Potato Value Chain Analysis in Highland of Guji Zone, Southern Oromia, Ethiopia

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Abstract: Potato plays a significant role in the national system and channels differ for different areas. Production of potato by smallholder farmers of the in highland parts of Guji zone districts are mainly for house consumption and market which is the most important and widely known cash crop of the area but there was lack of properly functioning marketing system and this often resulted in lower producers' price. Therefore, this study focused on identifying potato market chain actors and their channels and factors that affect the volume of potato market. The target population was 14547 household farmers of which 141 producer households were selected using simple random sampling ad 24 traders and 13 consumers were selected purposively. Data were collected from both primary and secondary sources. Secondary data were gathered from district agriculture and rural development offices and trade and industry offices. Both descriptive and econometric analyses were employed for data analysis. The study indicated that, out of the total potato produced in 20120/21 cropping season of 6538 quintal, 89.8% of the product was supplied to the market in the study area. The result showed that about six marketing channels were identified in transferring 5897 quintals of potato, where, 38.92%, 26.13%, 11.2% and 23.75% were sold to wholesaler, retailers, collectors and consumers respectively. Result of a multiple linear regression model indicated that Age, potato production experience, amount consumed, quantity of potato produced, information access, off farm income and credit access were variables significantly affected volume of potato supplied to market in the study area. Production constraints of shortage of improved seed supply, disease and credit availability and marketing constrains of low price, and poor linkage with actors and lower consumer demand were identified. Therefore, improving seed supply problem, cooperative management, strengthening market information delivery system, post-harvest potato handling are intervention needed to boast potato production and marketing in the study area.

Keywords: Guji, Actors, Constraints, Potato, Producer, Value Chain, Analysis

1. Introduction

1.1. Background and Justification

Potato is considered to be the world's fourth important food crop after maize, wheat, and rice because of its high yield potential and nutritive value [20] and the third most important food crop after rice and wheat is being grown and consumed in all over the world [13, 14, 15].

Potato is cultivated worldwide in over one hundred countries throughout Africa, Asia, Australia, Europe, and North and South America [27] Potato is one of the widely grown root and tuber crops of the world being a rich source of nutrients for human nutrition. It contains about 79% water, 18% starch as a good source of energy, 2% protein and 1% vitamins including vitamin C, minerals including calcium and magnesium and many trace elements [2]. The past few decades have seen a dramatic increase in potato production and demand in many developing countries [14].

Potato has been widely described as global food and nutritional security option particularly for the poor people (Singh and Rana, 2013). Farmers consider potato as a transitional crop that helps them survive the severe and prevailing food shortage that occur every year [26].

Potatoes are among the most widely-grown crop plants in the world giving good yield under various soil and weather conditions of requiring high altitude of about 1200 m above sea level, cool temperatures ranging between 15 and 20°C and high rainfall ranging between 1000 and 1500 mm per year and optimum soil pH ranges from 5.0 and 6.5 [5].

As [10] report of 2018/19 production year, Even though, Ethiopia has suitable environmental condition, the average national yield of potato productivity was $14.176\ tha^{-1}$ which is very low as compared with world average yield of $20\ tha^{-1}$ [16]. On the other hand, the yield potential of the released potato variety in Gudanie ranges between 21 to 29 t tha^{-1} [22]. Moreover, at Bore Agricultural Research Center (2013) an unpublished research progress report clearly indicates that average yield of Gudanie 46.4 t tha^{-1} in the highlands of Guji zone. However, after four years of cultivation, the average yield of variety declined from 46.4 to 29.4 t tha^{-1} in the study area [12].

Oromia is the major potato producing region in Ethiopia that constitutes 51% of the national potato production [8]. Even though the country has suitable environmental conditions for potato production, the region (12.22 t/ha) as well as the national (13.69 t/ha) productivity of potato is very low [8], as compared to the world average of 17.16 t/ha. This is mainly due to shortage of improved potato varieties, lack of certified potato seed and poor agronomic practices which leads to low potato productivity in the region.

Highland parts of Guji zone is potential for potato production potato where 14,547.00 household farmers were participated on production of the crop [9]. In the area the main objective of growing potato is for both household consumption and income generation. Potato is an interesting crop because the land used for potato is reused for other crop or vegetable production helping famers double cropping that enhances their food security and maintains their livelihood. Despite these benefits, potato producing farmers are still not benefiting from potato production due to nature of crop high perishability, Input supply shortage, transportation problem, and low market price of output during harvesting and high cost of inputs during planting. Moreover, poor post-harvest management and low trust among actors were major constraints of potato production in the highland of Guji Zone. In doing so, the study attempted to contribute in filling the knowledge gap by assessing potato value chain and its performance, constraints and opportunities faced by potato value chain actors, marketing costs and margins across market channels and factors affecting potato marketed surplus in the study areas.

1.2. Objective

The specific objectives of the study were to:
1) Identify the major value chain actors and develop potato value chain maps in the highlands of Guji zone.
2) Analyze marketing costs and margins across market channels.
3) Identify the determinants quantity of potato supplied to the market by farmers in the study areas.
4) Identify the constraints and opportunities faced by potato value chain actors in the highlands of Guji Zone.

2. Methodology

2.1. Research Design

A cross sectional survey research design was employed for this study. Quantitative and qualitative research data were collected from primary and secondary data sources. Quantitative data was collected from district agricultural offices whereas qualitative data was collected from farmers, traders and consumers using questionnaires.

2.1.1. Sampling Technique and Sample Size

The study was undertaken in all highland area of the zone in which potato is evenly produced. Samples were selected from each segment of the value chain using simple random sampling since the area is potential in producing potato and each and every household were expected to cultivate the crop. Thus based on the [9], the total population of producing the crop of 14547 household farmers, 141 household farmers where selected using [30] sample size determination formula using 0.085 margin of error and data was collected from each producers through structured where the sample size determination formula of (Yamane, 1967) is defined as:

$$n = \frac{N}{1+N(e)^2} = \frac{114547}{1+0.085^2} \approx 141 \qquad (1)$$

Where: n= Sample size, N= Population size which was 4547 and e = is margin of error. Based on the above formula a total of 141 households were interviewed in the study area.

Sample traders were collected using a purposive sampling method where the actors, wholesalers (6), rural collectors (2) and retailers (16) from the markets that potato passed through. Accordingly, a total of 24 traders were selected. Furthermore, 13 consumers were interviewed.

2.1.2. Methods of Data Analysis

Descriptive statistics was used to analyze the data collected, employed maps, percentages, frequencies, means and standard deviations. To evaluate the market performance in the value chain net returns and estimated costs of value chain actors along the value chain were calculated. for describing market chain actors of producing and transacting potato from farmers to final were consumer were identified and mapped. These actors include potato producing farmers, input suppliers, wholesalers, retailers, collectors and final consumers. The value chain was visualized the chain of actors, identify roles and linkage among the actors. The data production, cost of production and marketing were obtained from survey result.

Potato market performance of the area was examined by analyzing market cost and price margins among different potato marketing actors in order to measures the degree of potato marketing efficiency where marketing margin is the difference between prices at different levels in marketing system and total marketing margin is different between what a consumer pays for potato per quintal and what producers or farmers receives for the produce [21].

$$TGMM = \frac{final\ consumer\ price - farmer\ price}{final\ consumer\ price} \qquad (2)$$

Where, TGMM is Total Gross Marketing Margin which is useful to introduce here the idea of producer participation, farmer's portion or producer's gross margin (GMM) which is the portion of the price paid by the end consumer that belongs to the farmer as a producer. The producer's margin

or share in the consumer price (GMMp) is calculated as:

$$\text{GMMp} = \frac{\text{consumer price} - \text{TGMM}}{\text{consumer price}} = 1 - \text{TGMM} \quad (3)$$

The consumer price share or portion of market intermediate is calculated as:-

$$\text{MM} = \frac{\text{selling price} - \text{buying price}}{\text{consumer price}} * l100 \quad (4)$$

Where MM is Marketing Margin in percentage

Net marketing margin (NMM) which is the percentage over the final price earned by the intermediaries as their net income after their marketing costs are deducted. Thus, the net marketing margin is calculated as:

$$\text{NMM} = \frac{\text{GMM} - \text{marketing cost}}{\text{consumer price}} * 100 \quad (5)$$

2.2. Econometric Model

In this study, multiple linear regression models were used to analyze data to generate information about determinants of potato supply. Multiple linear regression models are employed to estimate the determinants continuous dependent variables and two or more continuous or categorical independent variables. This model is also selected for its simplicity and practical applicability [28]. Based on literatures, the potato supply model to be estimated in this study was taking the following form. Model is like:

$Y_i = f(x_1, \dots, x_n)$ Where sample size and n is number of explanatory variables used for building model.

Econometric model specification of supply function is the following defined as:

$$y_i = \alpha + x_i \beta_i + \varepsilon_i \quad (6)$$

Where is ε_i distributed as $\varepsilon_i \sim N(0, 1)$

X_i is a vector of explanatory variables hypothesized to affect farmers' potato market supply,

β_i is a vectors of parameters to be estimated which measures the effects of explanatory variables on the farmers decision of potato market supply.

ε_i is random error normally distributed with mean zero and constant variance.

3. Result and Discussions

3.1. Descriptive Statistics

3.1.1. Demographics and Socioeconomics Characteristics of Households

The variables used to describe demographic characteristics of sample farmers were sex, educational level, marital status, age and family size. The results presented in Table 1 depicts that, 90.78% indicating only 9.23 % remaining were female headed households among sample respondents in the study area revealing that females participation is low in determining family livelihood among assessed respondents. The results of the study also indicated that 17.73% of the respondents were not participated in formal or informal education. Whereas 46.81% of respondent household heads were leant 1 to 8 grades revealing the educational level of major respondents in the study area is more of less in similar ranges. The result also revealed that around 96.45% of the respondents in the were got married.

Age is one of the important characteristics of the community. It reflects on the productivity of the population as it has a bearing on the overall health situation within the community. In developing countries, aged members are more prone to diseases and thus are less productive. It has a bearing on the employment pattern, spatial mobility and quality of work done. Age plays a significant role in any kind of business, particularly in agriculture, because the use of child labor on the farms is quite high. Accordingly, the mean age of the respondent was 32.2 with standard deviations of 11. 6 in the study area which is in working force range and expected to increase potato production. The livelihood of rural farm households mainly relies on agriculture which requires more labor for various activities like land preparation, planting, weeding, cultivation, harvesting, threshing, animal keeping, fetching water and fire wood collection and so on. The family size with age composition is important to carry out different agricultural activities. The average family size in the study area was around 8 family members (table 1).

Table 1. Demographic and Socio-economic characteristics of Respondents.

Variable	Description	Frequency N = 141	Percent N = 141
Sex	Male	128	90.78
	Female	13	9.23
Educational level	No –education	25	17.73
	8th grade or less	65	46.81
	9th to 10th grade	34	24.11
	11th to 12th grade	9	3.38
	Diploma and above	10	7.1
	Married	136	96.45
Marital status	Unmarried	4	2.84
	Widowed	1	0.71
Age	Mean	32.2 (11.6)	-
Family size	Mean	8 (4.1)	-
Distance from market center hour	Mean	33.83 (22.28)	-
Distance of from main road in hour	Mean	20.53 (20.37)	-
Potato production experience	Mean	4 (3.87)	-
Farm size in hectare	Mean	3 (2.41)	-

From table 1 it can be observed that the average market distance producer travel is about 34 minutes in study area. The result also revealed that information collected from sample respondents of about 4 years of potato production experience with average farm size of 3 hectare land holding.

3.1.2. Access to Services

Provision of adequate services for the communities enhances the communities' socioeconomic development in general and the well-being of individuals in particular. It has important contribution in improving production and productivity and thereby increasing marketable surplus and ultimately for increasing the income of smallholder farmers. The most important services that are expected to promote production and marketing of potato in the study area include access to credit, access to extension service, and access to market information.

Access to extension services: Extension service in agriculture is indispensable and it provides assistance for farmers in improvement of production and productivity, it also enables flow of information and transfer of knowledge and scientific findings to practice. Access to agricultural information services makes farmers to be aware of and get better understanding and ultimately leads to decision to take risk for improved agricultural practices. It helps in disseminating new innovations and ideas that emerges from research findings and improves better understanding of technologies that benefit farmer's production and productivity. In addition, access to agricultural extension services helps to facilitate dissemination and adoption of improved technologies and ensure the local availability of these technologies for the majority of smallholders.

Currently in Ethiopia the government has been attempting to fill the required knowledge and achieve food self-sufficiency in the country by placing in each PA administration three development agents (DAs) and building a farmer training center (FTC). Development agents are assigned as better source of extension services for farmers at PA level that strengthens intensive method of extension work.

However, some development agents revealed that district level bosses from different streams influenced them to do different activities out of agricultural extension professionally. The key informant discussions pointed out that some development agents have no time to deliver technical advice to farmers sufficiently. The result indicated that 50.4% of respondent farmers have access to agricultural extension services which is low where it crucial in boasting potato production and for post-harvest management (Table 2).

Access to credit: The availability of financial sources for credit is crucial for farmers. Some farmers are using as an important input for agricultural activities. Table 2 shows that 94% % of respondents haven't access to credit in the study area. According to information obtained from FDG Factors that hinder farmers from taking credit in study area were limited access, farmers fear of its interest and using credit for crop production is not practiced in the area. The credit source for these farmers was local money lenders and microfinance. In addition, Oromia Credit and Saving Institution provide credit to farmers. However, the credit provision is based on group collateral but farmers are not much interested in this approach in order not to pay for defaulters in their group.

Access to market information: Access to agricultural markets and marketing information are essential factors in promoting competitive markets and improving agricultural sector development. A well-organized market intelligence information system helps all the producers and traders freely interact with one another in arriving at prices. Access to reliable market information help farmers sell their surpluses of potato and choose modes of transaction, each of which yields a different benefit. It has been postulated that farmers will choose a profitable mode of transaction if they can receive reliable market information on the prevailing market conditions. Access to price information and source information of respondents in Table 2 showed that the major source of information was friends or neighbor farmers, indicating 96% of the respondents can get market information.

Table 2. Household's access to service for potato production and marketing.

Service Type		Total (N=141)		
		Count	Frequency	Percentage (%)
Extension service	Yes	71	71	50.4
	No	70	70	49.6
Credit service	Yes	9	9	6
	No	132	132	94
Market information	Yes	135	135	96
	No	6	6	4

3.1.3. Input Utilization

Inputs used by farmers of the study area are Seed, fertilizer, herbicides and pesticides. These inputs are supplied to farmers either by District Agricultural office, cooperative/unions, private traders or local markets.

The value chain map of potato in both district was similar and presented in Figure 1, the two potato value chain actors were identified namely direct actors those are input suppliers, producers, traders, consumers and indirect actors were those that provide financial or non-financial support services, such as government offices, research institutions, credit agencies, business service providers, union and cooperatives.
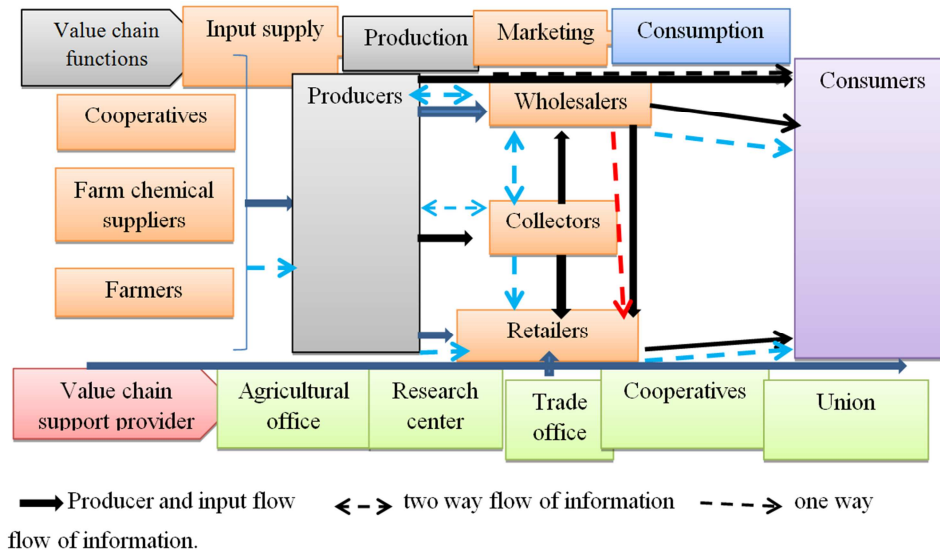
Figure 1. Potato value chain map of study area.

Use of improved seed varieties with its appropriate recommendation is believed to improve production and productivity of potato crop and its market supply in the study area. The major suppliers of seed for the study area were district agricultural office and union or cooperatives are two primary agents to supply improved seed to the area. The result revealed that 88.65% of the respondents have used improved potato seed where the available improved seeds were Guidane and Belete varieties.

The survey result indicated that around 98 of sample respondents applied fertilizers for production of potato in the study area (Table 3).

The result revealed that major respondent were not used farm chemicals especially where Gudane potato variety was highly attacked by disease like early blight and late blight and Belete is highly attacked by bacterial wilt as [12]. As it can be observed from the result, the potato production in the study area was not practiced with its full package which may due low performance of extension service (Table 3). The major problem of not using input especially farm chemicals for potato protection in the study area for controlling early blight and late blight is there are no supplies of these chemicals in the study area as raised by sample respondents. Out of the total interviewed households 98% were used inorganic fertilizer of DAP and UREA (Table 4). About 22% of farmers used chemical for controlling potato diseases in the study area indicating all most no chemical controlling is experienced (Table 3).

Table 3. Input usage of sample Respondents.

Input	Measurement	Total (N=141)	
		Frequency	Percentage (%)
Improved Seed	Yes	125	88.65
	No	16	11.35
Fertilizer	Yes	138	98
	No	3	2
Chemicals	Yes	31	22
	No	110	78

Input Suppliers: Primary multipurpose farmers' cooperatives, Union, district agricultural office and local market were major suppliers' seed, fertilizer and chemical input to producers in both districts (Table 4). Potato farmers also participated in preparing their own inputs and they also supply to fellow farmers. Over all, these actors supplied seeds, fertilizers, chemicals and trainings. In the study area, farmers use inorganic fertilizer of DAP and UREA fertilizers supplied from cooperatives and agricultural office (Table 4).

Table 4. Major input Suppliers.

Input	Source	Total (N = 141)	
		Frequency	Percentage (%)
Improved Seed	Agriculture Office	40	28.4
	Local Market	15	10.6
	Research Center	10	7.1
	Cooperatives	45	31.9
	NGOs	2	1.4
	Fellow farmers	29	20.6

Input	Source	Total (N = 141)	
		Frequency	Percentage (%)
Fertilizer	Agriculture Office	84	59.6
	Local Market	23	16.3
	Union	29	20.6
Chemicals (Pesticides and Herbicides)	Agriculture Office	3	2.1
	Local Market	25	17.7
	Cooperatives	2	1.4
Labor	Family labor	93	66
	Hired labor	17	12
	Labor Exchange	14	10
	Cooperation	17	12

A larger proportion of farmers (28% and 31%) were purchased seed from cooperatives or agricultural office from market (Table 4).

Producers: Potato producers in the study area are smallholder farmers. The average own land holding was 3 hectare per household. Average production was 279 quintal per hectare as reported by [12] which is more than double of national average estimate of 136.85 quintal per hectare as reported by [8]. All area covered potato was rain fed production.

Potato sole cropping is the most popularly practiced cropping pattern in the study area. Sample farmers sell their potato product at the available market options which were farm gate and nearest village market and urban (town) market to different value chain actors like collectors, wholesalers, retailers and consumers (including individual households, hotels and restaurants).

Collectors: Collectors are found in village markets. During peak harvest seasons July to end of August they assemble potato from farmers either at farm gate or from nearest market for the purpose of reselling to wholesalers that found in the same PAs or wholesalers from Adola and Shakiso and those come from other places and also to retailers at urban market. They also retail seed potato (supply input) to farmers April to end of May. These collectors communicate with wholesalers and asses the demand for the product before going to purchase. They do not store the collected potato for more than 3 days because of the fear of loss due to product perishability. Some collectors receive in advance payment from wholesalers and assemble the product. In the study area, it is common the collectors negotiate with farmers to purchase potato at farm field and collectors use hired daily laborers to harvest a product. They use horse/donkey carts for transporting the product from farm gate to their work place (storage house) and also use human back loading to areas which is not accessible for carts and horse.

Wholesalers: They handle large volume than other value chain actors were purchasing from collectors and producers to resell to wholesalers, retailers and/or consumers. In the study district wholesalers found in markets like Bore and Yirba markets. Wholesalers at local market were selling potato through cell phone communication with traders in different cities in the zone and Sidama regional state.

Retailers: There were considerable number of retailers who traded potato with other vegetables like onion, tomato, cabbage, green pepper and other vegetables. Retailers purchased potato mainly from wholesalers, producers and collectors for reselling to consumers (including individual households, hotels, cafes, restaurants and road vendors).

Consumers: Consumers are found in both rural and urban areas include individual households, institutions, hotels, café and restaurants. They purchased potato from retailers, farmers and wholesalers.

Value chain support providers: In the study area, different governmental and non-governmental organizations supporting potato value chain. District Agricultural Offices, Trade and Transport Office, Primary Farmers' Cooperatives, Bore research center, Private Transporters and NGOs are value chain supporters identified in the study area. Some service providers extend their supportive functions along the value chain and also have multiple functions. Agricultural offices provided agricultural extension services, follow closely the potato farmers, they advise on potato cultivation, management of agronomic practices and organizing and providing trainings. Multi-purpose primary cooperatives have a responsibilities and duties on supplying different agricultural inputs and purchase farmers produce. But the information from the study showed that these multi-purpose primary cooperative were only supplying fertilizers, both DAP and Urea either on cash or on credit to potato producer farmers

3.2. Analysis of Value Chains

Six marketing channels were identified for potato value chain in the study area. The total product passed through the channel was 5897 quintal of potato. The channel comparison was made based on volume passed through. Accordingly, a channel of Farmers→Wholesalers→Retailers→consumers is the largest in which was about 31% of the product passed through (channel 3) and followed by a channel of Farmers→Retailers→Consumers in which 26.13% of the product passed through it (channel 4) in the study area (figure 2).
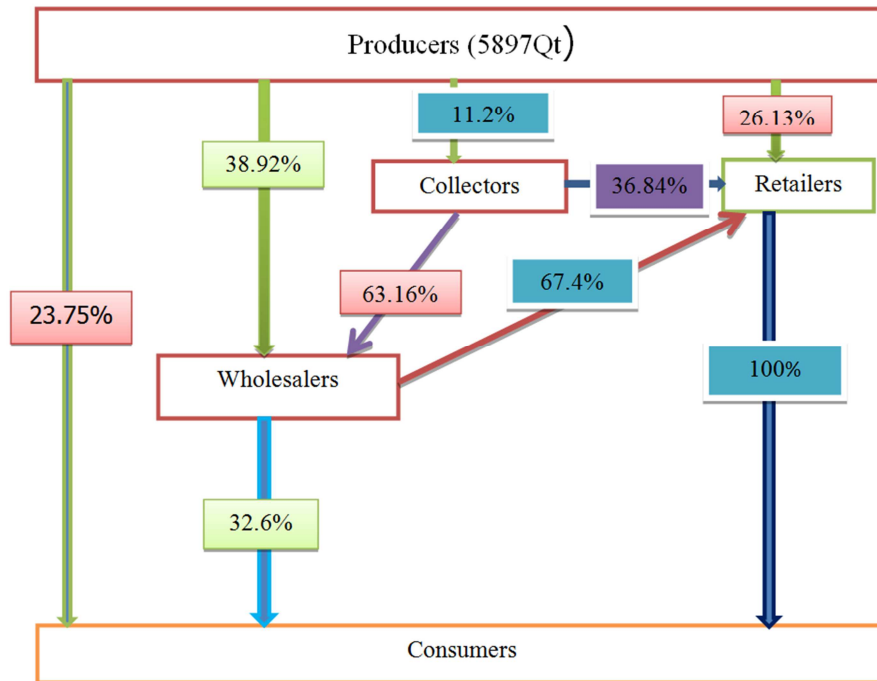
Figure 2. Potato Marketing Chanel of study area.

Channel I. Farmers→Consumers (23.75%)

Chanel II. Farmers→Wholesalers→Consumers (14.99%)

Channel III. Farmers→ Wholesalers→ Retailers→ Consumers (30.99%)

Channel IV. Farmers→Retailers→Consumers (26.13%)

Channel V. Farmers→ Collectors→ Wholesalers→ Retailers→Consumers (7.07%)

Channel VI. Farmers→ Collectors→ Retailers→ Consumers (4.13%)

Farmers sold about 38.92% of their potato to wholesalers, 26.13% Retailers, 11.2% to collectors and 23.75% to consumers.

3.2.1. Marketing Margin

Marketing margin is one of the commonly used measures of the performance of a marketing system. It is defined as the difference between the price the consumers pay and the price the producers receive. Computing the total gross marketing margin (TGMM) is always related to the final price or the price paid by the end consumer, expressed in percentage [21].

Gross marketing margin (GMM) is the gap between prices at consecutive levels in the marketing channel. Therefore for this study the marketing margins were computed based on the data collected of value chain actors.

In Table 5 GMMp, GMMr, GMMc and GMMw means gross marketing margins for producers, retailers, collectors and wholesalers agents respectively were computed.

Table 5. Marketing margin (Birr/Qt).

Channels	GMMP	GMMr	GMMc	GMMw	TGMM
I	100	-	-	-	0.00
II	74.2	-	-	0.258	25.8
III	67.45	0.0675	-	0.1905	32.55
IV	79.4	0.206	-	-	20.6
V	54.44	0.198	0.079	0.1786	45.56
VI	73.46	0.1984	0.067	-	26.54

Total gross marketing margin is the highest in channel V which is 45.56%. Without considering channel I, which farmers sell directly to consumers, producers gross marketing margin is the highest in channel VI which is 79.4%.

3.2.2. Profitability of Potato Production in the Study Areas

In conducting profitability analysis of potato production, market prices for purchased inputs and output were considered. For inputs like family labor, exchange labor, own animal draft power, own land and other inputs which the households use in potato production without paying direct cost, its opportunity costs were used. Sampled farmers sold potato product in fresh form so the reference product was taken in fresh potato form. Prices differ per marketing channel, per quantity sold, change over the season, and even prices can vary during one single day. Therefore, weighted average price was used in analyzing profitability of potato production and marketing for the value chain actor.

Table 6. *Profitability analysis of potato producer sample farm households.*

Input cost Items	Average Cost	
	Birr/Qt	Production cost (%)
Labor cost	58.70	15.5
Seed cost	137.03	36.27
Land rent	57.32	15.17
Fertilizer cost	109.81	29.1
Oxen cost	12.80	3.4
Pesticide cost	2.15	0.57
Total cost	377.81	
Marketing cost		
Packing material	9.60	
Loading and unloading	6.60	
Transportation	19.50	
Broker	6.20	
Sell tax	0.18	
Other cost	20.40	
Loss	0	
Total marking cost	52.88	
Overall total cost	430.69	
Selling price	850	
Net return	419.31	

Qt = quintal, % = percentage, other cost implies opportunity costs
Source: Own survey result, 2021

As observed in Table 6, the average production cost of potato was 377.81 Birr/ Qt. Out of the total costs of production, seed accounts 36.27% of the total production cost which was major cost component in potato production in the study area. [4] found that the largest input cost was seed in production of potato in South and Tigray regions of Ethiopia. The average selling price was 850 Birr/Qt and net return of farmers from potato production was estimated at 419.31 Birr/Qt, which is 49.33% their selling price and 97.36% of total cost the area in the year 2020/21. This variation could be arising from types of market agency where farmers were selling and land allocation affected vegetables production profitability.

Table 7, depicts the total cost and net return of different actors from a quintal of potato. Retailers in general get highest net return of 168.8 Birr per quintal than other value chain actors followed by wholesalers and the least earner was collectors. Among actors, retailers earn highest percentage of net profit that was a net return about 17.88% of the purchase price. But this does not mean that retailers are generating more profit in total than other actors. Even if they get highest net profit per unit, they handle small quantity of potato than other trade actors of low total profit. This finding in line with [11] retailer earns the highest marketing margin from all other vegetable traders in East Shoa, Ethiopia. Wholesaler's total benefit is greater than the others because they handle large volume.

Table 7. *Cost, Marketing margin and profit margin of value chain actors.*

Cost items	Producers	Collectors	Wholesalers	Retailers	Total
Production cost	329.425	-	-	-	-
Purchasing price	-	850	950	1010	2810
Labor for packing	-	0	1.25	1.5	2.75
Loading and unloading	-	10	20	18.25	48.25
Transport	-	0	40	26	66
Packing material	-	10	10.5	13.2	33.7
Sorting	-	15	0	3	18
Telephone	-	12.5	56.25	19	87.75
Storage	-	15	0	-	15
Marketing cost	123.17	62.5	128	81.2	394.87
Total cost	452.6	62.5	128	81.2	724.3
Total cost (%)	54.5	7.52	15.4	9.8	100
Sale price	850	975	1175	1260	4260
Marketing Margin	520.6	125	225	250	1120.6
Share (%)	46.46	11.15	20.08	22.31	100
Profit margin	397.43	62.5	97	168.8	944.23
Share (%)	42.09	6.62	10.27	17.88	100

Source: Own computation from survey result, 2021

3.3. Econometrics Model Results

In this section the results of the econometric analysis on the determinants of the volume of marketed supply of potato is presented. Several variables are hypothesized to influence the volume of market supply of potato by sampled farmers. The results for all VIF values were ranges between 1.17 and 4.43. Likewise, the values of CC were ranging between 0.0001 and 0.25. Hence, multicollinearity was not a serious problem both among the continuous and discrete variables. Heteroscedasticity was tested by running heteroscedastic regression using Stata statistical software. There was no serious problem of Heteroscedasticity in the model. And hence all the explanatory variables were included for the model analysis of determinants of market supply of potato. The problem of endogeniety occurs when an explanatory variable is correlated with the error term in the population data generating process, which causes, the OLS estimators of the relevant model parameters to be biased and inconsistent. Test of endogeniety showed that that there is no problem of endogeneity problem.

The overall goodness of fit of the regression model is measured by the coefficient of determination R^2. R^2 Values of the model were 0.91 which tells what proportion of the

variation in the dependent variable is explained by the explanatory variable. R^2 lies between 0 and 1, the closer it is to 1, and the better is the fit. Hence, the overall model goodness of fit represented by model count R-square is very good and this result indicates that about 91% of the variation in marketed supply of potato was attributed to the hypothesized variables in the study area. In table 8, estimates of the parameters of the variables expected to determine volume of potato marketed are presented. There are 6 continuous and 15 dummy independent variables of which 9 variables significantly affect the market supply of potato at less than 1% and at 5% significance level.

Table 8 below presents the results of the estimated effects are discussed in terms of the significance and signs on the parameters. The positive estimated coefficients of a variable indicate that the probability of the producers being in either supplying increases as these explanatory variables increase or changed from level of attribute to other level of attribute for dummy variables. The implication is that the amount of the producers to be supplied to market is appreciated by those factors positively affected. The negative and significant parameter indicates the volume of the potato supplied to the market decreasing in increasing or from the border of level of categorical variables. Estimates not significantly different from zero indicate that the explanatory variable concerned does not affect the supplying of the producers decision to the market. The result of the multiple regression and their possible explanations are presented below.

Table 8. Results for factors influencing volume of potato supplied to market in Bore and Ana Sora districts.

Volume	Coefficient	Std. Err.	Tcal	P>t
Sex	-1.192	3.720	-0.32	0.749
Age	0.162	0.075	2.16	0.034**
Education level	1.101	1.673	0.66	0.512
Marital Status	0.491	1.777	0.28	0.783
Market Distance	-0.077	0.047	-1.65	0.103
Cooperative member	6.096	2.712	2.25	0.027**
Family Size	0.131	0.205	0.64	0.525
Land owned	-0.505	0.569	-0.89	0.376
Transport facility	-1.799	2.025	-0.89	0.377
Potato production Experience	0.451	0.265	1.7	0.092*
Production amount	0.783	0.051	15.39	0.000***
Amount Consumed	-1.055	0.352	-2.99	0.004***
Information access	4.491	2.574	1.74	0.085*
Off farm income	3.524	1.713	2.06	0.043**
Credit access	10.821	4.099	2.64	0.01**
Total Livestock Unit (TLU)	0.183	0.210	0.87	0.385
Constant	-6.697	9.550	-0.7	0.485

(N = 141, F (15, 87) = 108.5, Prob >F = 0.000, R^2 =91.04, RMSE = 9.163) *, **, *** is significant at 10 %, 5% and 1% respectively

Age of household head: as expected age of household head significantly and positively affected potato market supply at 5% significance level. The result identified that one-year increase in age of households increase the quantity of the potato supplied to market by 0.162 quintal keeping all other factors constant. It implies aged farmers share greater experience of deciding to share land for producing the potato and supply to market.

Membership to any Cooperatives: Membership in any cooperative determines farm household's potato market supply. As hypothesized the coefficients for this variable is positively and significantly related with volume of suppliers at 5% significance level. This result indicated that those households who were members of cooperatives supply increased by 6.096 than No-members in bore district. This is mostly related to the reality that those multipurpose cooperatives passing down production and market information they accessed directly or indirectly to their members.

Potato production experience: The potato production experience of households affected potato market supply positively and significantly at 1% significance level. The model result implied that as production experience increase by one year, the quantity of potato supplied to the market increases by 0.451 keeping others factors constant. This means the potato producers with more experience in potato production and marketing supplied more 45.1 quintal to market than less experienced due to their having more knowledge in potato management and marketing network. This result is in line with finding of [25, 3] illustrated the positive relationship between beekeeping experience and volume of honey supplied to the market.

Potato Production (Output): As result in table 8 revealed quantity of potato production has a positive and statistically significant relationship with quantity of potato market supplied. For variables, positive coefficient indicates that an increase in production in a one quintal unit of potato increases market supply of potato by 0.451in the study area (Table 8). This finding is congruent with [30] report of potato production output positively and significantly influenced the extent of market participation. Amount of potato used in household consumption was statistically significant and negatively affecting the volume of potato market supply.

Information access: The finding also described that Access to market information is positive and significantly affect the quantity of potato supplied to the market indicating that, producers who has potato related market information access

will increase their supply to market by 4.491 quintals than those who hasn't obtain market information in bore district (Table 8). This shows that access to market information like where to sell, how to sell, when to sell and price information plays a pivotal role in deciding the amount of potato to be supplied to the market. Updated and current market information accessed through different sources like radio programs, telephone services, personal observations, from other traders or from extension agents encourages farmers to produce more. This leads to an increase in marketed supply of potato. This finding is similar with findings of [23], [1] and [24] declaring that access to market information by household heads increases marketed supply agricultural products.

Access to credit: Access to credit: Farmers' access to credit as hypothesized significantly and positively affected the quantity of a groundnut supplied to market at 1% significance level. It indicates that farmers who had accessed to credit service supply more by 10.821 quintal than who did not access. This might be due that credit enables farmers to purchase improved varieties, fertilizers, oxen, hire labor, and other supplementary machineries which could help them to produce larger quantity of a potato and supply more to market. The research finding of [6], [19], [17], and [18] are in line with the result of this study. Similarly, [7] reported that in poor societies, lack of credit is a major constraint to everyone concerned with selling and buying of honey.

3.4. Constraints and Opportunities in Potato Value Chain

Even though potato is widely grown and marketed for a long time in the study area, farmers face many constraints. In the study area, shortage of improved seed, disease, credit availability, pesticides, shortage of fertilizer and insect pests, product perishability and low linkage with value chain actors, low price, and lack of market information and low consumer demand and collective marketing were some of the Problems existing at farmers in potato value chain.

Limited access to supply of agricultural inputs: The most important physical inputs for potato production are improved seeds, fertilizers and pesticide or herbicides. Farmers replied limited access and supply of inputs like improved seed as their production problem due to absence of potato seed multiplying and distributing enterprise where farmers get inputs from informal seed system they purchased from private traders or prepare their own seeds locally and remoteness of input supplying site for chemicals and often for fertilizers. As farmers reported that supply of agricultural input of improved seed, fertilizer and pesticides shortage accounts 80.9% as a problem in the locality.

Diseases and pests: A proportion of the respondents reported that diseases (12.1%) and pests (0.7%) was not severe problem of farmers for currently producing potato. According to key informant interview with agricultural experts' bacterial wilt, late blight diseases and insects were the major problems prevalent in the area. It is possible to control late blight disease by using chemicals but bacterial wilt is becoming a major limiting factor for potato production

in all seasons mostly occurred in rain fed and residual production systems that remains unresolved till now. According to key informant interview with *Bore* Agricultural Research center researcher the main causes of widespread of disease in the area were improper potato farm management practices and not practicing crop rotation (Table 9).

Table 9. Potato production and marketing constraints.

Constraints	Respondents	Percentage
Production constraints		
Improved varieties	104	73.8
Insect pests	1	.7
Disease	17	12.1
Credit availability	9	6.4
Fertilizer	4	2.8
Pesticides	6	4.3
Marketing Constraints		
Market information	15	10.6
Market distance	3	2.1
Low price	38	27.0
Low consumer demand	20	14.2
Transportation facility	2	1.4
Brokers	8	5.7
Poor linkage of with actors	39	27.7
Low quality of product	3	2.1
Storage	13	9.2

Source: Own survey result, 2021

Postharvest and marketing problems: The use of traditional harvest tools resulted for poor product handling, perishability and lack of proper storage facility among postharvest problems and, low price and poor linkage of value chain actors, absence of formal marketing information and far market distance as the problems they are among marketing problems occurred in potato farmers. Poor linkage with value chain actors and low price was the main problem of farmers in the study area, about 27.7% and 27% of the sample farmers replied that poor linkage with value chain actors and low price are their marketing problem respectively (Table 9). Potato selling and buying process is mainly undertaken at farm gate and pricing is usually estimated mostly at farm field before harvested and others estimated by using sack as if it were standard measurement which is considered as defective. Storing potato is almost not practiced in the study area. The main benefit of storage helps the farmer to sell when the price is good but the result indicated that farmers were not benefited because a majority of farmers do not had a modern way of storage.

The problems identified by traders in the value chain were, poor product handling resulted in low quality of product (perishability and absence of storage facility), credit availability, price fluctuation, administrative problems (lack of sectorial support), inadequate information and lack of demand were the most important problems which have been raised by traders. Traders reported absence of proper storage facility and product perishability as the main problems in potato trading which cause price fluctuation and lower price. About 37.5 % of the traders reported that low quality of potato product of the area as a problem. Lack credit for

trading to the area (25%), price fluctuation (12.5%), limited information (8.3%) and absence of government support and lack demand (4.2%) each was the major problems at consumption level of potato value chain (Table 9). Researchers were identified a wide range of challenges in vegetables value chain in Nepal, problems with respect to inputs like unavailability of fertilizers, low quality seeds, poor linkage and coordination among value chain actors, problem of trust between value chain actors, limited collection centers, unreliable market information, and lack of proper post-handling and transportation and lack of proper operation guidelines were hindrances of well performance of vegetable value chain.

Suitable agro ecology, presence of experienced and interested farmers in production of potato, the support of different NGOs'(like SASAKAWA) and governmental organization (district agricultural offices and Bore agricultural research center), the presence of FTC and PA agricultural office at PA level which are playing great role in improving farmers livelihoods regarding potato production. On the other hand, availability of market demand throughout the year, growing number of buyers, high experience in potato production and marketing were some of the opportunities of potato. The natural proximity to market and being found on high demanding cites Adola, Shakisso, Hawassa, Negele and Somali region. Potato also consumed by both rural and urban societies across in all income groups taken as a good opportunity.

Table 10 *Potato marketing constraints of traders.*

Constraints	Number of respondents	Percentage
Credit	6	25.0
Price	3	12.5
Lack of demand	1	4.2
Inadequate information	2	8.3
Quality problem	9	37.5
Absence of government support	1	4.2

Source: Own survey result, 2020

4. Conclusion and Recommendations

4.1. Conclusion

In the study area potato is the most important and widely known cash crop mainly produced for the market. This study focused on identifying potato market chain actors and channels and factors that affect the volume of potato marketed in the study area. Simple random sampling was used based CSA (2018) report of 14547 potato producers' households of the study area on where 141 household producers was selected using [29] sample size determination with 0.085 margins of error.

Both primary and secondary sources were used. The primary data were collected from 141 producers 24 traders and 13 consumers. The survey result indicated that on average 6568 quintals of potato produced by sample smallholder farmers. Out of the total potato produced in the study area 89.8% (5897Qt) was supplied to the market and distributed through farmers to consumers. The most important market actors of potato market chain are producers, wholesalers, retailer, rural collectors and consumers. About six marketing channels were identified in transferring 5897Qt of potato from producers to final consumers. In terms of volume of potato transacted Channel III was the dominant channel in the study area.

Multiple linear regression models was used to identify determinants of volume of potato supplied market. The result of the regression models indicates that among 16 explanatory variables hypothesized to determine the household level of market supply of potato were Age, potato production experience, potato production output, amount of potato consumed, cooperative member, information access, off farm income and credit access were important variables determining potato supply market in the study area.

4.2. Recommendations

To improve the value chain of potato in the study area, it is important to work on promoting and encouraging the production and dissemination of quality seed systems since the area is suitable for seed and ware potato production. Furthermore, strengthening provision of training on proper farm management and postharvest handling and strengthening primary cooperatives financially and technically that can supply inputs and at the end it purchase the product to sell to distance areas at premium price to benefit the potato farmers there by facilitating use of common transport; exchange of marketing information by strengthening negotiation.

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