Factors affecting onion market supply in Medebay Zana district, Tigray regional state, Northern Ethiopia

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Abstract: A number of challenges hampered the development of the onion sector along with the market in the Medebay Zana district, Tigray, Ethiopia. This study was initiated to analyze the determinants of the onion market supply by farm households in the study area. Both primary and secondary data were used for the study. Primary data were collected from 121 farm households selected randomly using a semi-structured questionnaire. About 12 wholesalers and 31 retailers engaged in onion trading were interviewed to explore the onion marketing channel in the study area. Results of the multiple regression model indicated that the amount of onion produced, access to extension service and market information positively and significantly predicted the quantity of onion supplied to the market. Hence, government, non-governmental organizations and other stockholders should play a vital role in addressing the constraints of onion production. Extension agents need to help onion farmers to improve onion production through improved farm management and conservation, as well as through improved varieties and integrated water, nutrient and pest management. An integrated agricultural marketing information system strengthens the linkage between onion producer and other value chain actors in the district and beyond.

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PUBLIC INTEREST STATEMENT
Onion is considered as one of the most important vegetable crops produced by smallholder farmers in Ethiopia. It is the main relish item and has high nutritional value. It also has high economic importance for the value chain actors such as producers, traders as well as the national economy. The area under onion is increasing from time to time mainly due to its high profitability per unit area and ease of production, and the increases in small-scale irrigation areas. Despite area increase; the productivity of onion is much lower than in other African countries. The low productivity could be attributed to the limited availability of quality seeds and associated production technologies, among the others. On the other hand, the demand for onion is dramatically increasing in Ethiopia. As a result, there is a mismatch between supply and demand for onion in Ethiopia. Hence, this study focuses on the factors affecting the onion market supply in one of the onions growing regions in Ethiopia.
1. Introduction
Onion (Allium cepa) is among the most popular vegetables in the world. Onion is a crop that is classified as a cool-season crop. However, it can be grown in a wide range of climatic conditions. It is grown mainly for its bulb, which is used in every home, almost daily, across Ethiopia (AgroBIG, 2016). Ethiopia, the third-biggest producer of onion in the African continent next to Egypt and South Africa, contribute only 2.7% to the total world production between 2000–2011 (FAOSTAT, 2019). Averaged over the period of 2010 to 2018, the onion area harvested, production, and yield at the national level are 28,942 hectares, 33,947 tons and 11.70 tons/ha, respectively, (Central Statistical Agency (CSA), 2019; Food and Agriculture Organization Statistical Division (FAOSTAT), 2019), which is far below the world average of 19.7 tons/ha (Megersa, 2017). In the major rainy (Meher) season of 2018/19, onion production covered about 11.46% of root crops area in the country. In the same season, it was grown by 28,682 smallholder farm households in Tigray, Ethiopia. Together, these households produced 8,223 tons of onion on 1,299.06 hectares with yields of 6.33 tons/ha which is less than the national average yield of 9.32 tons/ha in the same season (CSA, 2019).

The most recent evidence shows that low quality of cultivars, inappropriate agronomic practices, weak extension system, disease and pests, and fluctuation of climatic conditions are the major constraints for the onion production and productivity in Ethiopia (Abebe, 2018; AgroBIG, 2016; Etano, 2019; Gebrselassie, 2013; Hallu, Zemedu, & Getnet, 2017; Megersa, 2017; Melese, Dessie, & Abate, 2018). Despite low productivity, onion is becoming the sources of livelihood for many people who have engaged in the production and trading. This has led to increased demand for onion production and marketing in Ethiopia (Gebrselassie, 2013). However, the evidence shows that lack of storage to increase its shelf life; poor handling of the products, imperfect price information, lack of horizontal coordination among producers, weak market linkage (lack of vertical coordination among chain actors), and lack of quality standards and grades are the major constraints for the marketing process of onion in Ethiopia (Abebe, 2018). This holds true in the case of Tigray region where the study area is located. The field reports from Medebay Zana District Office of Agriculture and Rural Development (DOARD) (2014), takes this further and stated that farmers of the district lack skills to apply chemicals on onion farm, they do not know how to find new buyers or market opportunities for their onion produce. Part of their knowledge and skill limitation is associated with traditional values and attitudes of farmers (Woldewahid & Woldemariam, 2013).

In Medebay Zana district, onion is a very important marketable cash crop of the smallholder farm households. However, there is a knowledge gap on the determinant of the quantity of onion supplied to the markets in the district. Hence, the study is vital to identify the key determinants of the quantity of onion market supply. Using data collected from Medebay Zana district in Tigray region of Ethiopia, this study explores the factors that determine the quantity of onion supplied to the market and to suggest the alternative solution for the identified problems in the district. By doing so, the study adds a new perspective on onion marketing in the study area and add knowledge of literature on high-value crop marketing in Ethiopia and elsewhere in the developing world.

The rest of this paper is organized as follows: Section 2 presents materials and methods, Section 3 provides results and discussion, and Section 4 concludes the paper.

2. Materials and methods

2.1. Study area
The study area is Medebay Zana district in the North-Western Tigray of Ethiopia. Medebay Zana is one of the eight districts in the North-western Tigray of the Ethiopia which has 20 kebeles (tabiyas): 18 rural
kebeles and 2 urban kebeles. Its geographical location is between 38º 20’ E longitude and 14º 06’ N latitudes. The total area of the district is about 1,055 square kilometers (Figure 1). Agriculture is the mainstay of the economy of the district. The land use pattern of the district shows that 27,271 hectare that is arable land and the remaining land is covered with shrubs and homesteads. Regarding agro ecologies, the district covers the lowland and temperate/midland/with a proportion of 62 and 38% of the district’s area, respectively. The average daily temperature ranges between 12ºc to 28ºc and the annual amount of rainfall ranges from 500 to 900 mm (Ayenew, Meresa, & Abdulkadir, 2011). The agro ecological composition makes the Medebay Zana district, one of the most suitable areas for onion production in the Tigray region. According to Werer Agricultural Research center report (2012, cited in Nigussie, Kuma, Adisu, Alemu, & Desalegn, 2015), the ideal location for onion production is between 500 and 2400 meters above sea level. And the best growing altitude so far known in Ethiopia is between 700 and 1800 meters above sea level. Optimum temperature of 18.3–23.90 day and 10–12ºC of night temperature are ideal for onion bulb production.

Based on the 2007 national census conducted by the Central Statistical Agency of Ethiopia (CSA), Medebay Zana district has a total population of 125,028, an increase of 97,237 over the 1994 census, of whom 61,977 are men and 63,051 women; 10,526 or 8.42% are urban inhabitants. In 2010, the projected number of populations based on 2007 census is 137,464 from which 124,759 live in rural and 12,705 in urban areas.

2.2. Sampling procedures and method of data collection

The sample for this study was drawn from producers and traders involved across onion value chain in the study area. The study employed two-stage sampling procedures to collect required data from the onion producers in the study area. In the first stage, with consultations of the district agricultural development agent, five rural kebeles were purposively selected out of the total 18 rural kebeles in the district. The selection of kebeles was mainly based on the extent of farmland allocation to onion production and the number of producers involved in onion production. Then, a complete and separate list of onion producers in each kebeles was prepared. In the second stage, a total of 121 producers were randomly selected from the list based on proportional probability sampling to the size, i.e., according to the number of onion producers in each kebeles (Table 1). In addition, the secondary data were collected from the review of related literature, documents of onion value chain development programs of the Tigray region, and Central Statistical Agency (CSA) of Ethiopia. The collected data included both quantitative and qualitative information as it was collected through semi-structured questionnaires. The main aim of the qualitative data was to support the results from the quantitative information.
Data were also collected from traders. It was estimated that about 12 wholesalers visited Medebay Zana district market at peak production (dry season) period; all of the 12 wholesalers were interviewed for the purpose in this study. According to the North-western zone of Tigray Medium and Small Enterprise office (2013), the estimated number of traders licensed to retail vegetables in Medebay Zana, Endaslassie, and Semema towns were 86 and they had homogeneity. Out of them, 31 (36%) retail traders were selected using a simple random sampling method.

### 2.3. Method of data analysis

The collected data were analyzed using descriptive statistics and econometric models. The descriptive statistics were percentages, frequencies, mean, standard deviation, and graphic representation of the socio-economic characteristics of the sampled producers and traders. A multiple linear regression model was employed to analyze the factors that determine the quantity of onion supplied to the market. According to Lyman and Michael (2010), the multiple linear regression equation is given as:

\[
Y = a + \beta X_i + U_i
\]

Where  

\( Y \) = quantity of onion supplied to the market in quintal,³  

\( a \) = constant number,  

\( \beta \) = a vector of estimated coefficient of the explanatory variables,  

\( X_i \) = a vector of explanatory variables,  

\( U_i \) = disturbance term.

Where  

\( Y \) = Quantity of onion supplied to market in quintal (100 kg),  

\( X_1 \) = Quantity of onion produced in 2014 production year,  

\( X_2 \) = Distance from production area to nearest market center in kilometer,  

\( X_3 \) = Age of household head,  

\( X_4 \) = Family size,  

\( X_5 \) = Gender of household head,  

\( X_6 \) = Educational level of household head,  

\( X_7 \) = Access to market information,

### Table 1. Number of samples selected from each kebeles

| Name of the kebeles | Number of onion producers | Sample selected |
|---------------------|---------------------------|-----------------|
|                     | Male | Female | Total | Male | Female | Total |
| Adekemalk           | 323  | 13     | 336   | 28   | 3       | 31    |
| Bahra               | 303  | 10     | 313   | 27   | 2       | 29    |
| Lmat                | 210  | 4      | 214   | 20   | 0       | 20    |
| Nefasit             | 205  | 8      | 213   | 18   | 2       | 20    |
| Walka               | 217  | 6      | 223   | 20   | 1       | 21    |
| Total               | 1258 | 41     | 1299  | 113  | 8       | 121   |

Source: Own computation from DOARD and kebele (tabiya) administration data, 2015
2.3.1. Diagnoses test
Before fitting the model to the data, the existence of serious multicollinearity among the explanatory variables was checked using the Variance Inflation Factor (VIF). As a rule of thumb, if the VIF is greater than 10, the variable is said to be highly collinear (Gujarati, 2004). Consequently, the VIF for all explanatory variables is less than 10 (1.06–1.56), which indicates that there is no serious multicollinearity problem among explanatory variables included in the model estimation. Another assumption, in Ordinary Least Squares (OLS) regression, is that the variances of error term should be constant (homoscedastic). If this assumption does not hold, the OLS estimators will not be the Best Linear Unbiased Estimator (BLUE) or they are no longer efficient. The regression prediction will be inefficient too because of heteroscedasticity that may be related to outliers in the sample. Because of the inconsistency of the covariance matrix of the estimated regression coefficients, the tests of hypotheses are no longer valid. Hence, a test for heteroscedasticity is required. There are different approaches used to detect the existence of heteroscedasticity in linear model estimation. In this study, Breusch–Pagan Test, which is introduced by Trevor Breusch and Adrian Pagan in 1979, was used to detect the existence of heteroscedasticity. The Breusch–Pagan Test is designed to detect any linear form of heteroskedasticity in a linear regression model and assumes that the error terms are normally distributed. It tests the null hypothesis that the error variances are all equal versus the alternative that the error variances are a multiplicative function of one or more variables. In this study, test statistics failed to reject the null hypothesis of the Breusch–Pagan Test; hence, there is no serious heteroscedasticity problem in the model estimation.

2.3.2. Definition of variables and hypothesis
In the course of identifying factors influencing the quantity of onion supply to the market by the producers, the main task is exploring which factors potentially influence and how (the direction of the relationship) these factors are related to the dependent variables. The determinants of the onion market supply for the study were identified and listed based on the review of related literature and our data sets. Accordingly, ten explanatory variables are selected for model estimation and defined as follows.

2.3.3. Dependent variable
2.3.3.1. Quantity of onion supplied to market (Qtysol). It is a continuous variable representing the dependent variable. It was the amount of onion supplied by households to market and measured in quintal, which is equivalent to 100 kilograms.

2.3.4. The independent variables
2.3.4.1. Quantity of onion produced (Qtypro). It is a continuous variable measured in quintals. The higher the produce, the more likely the household would supply to the market. Thus, in this study, the total amount of onion produced by the farm household is expected to influence the market supply positively.

2.3.4.2. Age (Aghh). Age of the household, a continuous variable measured in years, is taken as one of the explanatory variables. The expected sign would be positive as age is one of the parameters of human capital. As an individual life long, he/she will have better knowledge to decide to allocate more land area, produce more and supply more quantity to the market.

2.3.4.3. Gender of the household head (Sexhh). This is a dummy variable that takes a value of 1 if the household head is male and 0 otherwise. In a mixed farming system, both men and women take part in crop production and marketing of vegetables in general and onion in particular. However, male

\[ X_8 = \text{Extension contact}, \]
\[ X_9 = \text{Value addition activities}, \]
\[ X_{10} = \text{Access to credit}. \]
household heads reported to have a better opportunity in access to the onion market than female household heads. Gebrselassie (2013) in his study in central Ethiopia stated that given their high labor demand for domestic activities, participation in irrigated onion production, which requires more labor and management skill, is less attractive to female farmers in Ethiopia. He added that high start-up cost for irrigated onion production, lack of truly competitive marketing system coupled with weak, non-binding trade agreements between producers and brokers and the lack of accountability of the latter for their practices hurts female more than male farmers in Ethiopia. The majority of the female household heads are resource-constrained given that they do not own critical resources in cash and food crop production (Gebre, Isoda, Rahut, Amekeawa, & Numora, 2019) as well as in vegetable marketing (Bebe, Lagat, & Magembe, 2012). As a result, male household heads have more resources to supply to the market than female household heads.

2.3.4.4. Education of household head (Edlh). This is a continuous variable and refers to the number of formal schooling of a respondent during the survey period. Those household heads who have formal education determine the readiness to accept new demand and supply information and this enhances farmers’ willingness to produce more and increase the quantity of sales. Moreover, the educational status of the farmer determines the speed with which he/she likely to adopt agricultural technologies. Thus, farmers with higher level of education tend produce higher yield and are therefore more likely to supply to the market. Therefore, it is hypothesized that the education level of household head would have a positive relationship with quantity supply to the market.

2.3.4.5. Family size (Fshh). This is a continuous variable, measured in the total number of members of the household, existence of high family size has a positive impact on the quantity of onion production, and it reduces the production and marketing cost. Hence, it is expected to affect the sale size of onion positively.

2.3.4.6. Distance to nearest market (DINM). Distance from the producer home to the nearest market is a continuous variable measured in meter. The closer the market, the lesser would be the transportation charges, reduced walking time and reduced other marketing costs and better access to market facilities. In this study, the distance to the nearest market is hypothesized to relate negatively to supply marketable surplus.

2.3.4.7. Access to market information (Maiorm). Access to market information is assumed to have a positive impact on marketable supply of onion. It is a dummy variable with a value of 1 if an onion producing household has access to market information and 0 otherwise. Therefore, it is hypothesized that market information is positively related to market supply of onion.

2.3.4.8. Extension contact (Excon). It is a dummy variable with a value of 1 if a household has access to extension contact and 0 otherwise. The aim of the extension service is the provision of training on agronomic practices to improve the yield as well as to link producers with the market to access better market opportunities for their onion produce. Farmers that have access to extension contact have better access to information and could adopt better technology that would increase their marketed supply of onion.

2.3.4.9. Value addition (Va). This is a dummy variable measured in terms of whether the producer practices value-adding activities on his onion products or not. It takes a value 1 if a household practice value-adding activity and 0 otherwise. Producers who practice value addition activities like (storage, curing, and separating quality product) may get a better price. When the price of the product is promising, producers are motivated to take their farm output to the market.

2.3.4.10. Access to credit (Ac). This is a dummy variable, which assumes a value of 1 if the farmer has credit access and 0 otherwise. Access to credit would enhance the financial capacity of the farmer to purchase the necessary inputs and increases output. Therefore, it is hypothesized that access to credit would have a positive influence on the quantity of sales.
3. Results and discussion

3.1. Socio-demographic characteristics of sample households

Gender composition is the major demographic feature used to characterize the respondents. Out of the total sample onion producers, 93.4% were male-headed whereas 6.6% were female-headed, implying that the majority of the onion producing households in the Medebay Zana district is male-headed. Gebreselassie (2013) noted that female farmers were discouraged owing to demands on their scarce time, price fluctuations, working capital, and difficulties selling onion and other high value crops in Ethiopia. He stated that a small but well-focused outside support can help smallholder farmers to seize local opportunities that, though incurring production and market risks, can raise their earnings and improve their livelihoods. Wholesale marketing which is usually done in the urban markets is also a male-dominated activity while the final sales in retail shops and in open market places were dominated by women (74.2%) who combine onions sales with other petty businesses (Table 2). However, women dominate onion retail marketing as it doesn’t require big startup capital and is usually done in their living areas.

Regarding the age of farm households, the results show that the average age of the producer household heads is 44.4 years with minimum and maximum age of 22 and 64 years, respectively. The average age of wholesalers is 36.6 years with minimum and maximum age of 28 and 57 years, respectively. With regard to retailers, the average age is 44 years with minimum and maximum age of 20 and 56 years, respectively (Table 3). These results indicate that, on average, wholesalers are younger than producers and retailers in the study area.

Large family size is a distinguishing characteristic in rural communities of many developing countries such as Ethiopia due to low family planning practices and the need for more labor for agricultural activities. The case is similar in the study area, where labor is mainly supplied by the farming household. The average family size of the producers is five persons with a maximum and minimum family size of eight and one, respectively (Figure 2). This figure is similar to the national average agricultural household size, which is about 5.2 persons but more than the average household size of the district (4.4). The existence of high family size has a positive impact on the quantity of onion production, and it reduces the production and marketing cost, as they use family labour force for production and transport to marketing.

Concerning the level of education of household head, the results show that, on average, the producer household heads attain lower educational level compared to traders. Among traders, wholesaler attained a higher educational level than retailers in the study area.

| Table 2. Demographic profile of sample respondents based on sex |
|---------------------------------------------------------------|
| **Sex** | **Producers** | **Wholesalers** | **Retailers** |
| Frequency | % | Frequency | % | Frequency | % |
| Male | 113 | 93.4 | 10 | 83.3 | 8 | 25.8 |
| Female | 8 | 6.6 | 2 | 16.7 | 23 | 74.2 |
| Total | 121 | 100 | 12 | 100 | 31 | 100 |
| Source: Own survey result, 2015 |

| Table 3. Descriptive statistics of the age of the sample household heads |
|--------------------------------------------------------------------------|
| **Actors** | **Minimum** | **Maximum** | **Mean** | **Std. Deviation** |
| Producers | 22 | 64 | 44.4 | 8.45 |
| Wholesalers | 28 | 57 | 36.6 | 10.4 |
| Retailers | 20 | 56 | 44 | 8.8 |
| Source: Own survey result, 2015 |

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With regards to years of experience in onion production and trading, producers have an average of 5 years of experience in onion production (ranging from 1 to 24 years) while wholesalers and retailers have, on average, 7 and 5 years of the experience in onion trading, respectively (Table 4).

Concerning distance from the main road, market, and farmers training center (FTC), the result indicates that the average distance of the respondents’ homes from the nearest market place was 10.4 km. About 46.3% of the respondents live in less than 10 km, 41.3% of the respondents should travel more than 10 km to reach the nearest market and only 8.3% of the respondents live in 10 km distance away from the nearest market. Likewise, the average distance of respondents’ homes from the all-weather road was 7.3 km. In addition, 69.4% of the respondents live in less than 10 km away from the all-weather road, 25.6% of the respondents live in greater than 10 km distance and only 5% of the respondents live in 10 km distance away from the nearest all weather road (Table 5). Availability and adequacy of the road is an important prerequisite to link producers with markets in reduced transaction costs. Furthermore, the location of the farmer training center from the household head had a mean of 3.55 km.

3.2. Land size owned by producers

Land is the main productive asset of farmers and measure of wealth in the study area. Farmers in the study area use both their own land and rented farmland for crop production. All 121 sample households selected for this study have their own land. The average total land holding of the sample households was 1.04 ha. The minimum and maximum total land holding of the respondents was 0.13 and 1.5 ha, respectively (Table 6). The average land used for the vegetable production was 0.31 ha per household. In the study area, most of the vegetables are grown under irrigated conditions. Most of the sample household engage in rainfed agriculture and cover their farmland with cereal crops production for home consumption. Immediately, after the rainy season is over and the cereals harvested, most farmers plant the onion crop under irrigation. They produce onion for marketing.

3.2.1. Land allocated to onion

The result shows that producers grow onion using irrigated and rain-fed production system. In the study area, onions were produced principally under irrigation (85.7% of respondents), although, there were some producers that used rainfall for onion production (14.3% of the respondents).

| Actors      | Minimum | Maximum | Mean | Std. Deviation |
|-------------|---------|---------|------|----------------|
| Producers   | 1       | 24      | 5.0  | 4.6            |
| Wholesalers | 1       | 20      | 7.2  | 4.9            |
| Retailers   | 1       | 15      | 5.3  | 3.1            |

Source: Own survey result, 2015
The common onion production system was sole cropping in the Medebay Zana district. The arable area allocated to onion production was small compared to that of cereals. The arable land under onion ranged from 0.01 ha to 0.5 ha and was scattered around the farms. The average area allocated to onion (irrigated as well as rain-fed) was about 0.16 ha.

Furrow irrigation method is mostly applied to irrigate the onion fields in the study area. Sources of water for irrigation were river diversion, water harvesting check dams and ponds. Significant number of onion growers have water pump to pull out water from all the water sources. The average number of times of irrigation used by total sample households is 1.6 times per week with minimum and maximum frequencies of one and two times per week, respectively. In addition, frequency of watering was different from kebele to kebele based on availability of water, soil type and ecology of the area.

### 3.3. Production and productivity

The average yield reported by the sample onion producers was 9.8 tons/ha, which is higher than the regional (Tigray) average of 6.95 tons/ha while lower than the national average of 10.13 tons/ha in the year 2014, both reported by the central statistical agency (CSA, 2015). This result indicates that the study area has huge potential for onion production in the Tigray regional states of Ethiopia. However, the result shows that, many producers produce a below-average yield of onion per hectare. The main reasons for low yield of onion in Medebay Zana as reported by producers and experts are lack of proper inputs such as seeds and agrochemicals, damage by...
pests and diseases, limited knowledge, and experiences of improved production techniques and poor access to market information and linkages. Furthermore, the most recent figure reported by the central statistical agency of Ethiopia shows that the average national yields of onion in 2018/19 production year was 9.14 tons/ha while in the Tigray region it was 6.33 tons/ha in the same year (CSA, 2019). This indicates that challenges related to yield improvement in the onion sector in Ethiopia is chronic and needs deep exploration.

3.4. Onion marketing

Producers also participated in transporting and marketing of onion they produced. Most post-harvest activities like sorting, grading, packing, storing, transportation, loading and unloading were done by the producers themselves. The marketing chain started from producers who had onions for sale. In the study area, it was found out that 98.3% of the producers sold their onion products immediately after harvesting to the nearby local market because they need money for the payment of farm inputs, fear of perishability and urgent family expenses. Producers sold onion products to wholesalers, retailers, and consumers. From the produced onion on average, 87.3% was marketed, and the remaining 6.1% and 6.6% were consumed and damaged (postharvest loss) respectively. In the study area, onion marketing by producers was not well organized, most of the onion was sold on spot deals to whoever arrives in the market and offers a relatively better price.

In the study area, there are three primary ways in which onion is transported to the market. The first and most frequently used one is pack animals like donkey and camel where bagged onion is loaded on donkey and camelback; the second one is women transporting onion on their back and men loaded on their shoulder. The third one is car known as Isuzu transporting onion from the nearest road to Shire-Endaslassie town, main market center.

3.4.1. Onion market channels

Four main alternative channels were identified for onion marketing in the study area. The estimated quantity of onion supplied to market by the sampled households, in year 2014, was about 1751.5 quintals. The four main marketing channels identified from the point of production to final consumer through different intermediaries were:

Channel1: Producer → Consumer = 3.25%.
Channel2: Producer → Wholesaler → Retailer → Consumer = 36.95%.
Channel3: Producer → Wholesaler → Consumer = 4.75%.
Channel4: Producer → Retailer → Consumer = 55.05%.

The result indicates that the producers sold their onion mostly to retailers in the nearest market. Producers in the study area sold approximately 41.7%, 55.05%, and 3.25% of the onion produced in 2014 production season to whole-sellers, retailers, and consumers, respectively. In channel-1, the producer sold the product directly to the consumer at the nearest market and farm gate. In channel-2, the producer sold the produce to the wholesalers who sold it to the retailer in the market who finally sold the produce to the consumer. In channel-3, the wholesaler sold it to hotels, restaurants, and cafes, which have the capacity to purchase above one quintal of onions. In channel-4, the producer sold the product to the retailer who finally sold the produce to the consumer.

3.5. Determinants of onion market supply

Table 8 presents the results of multiple linear regressions. The overall goodness of fit represented by model count $R^2$ is 80.74% and the adjusted $R^2$ value is 78.99%. This result indicates that about 79% of the variation in farm-level market supply of onion was attributed to the hypothesized variables. Ten explanatory variables were hypothesized to determine farm household level onion
supply to the market. Among those variables, quantity of onion produced, access to market information, and contact with extension agents are found to significantly influence market supply of onion in the district. The signs of the parameter estimated the significant variables were also as expected.

However, the remaining seven variables (age of the household head, gender of household head, education level of the household head, family size, distance from the nearest market, value addition, and access to credit) had no significant linear predictive values in the model.

3.5.1. Quantity of onion produced
As hypothesized, the multiple linear regression output shows that the quantity of onion production influenced the quantity supplied to the market positively and statistically significant at 1%. The positive coefficient indicated that an increase in the quantity of onion produced increases the quantity of marketable supply of onion by producers. This is explained by the fact that onion is the major cash crop for the majority of sampled farm households, and it shows that the higher the household produces, the higher they supply to the market. This result is similar to the findings by Giziew (2013) who stated that the amount of tomato, onion, leafy vegetables, potato, mango, avocado, and papaya, respectively, produced by household affected marketable supply of each of the commodities significantly and positively. Moreover, Melese et al. (2018) found the positive relationship between onion yields, which is proxy for production, and volume supplied to the market in the Fogera district of the Amhara regional state of Ethiopia.

3.5.2. Access to market information
Access to market information has shown a positive effect on the quantity of onion supplied to the market as it was hypothesized. The result was found to be statistically significant at 5%. The positive and significant relationship between variables indicate that obtaining information helps onion producers to supply more quantity of onion to the market. Similarly, a study conducted by Giziew (2013) found that if wheat producer gets market information, the amount of wheat supplied to the market increases.
3.5.3. Extension contact of the household

The other significant variable was extension contact, which as expected influenced the quantity of onion marketed positively and statistically significant at 1%. Extension contact is related to access to formal training and informal (contact with agricultural Development Agents and experts) on onion production and marketing for producer farmers. The positive and significant relationship indicates that extension contact had improved onion farming household ability to acquire new technology and capacity of production, which in turn improves productivity and thereby increase marketable supply of onion. Furthermore, the coefficient shows that onion producers who received extension services on onion production had more probability to supply 5.4 quintals of onion than those who didn’t receive extension services, other variables are held constant. This suggests that access to extension service avails information regarding technology which improves production that affects the marketable surplus. This is also in agreement with the previous study conducted by Mussama (2006) found that access to extension service on red pepper and teff (eragrostis tef), respectively, affected marketable supply of each of the commodities significantly and positively. Moreover, Hailu (2017) found the positive relationship between the number of extension contact and the onion market choice in Ejere district Oromia regional states of Ethiopia. He noted that the extension contact enables the farmer to improve production methods hence leading to more output which in turn more likely to sell onion in the market. However, our finding is opposite to the findings by Melese et al. (2018) in Fogera district, Amahara regional states of Ethiopia. They found that the contact to extension agent could lead a 5% reduction of onion farmer market participation. They indicated that the farmers those who have access to the extension service do not appropriately apply the techniques and advice suggested by the extension agents such as the method of applying fertilizer, herbicides and pesticide, these have abilities to kill and destroy the onion bulb during the production stage if not used appropriately. The other important thing related to extension service in Ethiopia is that agricultural extension implementation modality differs in one regional state to the other (Leta, Kelboro, Stellmacher, & Hornidge, 2017). Hence, our result may be due to a better agricultural extension delivery system in Tigray regional state relative to some other regional states that have reported a negative relation with the market supply in Ethiopia.

4. Conclusion and recommendations

4.1. Conclusion

Marketing of onions was done on an individual basis and farmers in a particular location faced usually small number of buyers for their product. This marketing situation puts farmers’ bargaining power on prices lower and they have to accept what the buying trader offers in order to avoid loss due to lack of market. From the 10 independent variables, the quantity of onion productions in 2014, access to extension contact and market information were statistically significant determined quantity of onion supplied to the market.

4.2. Recommendations

Quantity of onion produced at the farm level affected marketable supply of onion positively and significantly. Arranging a sufficient number of training, field days and demonstrations are paramount importance to equip producers with onion production management skill. The collaborations of different stakeholders DOARD office, Shire research center, agricultural development agents and NGOs interested in onion value chain development are required to solve this problem.

Onion value chain actors should work in an integrated way to reduce post-harvest losses and to strengthen sustainable market linkage in the study area. Therefore, the district agriculture cooperative and medium and small enterprise offices and line offices should establish the onion or vegetable cooperative market center of producers at the nearest market center. Then, producers would supply onion to cooperatives and cooperatives would be sold the onion produce. To its establishment, the active participation of producers’
representatives, agricultural experts, traders, and other stakeholders should be encouraged. In addition, organizing onion value chain multi-stakeholder platform is essential.

The results of the study showed that the provision of market information improved the market supply of onion. Farmers had to link production with marketing. Traders are capable to sourcing price information from different sources whereas poor farmers rely on other farmers and government extension staff for the same information. Therefore, there is a need to make information available to producers and traders at the right time and place in response to this challenge and it is also good to develop an integrated agricultural marketing information system that will be linked to District information center and to link them to government’s program.

The results of the study indicate that provision of extension service improve supply of onion. Farmers have to linking production with marketing. And also, it is good to enlightening farmers to produce based on market signals, consumer preferences and to direct or advice on the proper methods of handling, storing, transporting and above all improving quality and quantity of onion. Hence, it is recommended to assign efficient extension system, updating the extension agent’s knowledge and skills with improved production and marketing system.

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Notes
1. In Ethiopia, there are two production seasons per year: Meher (main) season and Belg season. Meher is between September and February while Belg season is between months of March and August. Accordingly, crops harvested between the months of September and February is considered as Meher season crop while any crop harvested between the months of March and August is considered to be a small rain (Belg) season crop (CSA, 2019). In Ethiopia, onion mainly harvest in the Meher season.
2. Kebele or tabiya is the smallest administrative unit next to district (woreda) in Ethiopia.
3. Quintal is a unit of weight equal to 100 kg. Farmers in Ethiopia commonly use quintal as a measurement unit to report the amount of their farm produce.

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