026819 | .00824 | .001 | .006 |
| LAND\_TOMAT | 4.950228 | 3.282653 | -3.029738 | 4.19214 | .1580098 | 4.3969 | 3.066 | 2.596 |
| TLU | .0009146 | .0493407 | -.114682\* | .062255 | .0514395 | .05987 | .051 | .048 |
| YIELD | 1.11671\* | .5820863 | -.0268218 | .562373 | -.1584801 | .67171 | .129 | .432 |
| POST\_HARVEST LOSS | .0176\*\*\* | .0015824 | -.021544\*\* | .009846 | -.0079\*\*\* | .00291 | .005\*\*\* | .0014 |
| MKT\_INFO | -.463919\* | .2676492 | .2977643 | .293907 | .480719\* | .28498 | .735\*\*\* | .2507 |
| CURR\_PRICE | -.0162276 | .0363034 | -.0926142\* | .051118 | .034742 | .04816 | .109\*\*\* | .0367 |
| EXT\_FREQ | -.0131156 | .0143908 | .0272448 | .019779 | .07300\*\* | .03527 | .070\*\*\* | .0226 |
| OFFARM\_IN | .157689\* | .0955833 | .111762 | .106090 | -.0387876 | .11912 | .029 | .085 |
| MOT\_OWN | .2036435 | .3438823 | -.6677709\* | .403830 | .2029394 | .36868 | .543\*\* | .318 |
| FARM\_EXPRE = | -.0324332 | .0358874 | -.0699671 | .045075 | .0637776 | .05246 | .052 | .034 |
| \_cons | -13.56926 | 5.419606 | 1.210759 | 5.04438 | .7489508 | 6.1573 | -4.582 | 3.827 |

Note: \*\*\*, \*\* and \* indicate statistical significance at 1, 5 and 10%, respectively RSE is robust standard error

Source: Own computation from survey result, 2019.

**Family size:** The rural collectors, consumers, and retailers market outlet choice of tomato producers is positively influenced by household size. This means that the family's active labor force enables the farmers to easily sell their tomato harvest to direct consumers, retailers, and local collectors using their own resources easily. On the other hand, when the household had a sufficient number of active labor force in the family to assist them in transporting tomato products to the nearest village market, the farmers' likelihood of selecting a wholesaler market outlet was slim because they were buying in bulk but at the lowest price. In comparison to households with a less active labor force, those with an active labor force were able to select better retail sources. Efa and Tura (2018) found that rural collectors, consumers, and retailers market outlets were favored over wholesale market outlets by households with broad family sizes.

**Yield:** At a 10% level of significant, an increase in farmer tomato yield results in an increase in the likelihood of selecting a rural collector market outlet. This meant that households with a high yield per hectare would tend to sell their produce to the nearest rural collector's market. The implication was that if the yield of tomato to be sold is higher, farmers should look for a nearby market outlet that buys large quantities at a high price per box in order to reduce post-harvest loss and transportation costs, as tomato has a short shelf life. This finding was in line with that of Taye et al. (2017), who found that onion yield had a positive impact on farmers' choices of rural onion assemblers.

**Post-harvest loss of tomato:** Post-harvest loss of tomato had a negative impact on consumer and retailer market outlets at the 5% and 1% level of significance, respectively, while collectors and wholesaler market outlets had a positive and significant impact at the 1% level of significance. The negative sign suggests that as tomato post-harvest losses increased, households were less likely to sell to consumer and retail markets, preferring instead to deliver to collectors and wholesale markets. The possible reason is that they want to maximize their tomato profits by selling large quantities to wholesalers and collectors so that the stock they have on hand is kept to a minimum. The volume of product removed during sorting and grading, proportional to the total volume of product initially harvested and sold in the market, was used to calculate postharvest loss of tomato.

**Market information:** At the 10% and 1% levels of significance, access to market information is positively and significantly associated with the likelihood of choosing retailer and wholesale market outlets, respectively. Market information helps producers analyze the price difference between their locality and the nearby main market, which increases the likelihood of choosing retailers and wholesalers who give producers a higher price. The findings of this study agree with those of Bezabih et al. (2015), who found that market information has a positive and significant impact on potato producers' retailer channel choice decisions. Furthermore, at the 1% significance level, the variable is negatively associated with the collector outlet choice. The negative relationship may be attributed to other outlets' preference for higher-priced products. Tomato growers no longer prefer to sell their produce to local collectors; instead, they transport it to the nearest market. This result was consistent with Astabah's findings (2015).

**Current price:** At the 10% and 1% level of significance, respectively, the current price provided by tomato market outlets per kg of tomato significantly and negatively affected consumer tomato market outlet access and positively and significantly affected wholesaler market outlet access. Farmers are less likely to sell tomatoes to consumer market outlets as farm gate prices rise, as shown by a negative sign on its coefficient. The reasoning behind this is that because price is the primary motivator for vendors, farmers are less likely to sell tomatoes to consumer market outlets when prices increase because consumers only buy a small amount when prices are high. According to Addisu (2016), the option of a consumer market outlet is heavily influenced by the current farm price. On the other hand, the price paid per unit kg of tomato calculated the wholesaler consumer outlet preference positively at a level of significance of less than 1%, while all other variables remained constant. This is because wholesalers buy tomatoes in bulk and overestimate the price charged per unit kilogram of tomato as compared to other market outlets. Similar findings revealed a direct or positive relationship between wholesale market outlet selection and produce price (Takele et al., 2017).

**Extension frequency:** Frequency of extension contact has a positive and significant influence on retailer and wholesaler outlet choice decision at 5 and 1% significance level, respectively. Extension services enhance farmers' ability to obtain valuable market information and allow tomato growers to improve production methods, resulting in increased output and, in turn, increased producers' ability to sell their produce through wholesalers. As a result, farmers who were visited by extension agents more often were more likely to sell tomatoes to retailers and wholesalers. This finding matched that of Addisu (2016), who discovered a positive effect of agricultural extension service on the likelihood of choosing wholesaler onion market outlet.

**Off farm income:** At a 10% significance level, the availability of logarithmic transformed off/non-farm income influences the likelihood of selecting a rural collector’s market outlet positively and significantly. One potential explanation is that farmers who earn more money choose to sell their tomatoes at a reasonable price to the nearest market outlet rather than travel long distances. Riziki et al. (2015) found that off-farm income affects the preference of marketing outlets at the farm gate and at the local open-air market.

**Motor pump ownership:** At the 5% and 10% likelihood levels, respectively, having a motor pump had a positive and negative major effect on the option of wholesale and consumer outlet. Farmers who had a motor pump were more likely to sell tomato to a wholesale outlet than farmers who did not have a motor pump, according to the positive sign. This could mean that farmers who own a motor pump for irrigation grow more tomatoes and, as a result, deliver their product to wholesale rather than consumer markets. However, this finding conflicts with Addisu (2016), who found that owning a motor pump had a positive and important impact on customer outlet selection.

1. **Conclusions and Recommendations**
	1. **Conclusion**

The aim of this research was to define the major tomato market channels and the factors that influence tomato growers' market outlet choices. To achieve the desired results, both primary and secondary data sources were used. Primary data was gathered from tomato respondents using a structured and semi-structured questionnaire as well as interviews with growers. Key informants from experts (researchers, extension officers, woreda and zonal experts) were also used, as well as focus group discussions using a checklist. Primary data for this study were collected from a total of 280 sampled tomato households in Bure, Jabitehinan, and North Mecha Woreda, as well as 60 traders from Bahir Dar, Merawi, Bure, Finoteselam, and Debremarkos town. The descriptive and inferential statistics (multivariate probit model) were used to analyze the results.

Extension services aided in the transition of expertise and skills to farmers in order for them to implement modern and developed agricultural technologies. In the study areas, however, the average extension touch of sampled tomato households was nearly two times per month.

According to the survey results, 29.4, 45.2, and 59.8% of tomato respondents in the study areas had access to tomato marketing and production information. As a result, information on the tomato market is scarce. Despite the fact that the actual tomato marketing channel was varied and multifaceted, 11 major tomato market channels were established, with the first channel being the strongest due to direct producer and end-user participation.

Tomato growers in the study areas sell their products through a variety of market channels, depending on their preferences. To classify factors influencing tomato market outlet choices, a multivariate probit model was used. The option of retailer and collector outlets, as well as the wholesaler and consumer outlet, are shown to have a strong and positive association in this model. Producers have been reported to use retailer outlets in place of collector outlets and consumer outlets in place of wholesaler market outlets. The probability of choosing rural collectors, customers, retailers, and wholesalers' outlets was 27 percent, 89 percent, 90 percent, and 50 percent, respectively, with 16 percent likelihood of choosing all outlets simultaneously (success) and 0.01 percent failure to choose both outlets simultaneously.

The model showed that family size, yield, off-farm revenue, and post-harvest loss all had a substantial positive impact on the likelihood of selecting a rural collector’s market source, while access to market knowledge had a negative impact. Only family size had a significant positive impact on the likelihood of selecting a consumer market outlet, while total livestock owned, current market price, post-harvest loss, and motor pump ownership had a significant negative impact. Similarly, family size, access to consumer knowledge, and frequency of extension contacts all had a substantial positive impact on the likelihood of selecting a retailer market outlet, while post-harvest tomato loss had a negative impact. Post-harvest loss, access to consumer knowledge, current market price, frequency of extension contacts, and motor pump ownership all had a substantial and positive impact on wholesaler market outlets.

## Recommendation

Based on the results of this study, the following recommendations were drawn so as to be considered in the future intervention strategies which are aimed at decreasing the perishability nature of the product, promotion of tomato production and market and pinpointing out the most lucrative market outlets in the study area.

## From multivariate probit model:

* + - Tomato growers would be discouraged if there was a surplus of tomatoes available at a lower price. As a result, providing a fair market price per kilogram will encourage tomato growers to sell their produce through the best market outlets, thus attempting to stabilize price volatility.
		- Market information is a critical component in increasing tomato production. The ability of producers to negotiate with buyers of their produce increases when timely and accurate demand information is available. To achieve this advantage, an improved extension system focusing on market linkage is needed, as well as a reliable market outlet for tomato growers. This should be bolstered by marketing organizations such as irrigation cooperatives, so that farmers can sell their produce at more fair rates and benefit from greater buying power.
		- Frequent extension communications had a positive and important impact on market channels for retailers and wholesalers. As a result, Woreda DAs and other concerned bodies should visit tomato growers on a regular basis, advising and educating them on how to choose profitable market outlets.
		- Ownership of a motor pump had a substantial negative impact on consumers and a positive impact on wholesalers. As a result, tomato value chain supporting actors can encourage tomato growers to form teams in order to obtain their own motor pump.
		- Post-harvest loss of tomato had a substantial negative impact on retailers and consumers, although it had a positive impact on wholesalers and collectors. As a result, producers who are experiencing post-harvest losses should supply tomatoes to wholesalers, as wholesalers buy tomatoes in large quantities from farmers.
		- To take advantage of the current rising demand for tomatoes and tomato products, development programs and approaches that bring together all tomato actors will be critical to improving tomato product quality and strengthening tomato market linkages.

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