Research article

Value chain analysis of potato in Farta District of South Gondar Zone, Amhara National Regional State of Ethiopia

Gedefaw Kindu Wubet a,*, Lemma Zemedu b,**, Bosena Tegegne c,***

a Debre Tabor University, Debre Tabor, Ethiopia
b Debre Zeit Research Institute, Ethiopia
c Bahirdar University, Ethiopia

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ABSTRACT

Potatoes are the world’s most important root and tuber crop. It is grown in over 125 countries and consumed by over a billion people daily. Millions of people in impoverished countries rely on potatoes product to their survival. Today, developing countries are the world’s major producers and distributors of potatoes and potato products. Potato can be effective produce for allowing smallholder families to achieve their food security. Ethiopia has probably the maximum prospective country for potato production. However, in Ethiopia, various factors influence potato production and commercialization. It is the main tuber crop produced in Farta District. Potato production and value chain status are not studied well. Hence the main aim of this study was to evaluate the value chains of potatoes in the Farta district, Ethiopia. 123 sample potato farmers were chosen using a two-stage random sampling technique in four kebeles. Descriptive, inferential, value chain approach and econometrics analysis were employed. In addition, Heckman’s two-stage selection econometrics model was employed to analyze the determinants of potato market participation and sales quantity. Probit model estimation result provides that: distance to the nearby market, family size, oxen owned by farmers, market information, land size allocated for potato production, and quantity of inorganic fertilizer were the significant variables affecting the decision to market participation positively except family size. The OLS estimation result provides that: the education level of the farmers, farming experience, the number of extension contact, the land size allocated for potatoes, and the quantity of inorganic fertilizer is the significant variables in influencing the amount of potato market supply positively. The main constraints for potato production and commercialization in study area were: Shortage of improved seed, lack of capacity building training to the post-harvest management approach, price fluctuation, shortage of market information, absence of policy framework in price-setting strategy was produced and marketing constraints of potatoes. Therefore, the study suggests that: increasing access to farm inputs, introducing new and improved crop varieties, establishing suitable post-harvest management facilities. In addition, follow up misconduct practice for price-setting strategies, strengthening market information service, facilitating conditions that can promote the smallholder farmers for participating in the market and minimize those constraints which impede the complete value chain in potato production and development.

* Corresponding author.
** Corresponding author.
*** Corresponding author.

E-mail addresses: gedefawkindu2013@gmail.com (G.K. Wubet), zemedul@gmail.com (L. Zemedu), bosenat@gmail.com (B. Tegegne).

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1. **Introduction**

1.1. **Background**

Vegetable production is vital economic activity in the world and Ethiopia particularly. The production method start from homegrown to smallholder farming and in commercial farms maintained together through public and private enterprises (ATA, 2014).

Potato is the world’s most significant root and tuber produce. It is grown in over 125 countries and consumed almost daily by more than a billion people. Potato is crucial to the survival of millions of people in developing countries. Potato production is increasing steadily in the evolving world, where potato ease of production and nutritional comfortable has prepared it valued food security and commercial crop for millions of farm households. Today, developing countries are the world’s major producers and distributors of potatoes and potato products. Once harvested, potatoes can be used for a variety of purposes: as a fresh vegetable for cooking at home, as raw material for processing into foodstuff products, food components, starch, then alcohol, as fodder for animals, and as seed tubers for growing the subsequent crop seasons. All across the world, consumer demand is ever-changing from fresh tubers towards processed products. An ever-greater quantity of potato is processed to meet the increasing demand for suitability diet and snacks. Expanding urban populations, rising revenue, diversification of food, and a way of life that leaves fewer time for making fresh products for consumption are all key drivers of this movement. The development of profit and viable potato subsector in non-developed countries rests on measurement to overcome several persistent constraints (FAO, 2009). Potatoes are members of the nightshade family like tomatoes, eggplants, and peppers. They have not rooted vegetables; potatoes are the enlarged portion of the stem of the perennial Solanum tuberosum. This section of the plant is known as a tuber, and it gives to feed the plant’s leafy part. Potato is one of the most widely distributed crops in the world, and it is grown in places where poverty, inequality, hunger, and malnutrition are prevalent. It has the potential to help smallholder families achieve food security and rise out of poverty (Haverkort et al., 2013). Potato production is affected by different climate changes or/and factors. The factors which affect potato production are high temperature, increased insects and diseases, water supply, and increased carbon levels in the atmosphere. Climate change curves global potato production severely. However, potatoes are produced everywhere because of their adaptability (IPCC, 2013). Potato production is severely harmed by global warming (Hijmans, 2003). Potato is a temperate crop, and rising day temperatures make some places unsuitable for potato production because tuber yields and quality suffer. Temperature variations outside of 5–30 °C have a significant impact on tuber growth and production (M. K. Jatav et al., 2017). From any country in Africa, Ethiopia has probably the maximum capacity for potato production. It is estimated that; 160,000 ha are now planted annually by approximately one million potato farmers. According to (Adane et al., 2010), many factors affect potato production in Ethiopia. From which: Shortage of improved varieties, poor tuber position due to substantial rains and extremely excessive temperatures, diseases, viral or/bacteriological fade diseases seem to be important challenges. Given the variety in Ethiopia, there are no certified or universally recognized varieties used, but most varieties are generally low yielding (8 tones/ha) and susceptible to disease and pests. Now a day, less than 3% of Ethiopian farmers have access to improved or uncontaminated seed potatoes (Vic, 2013). The climatic and edaphic conditions in Ethiopia are ideal for increased potato productivity and production (Endale et al., 2008a). In Ethiopia, potato is a short-duration crop compared to cereals, yielding up to 30–35 tons/ha in 3–4 months (Endale et al., 2008b). Ethiopia is a major producer of seed and ware potatoes. According to the CSA, 2016 report, about 1,288,146 private peasant holders participated in potato production in Ethiopia, on 67,361.87 ha (having 31.13% distribution) covered by potatoes 9,218,320.70 quintals of potato were produced, with an average yielding of 136.85q/ha in Meher Season. Amhara Region is the second major producer of potatoes in the country, next to Oromia. The total area covered by potatoes in the year 2016 in Amhara Region was 17,719.49 ha, by 484,554 private peasant holders with total production was 2,735,267.06 quintals with its average productivity was 154.36 quintals/ha. In addition, the area covered by potatoes in the study Zone was 6,125.49 ha by 96,262 private peasant holders were engaged in potato cultivation with the total production of potato was 935,059.17 quintals with average productivity was 152.65 quintals/ha. In contemporary agricultural development debates, value chains appear to be the catchword, along with rural economic development and agribusiness advancement. To tackle different challenges, value chains have built rural-urban linkages that can benefit both rural producers and urban customers. The value chain approach encourages looking at the production process from the consumer’s end (Methu et al., 2013). According to Tewodros et al. (2014), Due to their high yield potential and nutritional quality tuber, short growing time, and broader adaptability, potatoes are a high potential food security crop in Ethiopia. However, the production and marketing of potatoes are subject to various challenges. Farmers are faced, with many problems in the production and marketing of potatoes (Getachew, 2013). Ethiopia is becoming a leading potato producer country in Africa. However, despite its growing importance to Ethiopia’s food security, infrastructural development to increase the productivity and production of potato crops remains very low. Suitable land and climatic situation, enabling policy environment and potential support from NGOs, great demand for seed and ware potatoes are a list of opportunities for potato production. However, value chain of potato is affected by many constraints. According to Wabbi et al. (2013), institutional and product-related constraints were the major inhibitors for potato value chain development. Although potatoes are a vital crop towards food self-sufficiency, the attention given by policymakers, extension workers, and researchers is found at lower levels. Smallholder potato farmers confront two major challenges production and marketing (ARARI, 2013). There are many types of research done on farmers’ market participation, from which most of those studies seemed to focus on other crops. Adequate weight has not been given to potato crops. Systematic and adequate information on the process of market participation, key-value chain actors, and their role have not yet been studied and analyzed for the target study area, even though there is enormous potential for potato production. Therefore, this study was initiated to identify key value chain actors for potato product and their roles, analyze determinants of potato market participation and volume sales, and finally, the main opportunities and constraints.

1.2. **The study’s objectives**

The study’s overall objective was to evaluate the value chain of potatoes in the study area;

The study’s specific objectives were:

1. To map value chain of potato and identify main actors, their role, and linkages in the chain
2. To analyze the determinants of potato market participation and intensity of participation
3. To identify main opportunities and constraints in the entire value chain.

1.3. **Conceptual framework**

Analysis of value chain is an approach that provides a framework that can bring a better understanding between producers and global markets. The framework allows for the evaluations of chain performance by distinguishing the strengths and weaknesses associated with differentiation activities and linkages and identifying barriers to chain development. In turn, this information uses to prioritize interventions that can be made along the chain to improve chain performances (FAO, 2010). Potato value chain conceptual framework shows as a network of horizontal and
vertical integrated value chain actors that are jointed providing products to customers.

The main actors, the chain supporters, and the enablers with their roles, opportunities, and constraints for potato production and marketing, the determinants that influence the decision for market participation and volume sales of farmers’ were studied. The volume sales, in turn, increased the household income. Based on the evidence through theoretical concepts and empirical studies, the value chain of potato conceptual framework was constructed, as illustrated in Figure 1.

2. Materials and methods

2.1. The study area’s description

The study was carried out in South Gondar Zone, Farta district, Ethiopia. Farta district is surrounded on the North by Ebenat district, on the East by Lay Gayint, district on the South by Misraq Este district, and on the West by Fogra district. It is located 666 km from Addis Abeba Town (FDACO, 2017), as illustrated in Figure 2. A district’s particular place lies between $11^\circ 32'\text{ to } 12^\circ 03'$ latitude and $37^\circ 31'\text{ to } 38^\circ 43'$ longitude, with an altitude range of 1900–4035 m above sea level. A district classifies under Wina Dega and Dega agro-ecological zone. The mean maximum temperature of the area is $21^\circ \text{c}$ from February to May. The mean minimum temperature is $9.6^\circ \text{c}$ from June to January. The mean annual temperature of a district is $15.5^\circ \text{c}$, and the rainfall pattern is uni-modal. The yearly averages rainfall is 1570 mm. Rain usually begins in mid-March, but the rainy season is most effective from May to mid-September, with an average precipitation of 1950 mm (FDACO, 2017). In the Farta district, agriculture contributes much to meet the main objectives of farmers, such as food supplies and cash needs. The main economic and commercial vegetable crops are cabbage, tomato, pepper, and root, and tuber crops are potato, sweet potato onion, and garlic. Compared to other grain crops in the area, potato is the first and most dominantly produced crop among tuber crops and it placed the third crop after wheat and barley.

2.2. Data type, sources, and collection method

For this study, both primary and secondary data were used. Primary data was gathered from a random sample of farm households and traders at different levels, from farmers to wholesalers. Secondary data also was gathered from secondary sources.

The Ethiopian National Health Research Ethics Review Guideline and the Helsinki Declaration were considered when conducting this research. But, due to the nature of the study, this research was not conducted on human and animal experiments, this is a survey study. Even if the study was not conducted on human and animals experiments, all concerned individuals or agents were advised and informed. As a result, all study participants including survey households; sample farmers, enumerators, supervisors, and key informants were well aware for the study’s objectives. In addition, they were asked for their permission to participate and gave the information for the analysis and then that they can help the research work and leave the study any time.

2.3. Sampling technique and sample size

No fixed rule to administer sample size determination for different research work. Various researchers determine sample size depending upon the nature of the study. Even applying a fixed sample size determination approach would be relevant for some parts of the research and may not be appropriate for the other research work. Thus, the sample size; for this study was determined by considering resource availability, the homogenous population, for adequacy of representation with random selection because all kebeles and farmers are potato producers in the selected study area (Similar Agroecology and High land area). Then sample potato farmers were chosen using a two-stage random sampling technique. In the first stage, out of thirty-seven kebeles found in a district, four kebeles; were selected randomly to represent the study district because all kebeles are potato producers. In the second stage, using the list of household from the sample kebeles, based on probability proportional to the population size of each selected kebele, potato producers’ households were selected.
randomly. According to Yamane (1967), the sample size was determined by considering a 95% confidence level, with a degree of variability of 5%, and a level of precision equal to 9% used to obtain a sample size required. The formula used to calculate and determine the sample size was:

\[ n = \frac{N}{1 + N(e)^2} \]

\[ n = \frac{46.812}{1 + 46.812 (0.09)^2} \approx 123 \]  

(1)

Where: \( n \) is the sample size, \( N \) is size of population for potato producer kebeles, and \( e \) is the level of precision considered. The minimum level of accuracy is acceptable at 10%. However, 9% of the precision level was used for this study. Because if a precision level is less than 9%, a big sample size and costly (Resource constraints), but this small sample size could represent the study population because of homogeneity characteristics of the study population (Table 1).

2.4. Methods of data analysis

Descriptive statistics, approach to value chain analysis and econometric method of data analysis were employed.

Table 1. Sample size distribution in the selected kebeles.

| Name of selected kebeles | Total no of potato producers | No of sample households |
|--------------------------|-----------------------------|-------------------------|
| Mokish                   | 1462                        | 30                      |
| Minet                    | 1806                        | 38                      |
| Kanat                    | 1569                        | 33                      |
| Limado                   | 1040                        | 22                      |
| Total                    | 5877                        | 123                     |

Source: Own computation survey, 2017.

2.4.1. Approach’s to value chain analysis

Approach’s to value chain analysis used to analyze based on commodity approach analysis. According to FAO (2013), the term commodity chain analysis was devised to describe the entire set of economic actors who directly influence the final product. Many of the calculations are carried out regarding the value-added created by individual actors involved in the chain. Value-added (VA) can be defined as by the equation:

\[ VA_i = \frac{Y_i - II_i}{C_0} \]  

(2)

\( II \) is the value of intermediate inputs used, and \( Y \) is the value of the output, \( i \) stand for each actor, and it starts from 1 then the difference, \( Y - II \), represents the value which the agent has added during the accounting period to the value of the inputs in the process of production or processing. At this stage, the calculation of value added is carried out using market prices. The value \( Y \) of the finishing product includes the value of all the factors that make up the production of \( Y \). The value-added of the entire chain is calculated as the amount:

\[ VA_{chain} = \frac{Y_{chain} - II_{chain}}{C_0} \]  

(3)

Or, since values added are additive, we can add algebraically the value-added of each of the agents of the chain:

\[ VA_{chain} = \sum VA_{agents} \]  

(4)

2.4.2. Econometric model

Heckman’s two-stage model was employed for estimating determinants that affect the decisions to market participation and levels of sale for farm households. The reason to use this model is to predict the two dependent variables. This model allows separated decision for participation and quantities of sales. To estimate the variables that affect the decision for market participation and level of sales, different
researchers used different models as various kinds of the literature revealed. The commonly used ones are the well-known Tobit and Heckman’s two-stage sample selection model. However, the Tobit model assumes that both the independent variables used to determine the decision to participate and the amount of product marketed are given. These problems can be overcome using Heckman’s sample selection model where a probit model for the participation or selection equation is estimated and a regression model, which is corrected for selectivity bias, is specified to account for the level of the amount marketed (Astewel, 2010; Amare, 2014; Getachew, 2015 and Habtamu, 2015). The specification of the Heckman two stages procedure is written in terms of the likelihood of potato market participation (PMP) and level of sale (LS).

The participation Equation/the binary Probit Equation

\[ Y_{i1} = X_{i1}B_1 + U_{i1} \quad U_{i1} \sim N(0,1) \]  

(5)

\[ PMP = 1 \text{ if } Y > 0 \]

\[ PMP = 0 \text{ if } Y < 0 \]

Where: \( Y_{i1} \) is the latent dependent variable, which is unobserved, \( X_{i1} \) is vectors of explanatory variable that affect participation in potato market, \( B_1 \) is a vector of an unknown parameter in participation equation, \( U_{i1} \) are residuals that are independently and normally distributed. The observation/the supply equation;

\[ LP = Y_1 = X_2B_2 + U_{2i} \quad U_2 \sim (0, \delta^2) \]  

(6)

\( Y_1 \) is observed if and only if \( PMP = 1 \), Where: \( Y \) is the observed dependent variable, \( X_2 \) is factors that affect the level of participation, \( B_2 \) is a vector of an unknown parameter in the supply equation, \( U_2 \) is residuals in the supply equation.

3. Results

Descriptive Statistics Result: The mean age of the sample farm households was 47.6 years, and it ranged from 22 to 80 years. On average, 5.16 people in the farm households. The potato farming experience of all sample farm households was 27.51 years. The average educational achievement of all sample farm households who attended informal education was 2.21 years in schooling. In the production year, the overall average annual potato production by sample farm households was 82.2 quintals with a 47.06 standard deviation. At a 1% level, annual potato production was statistically significant, which means in terms of yearly potato produce, there was a mean variation between potato market participants and non-market participants. Overall mean land size holding of the sample farm household was 2.71 ha with a 0.79 standard deviation. With a standard deviation of 0.35, the land allocated for potato production was 0.74 ha. From an average part of land allotted for potatoes, 0.16 ha was irrigable land. From total land owned by sample farm households, about 27.31% of the land was earmarked for potato production. At a 1% level, landholding and land allotted were statistically significant. This means that there was a significant mean difference between market participants and non-market participants in terms of land size holding and land allotted for potato production. Sample farmers use lesser amounts of inorganic fertilizer for potato production. However, market participant households used more fertilizer than non-market participants. At a 1% significance level, the amount of inorganic fertilizer was statistically significant. Sample households were located 17.43 km away from the nearest market on average even market participant households located far from 17.84 km to the nearest market. But, it might not be the factor for their market participation (Table 2). According to the survey result, nearly 70% of sample households were male-headed. And more than 75% of sample farm households were informed with different market information sources. At 10% significant level, access to market information is statistically significant.

### Table 2. Two-sample t test (mean comparison test) for continuous variables.

| Variable                  | Participants (N = 96) Mean | Participants (N = 96) Std. Dev. | Non Participants (N = 27) Mean | Non Participants (N = 27) Std. Dev. | Total samples (N = 123) Mean | Total samples (N = 123) Std. Dev. | t-ratio |
|---------------------------|---------------------------|---------------------------------|-------------------------------|-----------------------------------|-----------------------------|---------------------------------|--------|
| Age                       | 46.88                     | 12.65                           | 50.04                         | 9.87                              | 47.57                       | 12.13                           |        |
| Family size               | 5.25                      | 1.58                            | 4.85                          | 1.70                              | 5.16                        | 1.61                            | -1.14  |
| Adult equivalent          | 4.80                      | 1.58                            | 4.45                          | 1.57                              | 4.73                        | 1.53                            | -1.06  |
| Farming experience        | 27.37                     | 10.33                           | 28.04                         | 9.4                               | 27.51                       | 10.09                           | 0.31   |
| Education level           | 2.27                      | 2.65                            | 2                             | 2.84                              | 2.21                        | 2.69                            | -0.46  |
| Land holding              | 2.87                      | 0.76                            | 2.14                          | 0.61                              | 2.71                        | 0.79                            | -4.56***|
| Land allocated            | 0.80                      | 0.36                            | 0.52                          | 0.14                              | 0.74                        | 0.35                            | -4.02***|
| Irrigated land            | 0.15                      | 0.19                            | 0.20                          | 0.22                              | 0.16                        | 0.20                            | 1.20   |
| Annual potato product     | 91.25                     | 48.5                            | 50.11                         | 20.58                             | 82.22                       | 47.06                           | -4.29***|
| Quantity of inorganic fertilizer | 1.39                   | 0.47                            | 0.97                          | 0.31                              | 1.3                         | 0.48                            | -4.46***|
| Oxen owned                | 1.99                      | 0.88                            | 1.78                          | 1.01                              | 1.94                        | 0.91                            | -1.07  |
| Distance to nearest market| 17.84                     | 6.44                            | 15.96                         | 5.18                              | 17.43                       | 6.22                            | -1.39  |
| Amount of credit obtained  | 6469.8                    | 4064.8                          | 7014.8                        | 2650.2                            | 6589.4                      | 3796.6                          | 0.66   |

* *** Significant at 1% probability level. Std. Dev. = Standard Deviation. Source: Own survey result, 2017.

### Table 3. Sample farm households’ characteristics by dummy variables.

| Variables | Market participants | Non Market participants | Total sample | \( \chi^2 \)-value |
|-----------|---------------------|-------------------------|--------------|---------------------|
| Sex of farmers |                       |                         |              |                     |
| Male      | 76                   | 79.17                   | 22           | 81.48               | 98                      | 79.67                          | 0.07   |
| Female    | 20                   | 20.83                   | 5            | 18.52               | 25                      | 20.33                          |        |
| Total     | 96                   | 100                     | 27           | 100                 | 123                     | 100                            |        |
| Access to market information | 79           | 82.29                   | 18           | 66.67               | 97                      | 78.86                          | 3.09*  |
| No access to | 17               | 17.71                   | 9            | 33.33               | 26                      | 21.14                          |        |
| Total     | 96                   | 100                     | 27           | 100                 | 123                     | 100                            |        |
| Non/off farm activities | 17             | 17.71                   | 6            | 22.22               | 23                      | 18.70                          | 0.28   |
| Yes       | 79                   | 82.29                   | 21           | 77.78               | 100                     | 81.3                           |        |
| No        | 96                   | 100                     | 27           | 100                 | 123                     | 100                            |        |

* Significant at 10% level; Freq. = Frequency; % = percent. Source: own survey result, 2017.
significant. This means that in terms of market information availability, there was a significant mean difference between market participants and non-market participants. Of the total sample households, 81.3% mainly focused on agricultural activity, and the remaining might be engaged in other non-farm activities (Table 3).

Over 90% of all sample households were married. Family members were the main sources of market information for sample farm households who lived in the town. The government bank provides credit services for wealthy farmers. But, other institutions offer credit for medium and lower-income level farmers. According to the result of survey, 94.31% of the sample farm households benefited from extension service. At 5% significant level, frequency of extension contact was statistically significant. According to the findings, participants and non-participants had a substantial mean difference (Table 4).

### Table 4. Sample farm households’ characteristics by categorical variables.

| Variables                      | Market participation | Non market participation | Total sample | Chi² |
|-------------------------------|----------------------|--------------------------|--------------|------|
|                               | Freq. %              | Freq. %                  | Freq. %      |      |
| Marital status                |                      |                          |              |      |
| Single                        | 1                    | 1.04                     | 0            | 1    |
| Married                       | 90                   | 93.75                    | 21           | 77.78|
| Divorced                      | 2                    | 2.08                     | 1            | 3.70 |
| Widowed                       | 2                    | 2.08                     | 1            | 3.70 |
| Total                         | 96                   | 100                      | 27           | 100  |
| Means of transportation       |                      |                          |              |      |
| Man power                     | 0                    | 0                        | 1            | 0.81 |
| Back animals                  | 78                   | 81.25                    | 18           | 18.75|
| Man power and back animals    | 18                   | 18.75                    | 8            | 29.63|
| Total                         | 96                   | 100                      | 27           | 100  |
| Sources of information        |                      |                          |              |      |
| Family members                | 30                   | 38.46                    | 8            | 44.44|
| Friends                       | 28                   | 35.90                    | 7            | 38.88|
| Traders                       | 6                    | 7.7                      | 2            | 11.11|
| Self-assessment               | 14                   | 17.95                    | 1            | 5.55 |
| Total                         | 78                   | 100                      | 18           | 100  |
| Means of transportation       |                      |                          |              |      |
| Man power                     | 0                    | 0                        | 1            | 0.81 |
| Back animals                  | 78                   | 81.25                    | 18           | 18.75|
| Man power and back animals    | 18                   | 18.75                    | 8            | 29.63|
| Total                         | 96                   | 100                      | 27           | 100  |
| Ng of extension contact       |                      |                          |              |      |
| No Contact                    | 4                    | 4.17                     | 3            | 11.11|
| 52 times in a year           | 35                   | 36.46                    | 5            | 18.52|
| 26 times in a year           | 4                    | 4.17                     | 0            | 0    |
| 12 times in a year           | 39                   | 40.63                    | 11           | 40.74|
| 2 times in a year            | 8                    | 8.33                     | 6            | 22.22|
| 1 times in a year            | 6                    | 6.25                     | 2            | 7.41 |
| Total                         | 96                   | 100                      | 27           | 100  |
| Source of credit              |                      |                          |              |      |
| Governmental bank             | 5                    | 5.21                     | 0            | 0    |
| ACSI                          | 65                   | 67.7                     | 25           | 92.59|
| Cooperatives                  | 2                    | 2.08                     | 1            | 3.70 |
| Governmental bank and ACSI    | 24                   | 25.0                     | 1            | 3.70 |
| Total                         | 96                   | 100                      | 27           | 100  |
| Sources of income             |                      |                          |              |      |
| On-farm income                | 2                    | 2.08                     | 1            | 3.70 |
| On-farm income and livestock production | 81 | 84.38 | 25 | 92.59 | 106 | 86.18 |
| On-farm income, livestock production and other source | 13 | 13.54 | 1 | 3.70 | 14 | 11.38 |
| Total                         | 96                   | 100                      | 27           | 100  |

**a**. Significant at 5% and at C level respectively; Freq. = Frequency; % = percent.
Source: Own survey result, 2017.

### 3.1. Value chain map, actors, and the roles they play and linkages

Value chain map of potato was drawn to identify value chain actors, their linkage, and the transaction between each actor. It was done in both qualitative and quantitative terms, with visuals depicting the various participants in the chain, their linkages, and all chain activities from pre-production (input supply) to industrial processing and marketing. Potato value chain maps were drawn using the basic map format to identify the activities that have been done and the actors that did those activities, information, products, and services were exchanged. Potato value chain map in Farta district is depicted in Figure 3.

#### 3.1.1. Actors and their functional role in the value chain of potato

The identified value chain actors for potato produce in the study area were; input suppliers, producers, local collectors, wholesalers, processors, retailers, and final consumers. Value chain actors are divided into three main groups based on their functions. Main actors: in a value chain of potato included input suppliers, producers, collectors, wholesalers, retailers, processors, and final consumers. Input suppliers: As we confirmed from the survey response, the agricultural office in the district, farmers’ association, research centre, NGOs (Vita), and traders were input suppliers. Their functions were supplied inputs for potato production. The significant difference between non-market participant and market participants’ households is by utilization of seed type and to conclude that potato market participants were used more improved seed than non-market participants (Table 5).

In the study area, some varieties of potato seed are being used by farmers like Belete, Jalene, Gudene, Gossaye, and Hochech. The highest yielding and disease resistance variety was Belete, which is used by 62.3% of farmers. Out of the total sample of farmers, more than 55% of farmers used only family labour. The share of labor for potato production used is depicted in Figure 4.

Producers: Their functions: produce potatoes mainly for consumption and generating income through marketing. More than 54% of farmers used rain-fed (Table 6).

Potato local collectors: Their functions; collect potatoes from producers in settlement markets then resale at a better price to other actors. Wholesalers: Value-adding functions done by wholesalers are buying and assembling, cleaning, washing, creating place, and adding time and place utilities for their product. Processors: Their main value-adding activities are creating form utility to the product. However, processors have no great contribution to the value chain of potato produce in the study area. Retailers: Retailers’ main value-adding functions are cleaning, grading based on size, and weighting with scale. Consumers: are the end actors in the value chain of potato produce and those purchasing the products for consumption.

#### 3.1.2. Value chain actors’ linkage

In the study area, potato value chain actors were linked backwards and forward, vertical and horizontal, as shown in Figure 5.

#### 3.1.3. Value added of actors in value chain analysis approach

The financial analysis examines a business from various perspectives to fully understand the greater financial situation and determine how best to strengthen the current industry. Based on the above justification for the potatoes value chain, economic analysis helps; identify the process of product flow, the linkage between actors, the distribution of income, and the creation of value-added, the amounts of benefit received by
Figure 3. Value chain map of potato in Farta District. Source: Own sketch from survey result, 2017.

1. DA = Development Agent (Experts who provide extension service); 2. A&R = Agriculture and Rural Development (District’s Agriculture and Rural Development office); 3. NGOs = Non-Governmental Organizations (Non-Governmental Organizations; Working in and around the district); 4. VC = Value Chain (Value Chain; the process or activities by which actors have undertaken in the potato production and marketing).
actors, in both absolute and relative terms. Activities performed in the chain and their contribution to the overall process of the entire value chain, the amount of value-added for the chain as a whole in which the chain creates a positive value-added. It also shows how the value-added is made and, in particular, by which actors and which actors produce the greater value-added, which actors only delivered negative or smallest value-added, and the role of the principal producers in the creation of this value. Financial analysis is so important to calculate the value-added released by the chain actors, and it is used to compare unit production and marketing costs and the overall effectiveness of the complete chain. The operating price of each actor, the value added by each actor, revenue, gross profit, and net profit of individual actor in the value chain represents in (Table 7).

\[ Y_i = TC_i - PP_i \]  

Where TC is the total cost of each actor, i start from 1 and PP is the unit purchase price of each actor, i start from 1. As indicated in Table 7, value-added by farmers, collectors, wholesalers, and retailers in the potato value chain were 140.65 Birr, 58.39 Birr, 1.28 Birr, and 20 Birr, respectively, and the total value added by all actors was 220.32 Birr. Value-added profit of farmers, collectors, wholesalers, and retailers was 97.35 Birr, 29.83 Birr, 52.5 Birr, and 50 Birr, respectively, and the total value-added profit was 229.68 Birr. Because value-added share calculation is done by taking the difference between output and intermediate inputs or adding the value-added for each of the actors comprising the chain. Gross profit is rarely calculated for the chain as a whole but, more often, broken down into the gross profit accruing to each actor. The gross and net profit was calculated for each actor in the potato value chain in this study.

### 3.2. Determinants of decision for market participation and amount of supply

Probit model result revealed that; family size, distance to the nearest market, number of oxen owned, access to market information, size of land allocated for potatoes, and quantity of inorganic fertilizer variables influence the decision of sample farmers' potato market participation are presented in (Table 8). Based on Heckman's two-step selection model assumption, non/off-farm income was excluded from OLS model estimation as an identification variable to identify the two regressions. The chi-squared likelihood ratio had a value of 59.58, which is very significant, indicating that the model has stout explanatory power. The value of Pseudo R2 is 0.4602; this indicates that it looks to be quite low; thus, the specification fits the data well. The results were estimated with the probit model do not represent the actual magnitude of changes. Therefore, the marginal effects from the probit model result are provided, which measure the estimated change in probability of a decision to participate for a unit change in an independent variable.

| Table 5. Type of potato seed used by sample potato farmers. |
|-----------------------------|-----------------------------|-----------------------------|
| Variable                      | Market participants | Non market participants | Total sample | \( \chi^2 \) |
|                              | Freq. | %   | Freq. | %   | Freq. | %   |
| Seed type used                |       |     |       |     |       |     |
| Local                        | 20    | 20.83 | 10    | 37.04 | 30    | 24.39 |
| Local and improved           | 76    | 79.17 | 17    | 62.96 | 93    | 75.61 |
| Total                        | 96    | 100  | 27    | 100  | 123   | 100  |

* Significant at 10% probability level; Freq. = Frequency of households. Source: Own survey result, 2017.

| Table 6. Irrigation user and non-user of sample potato producer farmers. |
|-----------------------------|-----------------------------|-----------------------------|
| Variable                      | Market participants | Non market participants | Total sample | \( \chi^2 \) |
|                              | Freq. | %   | Freq. | %   | Freq. | %   |
| Irrigation user/non user     |       |     |       |     |       |     |
| User                        | 41    | 42.71 | 15    | 55.56 | 56    | 45.53 |
| None user                    | 55    | 57.29 | 12    | 44.44 | 67    | 54.47 |
| Total                       | 96    | 100  | 27    | 100  | 123   | 100  |

Note; Freq. = Frequency of farm households; Source: Own survey result, 2017.

| Table 7. Value added and share of actors in the potato value chain. |
|-----------------------------|-----------------------------|-----------------------------|
| Potato value Chain actor    | Costs | Value added | Revenues | Profit |
|                            | Unit total cost | Added unit cost | % added cost | Unit selling price | share/ profit | % share/ profit |
| Farmers                    | 140.65 | 140.65 | 63.84% | 238 | 97.35 | 42.34% |
| Collectors                 | 296.39 | 58.39 | 26.5% | 326.22 | 29.83 | 12.99% |
| Wholesalers                | 327.5 | 1.28 | 0.58% | 380 | 52.5 | 22.86% |
| Retailers                  | 400 | 20 | 9.08% | 450 | 50 | 21.77% |
| Total                      | 140.65 | 140.65 | 63.84% | 238 | 97.35 | 42.34% |
| Note: Unit of measurement is Birr/qt.; \( T^* = \sum \text{All actors value added} \); VA = Value added. | |
| Source: Own computation from survey result, 2017. |
Family Size of the Households (ADULTEQ): Family size is associated with farmer’s market participation decision negatively at a 10% significance level. If the family sizes increase by one member, the probability of farmers’ participation in the potato market decreases by 3.5%.

Distance to the Nearby Market (MDIST): This variable affects the decision to farmers’ potato market participation positively at a 5% significant level. The result showed as the distance to the nearby market increases by one kilometer, the likelihood of farmers participating in the potato market increases by 0.9%.

The Number of Oxen Ownership by Sample household (OXEN): Oxen owned influenced farmers’ participation in the potato market positively at a 5% level of significance. The probability of participating in the potato market increases by 5.8% as the number of oxen increases by one ox.

Households’ Access to Market Information (ACMARKT): This variable affects the decision of farmers’ market participation positively at a 1% level of significance. Farmers who had access to market information boosted their likelihood of participating in potato markets by 26.3% as compared to farmers who did not have access to market information.

Land Size Allotted for Potato Production (LANDAP): Land allocated affects farmers’ decision to market participation positively at a 1% significant level. The probability of market participation increases by 26% when the size of the land increases by one unit.

Quantity of Inorganic Fertilizer Used: Quantity of inorganic fertilizer influenced farmers’ decision to market participation positively at a 1% significant level. Farmers’ fertilizer application increases by a unit, resulting in a 42% increase in market participation.

The second-stage OLS model result revealed that; five variables affect the supply of potatoes to the market: education level, experience in potato production, number of extension contact, land size allotted for potato production, and inorganic amount of fertilizer. The inverse Mill’s ratio affects the amount supplied positively with a 10% significance level, and it indicates that in Heckman’s two-stage model, the correction for selection bias is significant. The overall significance of the model is measured by the Wald chi-squared distribution with 11 degrees of freedom. This implies that the independent variables jointly explain a substantial extent of various independent variables. The value of rho is positive; this indicates that unobservable are positively correlated. The adjusted standard error for the market participation equation regression level is given by sigma = 7.119 as depicted in (Table 9).

Education Level of the Households (EDU): This variable influenced quantity supply to the market positively at a 1% level of significance. The number of potatoes supplied to the market increases by 0.873 quintals for every year of schooling gained by potato producer farmers.

Farming Experience of the Households (EXPR): This variable has a significant positive effect on potato market supply at a 5% level of significance. As farmers’ farming experience increased by one year, potatoes supplied to market increased by 0.18 quintals.

The number of Extension Contact (NEXTC): The number of extension contact significantly and positive effect to the amounts of potatoes market supply at a 10% significance level. Suppose the farmer’s connection with the extension agent increases by a unit, amount of potato market supply increases by 1.205 quintals.

Land Size Allotted for Potato Production (LANDAP): Land size allotted for potato cultivation was related to the amount of potato market supply positively at a 1% significance level. If farmers’ land allocation increases by 1%, the potato supply to market increases by 0.172 quintals.

Quantity of Inorganic Fertilizer Used (FRTQT): Inorganic fertilizer usage was associated positively with the marketed supply of potatoes at a 5% significant level. The result suggested that the use of inorganic fertilizer improves potato production then leads to increases amount of sales supply. An increase in farmers’ use of inorganic fertilizer by 1% resulted in the number of potatoes supplied to market increases by 0.09 quintals.

### Table 8. Estimation of determinants affecting market participation probit model.

| Variables                  | Coefficient | Std. Err | z-ratio | Marginal effect |
|----------------------------|-------------|-----------|---------|-----------------|
| Sex of the household head  | -0.508      | 0.516     | -0.98   | -0.053          |
| Education level of household head | 0.097     | 0.080     | 1.21    | 0.013           |
| Distance to nearest market | 0.070**     | 0.036     | 1.97    | 0.009           |
| Farming experience of household head | -0.026   | 0.019     | -1.37   | -0.003          |
| Family size in Adult equivalent | -0.269*     | 0.141     | -1.91   | -0.035          |
| Oxen owned of the household head | 0.446**     | 0.219     | 2.04    | 0.058           |
| Amount of credit obtained (acredit) | -0.125    | 0.451     | -0.28   | -0.016          |
| Extension contact by household head | -0.039     | 0.147     | -0.27   | -0.005          |
| Access to market information | 1.240***    | 0.450     | 2.76    | 0.263           |
| Land allocated for potato production | 1.995***    | 0.715     | 2.79    | 0.260           |
| Fertilizer quantity used | 3.202***    | 0.953     | 3.36    | 0.420           |
| On/off farm income         | -0.349      | 0.532     | -0.66   | -0.054          |
| Constant                   | 1.972       | 3.992     | 0.621   |                 |

***, ** and *, Significant at 1%, 5% and at 10% level respectively; Std. Error = Standard error.

Log likelihood = -34.945725; LR chi2 = 59.58; Number of observation = 123. Prob > chi2 = 0.0000; Pseudo R² = 0.4602; Source: Model output survey, 2017.

### Table 9. Estimation of potato marketed supply using OLS Model.

| Variables                  | Coefficient | Std. Err | z-ratio |
|----------------------------|-------------|-----------|---------|
| Sex of the household head  | -3.008      | 1.994     | -1.51   |
| Education level of the household head | 0.873***  | 0.293     | 2.98    |
| Distance to nearest market | 0.055       | 0.130     | 0.42    |
| Farming experience of household head | 0.180**     | 0.080     | 2.25    |
| Adult equivalent           | -0.059      | 0.586     | -0.10   |
| Oxen owned of the household head | -0.684     | 0.845     | -0.81   |
| Amount of credit obtained  | -0.153      | 0.733     | -0.21   |
| Number of Extension contact| 1.205*      | 0.622     | 1.94    |
| Access to market information | -2.735   | 2.067     | -1.32   |
| Land allocated for potato production | 17.206*** | 2.612     | 6.59    |
| Fertilizer quantity used   | 9.002**     | 3.853     | 2.34    |
| Cons                       | 19.431      | 8.131     | 2.39    |
| Mills lambda               | 6.954*      | 3.653     | 1.90    |

***, ** and *, Significant at 1%, 5% and at 10% level; Std. Error = Standard error. Number of observation = 123; Uncensored observation = 96; Censored observation = 27. Prob > chi2 = 2.0000; Wald chi2 (11) = 120.28; rho = 0.97674; Sigma = 7.1192874.

Source: Model output survey, 2017.

During the survey, several opportunities and constraints are described through value chain actors of potato in the research area. Those main constraints currently impeding the development of the value chain of potato in the research area are categorized based at each phase of the entire value chain. Potato production constraints like; shortage of land, traditional production systems, shortage of improved seed, high cost of inorganic fertilizer, absence of modern production technology, low irrigation facility, lack of adequate pesticide/herbicide, and scarcity of rainfall. Opportunities for potato production: A district’s geographical location, environmental condition, fertile arable land, and irrigation water are very suitable for potato production. Continuous market demands for potato products due to this 98.6% of the farmers were interested in expanding potato production. Moreover, the Ethiopian
government now designed a policy to support farmers that promotes investment in agro-industry and market-oriented agricultural production. Marketing constraints: the low price of the product during high supply, price fluctuation, lack of modern packaging services, lack of working capital, poor road condition, deficiency of market information, absence of standardized packaging and weighing scales, and lack of policy framework in price-setting strategy. Marketing opportunities: The availability of market demand throughout the year, low working capital, and periodical increasing the value of the produce by processing and, as a result, growing urban consumers’ demand for fresh and processed potato products continually.

4. Discussion

Descriptive Statistics discussion: Households' farming experiences are of paramount importance for any part of agricultural activities. This research result revealed that sample households have rich experience in potato production and commercialization. The average potato farming experience reported by (Abduselam, 2016) was 19.96 years; thus, the current study farming experience is better than with the previous study result. Education is the unique driving factors which help producers receive information from different sources. But the result of this study indicated that farmers were located at lower educational status. These results are related to the results of (Abduselam, 2016). Education level plays an immense role in ensuring household access to basic requirements such as food, shelter, and clothing. Skills and education amplify the working efficiency resulting in more income and food security (Addisu, 2016). However, this result depicted those market partici- pant households are more educated than potato market non-participants. The current annual potato production is better than the previous studies 80 quintals per hectare reported by (Shambel, 2017) in the same production year. If the amount of potato production increases annually, the probability of farmers’ market participation and volume of sales will increase (AgroBIG, 2016). From the survey result, land allocation for potato production was better than for other vegetables and fruits crops. The land allotted for potato cultivation for this study is similar to the study conducted by Kassa (2014) for Bibugn and Sinan district households. But, for this study, land allocation is greater than the land allocated in the Sheka zone confirmed by (Benyam and Fayera, 2018). Market participant households have better land allocation than non-market participants concerning landholding and land allocation for potato production. Market information is a significant variable for motivating production and for marketing activities. It is a beginning point for at all marketing decisions regarding the succeeding production, post-harvest management, processing, and commercial activities (Shambel, 2017). Compared to non-market participants, market partici- pant households had better access to market information. Addisu (2016) concludes that there is a significant variance in between producers by the type of crop produced with access to market information.

4.1. Value chain map, actors, and their roles

The main purpose of value chain mapping and analysis is to create value that exceeds the cost of providing the product or service and generates a profit margin. Potato value chain mapping is a tool used to get a clear understanding of the categorization of activities and the crucial actors and their interactions convoluted in the value chain of potato. As it is a diagnostic tool, it helps to identify collaborative implementation of activities that can benefit the whole chain, for identifying constraints and opportunities in the entire value chain, and which help to organize key information about who was doing what in the value chain of potato. The primary step in the analysis of value chain approach is to complete value chain analysis map of the chain, which allows tracing of the relationships between actors such as producers, collectors, wholesalers, processors, retailers, and consumers, and the flow of production input, service and information through the chain (Mmusa et al. (2012). The current value chain map of potato indicated the involvement of different actors that are directly or indirectly involved between farmer and final consumer in the value chain of potato. This could be creating a strong association of actors in bringing the product or service from its basic raw materials through final consumption. Actors of value chain are those individuals or institutions who take possession during the transaction process of moving the potato product from conception to end-user. The potato product is exchanged for money or equivalent commodities or services. Many value chain actors of potato produce were involved in the entire chain from its production to final consumption by undertaking various activities. Input suppliers, pro- ducers, traders, processors, consumers, and chain enablers/supporters were the main actors. The similar results were stated by (Bezabh and Mengistu, 2011; Abduselam, 2016, Shambel, 2017 and Benyam and Fayera, 2018). Input suppliers play the main role in supplying agricultural input, including improved seed for potato production. Market participants' households were used more improved seed than non-market participants' households. As farmers can adopt new and improved seeds, they can partake in the market. From the produced potato varieties in the study area, Belete is the highest yielding and disease resistant variety. It was preferred by more than 60% of farmers. This implies that belete is a better variety in increasing production, and farmers need to supply the portion of potato product to the market compared with other types. Each value chain actor of potato has undertaken various value chain activities, but producers carried out many activities compared to other actors in the complete potato value chain. Hiring labour was too expensive; due to this, more than 55% of farmers used only their family labour and improved the net profit from their farming business. Modern irrigation technology for potato cultivation in the research area is still at the infant stage. More than 54% of farmers were produced by only rain-fed, and the remaining farmers produce both in irrigation and rain-fed. When potato exchanges starting single actor to the next, the amount of price frequently increases. Various value addition activities were undertaken for potato products with different chain actors to attract customers and receive an optimum price for producers.

4.1.1. Actors linkage

Producers were linked with input suppliers (backward linkage), and input suppliers were linked with producers (forward linkage in financial and information cases). Producers were linked with wholesalers, local collectors, retailers, and consumers in vertical linkage for giving products and downward linkage for receiving money. Chain influencers and chain supporters were linked horizontally in their similar functional activities and vertically with other main actors in the value chain of potato in different operational activities. Potato farmers made horizontal linkage with other fellow farmers for the market transaction, exchange of different seeds, and sharing farming experience. But, their relationship seemed to be weak. In the same way, traders also made horizontal and vertical linkages in the same function and different functions respectively in the complete potato value chain.

4.1.2. Value added of actors in analysis of value chain approach

Farmers added the highest value in the chain; this indicated that value-adding activities carried out and the operation cost incurred by farmers is larger than other actors involved in the value chain of potato. Fertilizer, seed, and labor costs account for a major portion of the total variable costs associated with potato production (Shambel, 2017). Value chain governance: The result from the analysis indicates that the wholesalers market highly influences the potato market in the district due to wholesalers having a good position with capital and quantity purchased. Hence, the wholesalers are the main value chain governors in the value chain of potato. The dominant value chain actors play a facilitation role in the market (Kaplinsky and Morris, 2000).
4.2. Determinants of decision for market participation and amount of supply

Different determinants that affect the decision for market participation and product sales volume. From those determinants included and fitted in the econometrics model, the most significant determinants discussed are as follows.

The larger the family’s size in the household, the higher the amount of potato product consumed. Similar to this finding, Siziba et al. (2011) and Eta et al. (2016) conclude that household size is negatively related with the likelihood of market participation. Opposite to these findings, Agete (2014) reported that household size had significant and a positive association with the market participation decision of red bean farm households.

Distance to the nearby market positively affects farmers’ potato market participation. The probable reason for this might be that farmers living near to market town produce other cash crops like carrot, cabbage, onion, garlic, and other vegetable and fruit crops other than potatoes for a short period of marketing. In supporting this finding, Sebata et al. (2014) and Habtamu (2015) concluded that distance to the nearby market has significant and positive effect to the likelihood of household market participation. Contrary to these findings, Berhanu and Moti (2012) reported that distance from settlement centre to nearest marketplace negatively influences the smallholders’ decision to market participation in Ethiopia.

Oxen owned influenced farmers’ participation in the potato market positively. This indicates that the amount of oxen increases; farmers can increase their production and promote market participation. In line with this finding, Habtamu (2015) and Shewaye (2015), in their studies, found that the number of oxen owned had positive and significantly associated with the likelihood of farmers’ participation in potatoes and haricot bean market respectively. Contrary to these findings, Amare (2014) found that the amount of oxen possessed by households was significantly and negatively affected the market participation decision of households to the pepper market.

Availability of Market Information affects the decision of farmers’ market participation positively. Market information improves farmers’ information accessibility and receives new technology. Supporting this finding, Astewel (2010) and Nuri (2016) found that availability of market information is positive and significantly affects household output market participation. In contradiction to this finding, Ohen et al. (2014) conclude that market information negatively influenced the capability of the household market participation.

Land size Allotted for Potato Production positively affects farmers’ decision to market participation. Hence, the large land allocated for potatoes, the higher the likelihood of market participation. Corresponding to this finding, Getachew (2015) and Eta et al. (2016) conclude that land allocated has significant and positive effect to the probability of farmers’ market participation.

The quantity of inorganic fertilizer influenced farmers’ decision to market participation positively. Fertilizer application increases productivity and, in turn, increases market participation. The research undertaken by Leykun and Jemma (2014) concluded that the fertilizer use variable is positively related to market participation.

Education Level of the Households influenced the quantity supply positively to the market. This means that education improve farmers’ ability to increase production levels. Improve the level of production and then increases the amount of market supply. Inconsistent with this finding, Ayelech (2011), Marshal (2011), and Yeshtilha (2012) found that the education level of the household heads has significant and a positive effect to the amount of output market supply.

Farming Experience of the Households has significant and a positive effect on potato market supply. This result implies that as farming experience increases, so does the quantity of potato supply to the market. In supporting this finding, Tadesse (2011), Abraham (2013), and Waziri (2013) conclude that experience of household heads was statistically significant and positively correlated with the marketed supply of their product.

The number of extension contact is positive and significantly affects the potatoes market supply. A study was conducted by Girma (2015), who found that extension contact frequency affected the marketed surplus of teff positively and significantly. This finding contradicts Namazzi et al. (2015) they found that the extent of extension visits in the past year negatively and greatly influenced market participation levels. This suggests that extension service provides information on new and improved varieties, production technologies transfer, production improvements, market availability and then leads to increase production and marketed supply by farmers.

Land Size Allotted for Potato Production (LANDAP): Land size allotted for potato production was positively related to the quantity of potato supplied to the market. Farmers who allocated larger land sizes for potatoes production sold larger amounts than farmers who administered smaller land sizes. Similar to this finding, Addissu (2016) and Girma (2015) concluded that land allotted for potato and teff productions had significant and a positive impact on the volume of sales for each commodity.

Quantity of Inorganic Fertilizer Used (FRTQT): Inorganic fertilizer usage was positively related with the marketed supply of potatoes. The result suggested that the use of inorganic fertilizer improves potato production then leads to increases marketed supply. Corresponding to this finding, Beza (2014) and Gashahun (2015) reported that fertilizers had a positive and significant influence on the marketed supply of their selected commodity. The Inverse Mills Ratio Lambda, which is a correction factor for selectivity bias, was substantial and revealed that unseen factors might influence the decision for market participation and amount of participation in potato markets. It has a positive and considerable effect on the volume of potato sales.

4.3. The opportunities and constraints in value chain of potato

Most farmer households in the research area faced a shortage of ploughing land, which caused detrimental potato market participation and intensity of potato market supply. Traditional production systems are being bottleneck for improving production and increasing marketed surplus, and it is also a positive correlation with the absence of modern production technology. The shortage of advanced seed and the high cost of inorganic fertilizer have a substantial influence on the quantity of potato cultivation and the amount of sales. Low irrigation facilities and scarcity of rainfall could negatively affect the productivity and duration of potato production. Lack of adequate pesticide/herbicide affected both the quality and quantity of potato products; in turn, it affected the net return of the farm households. The main positive drivers for potato production and sustainable value chain development are a district’s geographical location, environmental condition, fertile arable land, and irrigation water. Potato plays an important role in indigenous food classifications and food security; however, due to the prevalence of production and marketing constraints, the crop had not supplied most of its advantages (Biruk et al., 2017).

5. Conclusions and recommendations

In the potato value chain, the main actors were input suppliers, producers, traders, chain enablers/supporters, and consumers. However, strong integration has not been observed between each actor. Due to good capital position and mass purchasing power, wholesalers were the main market governors compared with other chain actors. The total value added by all actors in the complete potato value chain was 220.32 Birr. Out of the entire covariates included in the model, distance, family size, number of oxen, market information, land allocated, and inorganic fertilizer significantly determine market participation decision whereas, education, experience, extension contact, the land was given, and inorganic fertilizer positively and assess the volume of potato sales...
substantially. A district's suitability for potato production, availability of continuous market demand, and increased product value were the main opportunities whereas, shortage of improved seed, diseases, natural factors, lack of a post-harvest management system, lack of policy framework for price-setting were the main constraints in the value chain of potato. Value chain actors build strong linkage to develop a sustainable potato value chain. The government gives special attention to stabilizing prices improving farmers' market share. Expansion information and communication technology is needed from the government and other concerned bodies, especially in a remote corner of the area. Farmers' farming experience should be strengthened for improving production and increase their market participation. Input suppliers would be motivated to supply adequate inputs for farmers. Private seed multipliers, research centres, NGOs, and other institutions should introduce new/improved seed varieties. Establishing a post-harvest management approach is also paramount for a substantial influence on the competitiveness of potato value chain.

Declarations

Author contribution statement

Gedefaw Kindu Wubet: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper. Lemma Zemedu; Bosena Tegegne: Analyzed and interpreted the data; Wrote the paper.

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Data will be made available on request.

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Additional information

No additional information is available for this paper.

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