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Research Article

Determinants of Rice Market Supply and Profitability on Smallholder Farmers in North Western Ethiopia

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Abstracts

Rice is a new crop in Ethiopia, and demand is increasing. Currently, rice growing areas are quite far from their potential, and the government is forced to import huge quantities of rice to meet domestic consumption due to insufficient production and market supply. The study focused on the factors influencing rice market supply and profitability for smallholder farmers in Pawe, North Western Ethiopia. Purposive and simple sampling techniques were used to choose target kebeles and respondents. The quantitative data were gathered from 185 farmers and 16 traders following triangulation of the qualitative data via focus group discussions and key informant interviews. Descriptive and inferential statistics were used to analyze the quantitative data that comprise gross margin analysis. A multiple linear regression model was used to analyze the factors of rice market supply. The findings revealed that farmers, local traders, wholesalers, and retailers were the main actors in rice marketing in the area. The results showed that retailors obtained the highest gross profit of 289.25 birr from paddy and 580 birr/100kg from milled rice. The regression analysis revealed that education level, farming experience, rice-allocated land, productivity, training, lagged price, and frequency of extension contact are all positively and significantly associated with rice market supply, whereas household size and market distance have been negatively and significantly associated with market supply. Therefore, it needs placing greater focus on each positive and significant variable in order to improve rice market supply and better connect it to rice value chains, ensuring sustainability of market supply.

Keywords

Market Supply, Rice, Multiple Linear Regression Models Margins, Pawe District

1. Introduction

Rice is a staple food for about 3.5 billion people worldwide, grown on four continents: South and Southeast Asia, Africa, Latin America, and Asia [1]. China is the world's largest producer, accounting for over 25% of global rice production [2]. In sub-Saharan Africa, rice is a vital crop for food security, grown under three different environmental conditions: irrigated lowland, rain fed lowland, and rain fed upland [3]. From the five staple crop consumed in the region, rice ranks the

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second most consumed crop next to maize with 11.4% of the daily per capita caloric intake especially in the western parts of Africa [4]. From 2009 to 2019, the average annual rice consumption in sub-Saharan Africa was 27.4 million metric tons [5]. In addition to this the Statista's, (2021) report shows that, 16.6 million metric ton rice was imported in Africa during the period 2020/2021 and most of the importers are sub-Saharan African countries. An estimated 14.5 million metric tons of rice are produced annually in sub-Saharan Africa, accounting for 15% of the region's total production of cereal crops [6].

Rice is a new crop in Ethiopia in comparison to other cereals, and the Ethiopian government has devised national rice research and development programs to promote and focus on the rice sector in order to ensure food security. Currently, about 43 improved rice varieties were adapted [7]. The ploughed rice land in 2007 was 24,434 hectares, which increased to about 85,288.87 hectares by 2021. At the same period, production has climbed from 713,160 quintals in 2007 to 2,682,235.14 quintals in 2021. Furthermore, the number of rice growers grew from 61,862 to more than 178,185. The need for rice crops increases from time to time.

Following the Dergue resettlement program and the establishment of the Pawe agricultural research center, the rice crop was introduced in the study area/Pawe in 1985 [8]. Between 2019 and 2022, the total cultivated land for rice production and yield increased from 1,728 ha to 3,386ha and 55,449 qt to 111,738 qt, respectively. This demonstrates that, despite the fact that the rice crop was just recently introduced to the area, due to its importance for household consumption and revenue, production and area coverage are rapidly increasing. Both milled and paddy rice was operated for sales, and farmers in the region mostly consumed milled rice.

Various studies have identified the factors that influence market supply of various cereal crops such as wheat, teff, and maize including the rice crop and different scholars looked into the obstacles and opportunities associated with various agricultural production methods [9-11]. Farmers in the region produce rice crop for both consumption and generating cash; however the quantity they supplied to the market is not as expected. There is little study available in this field to discover the factors that influences the quantity of rice market supply. Furthermore, producers have restricted access to documents about marketing routes and crop prices. As a result, this study addresses a gap in knowledge about the factors that influence the quantity supply of rice and its profitability in the area.

2. Research Methodology

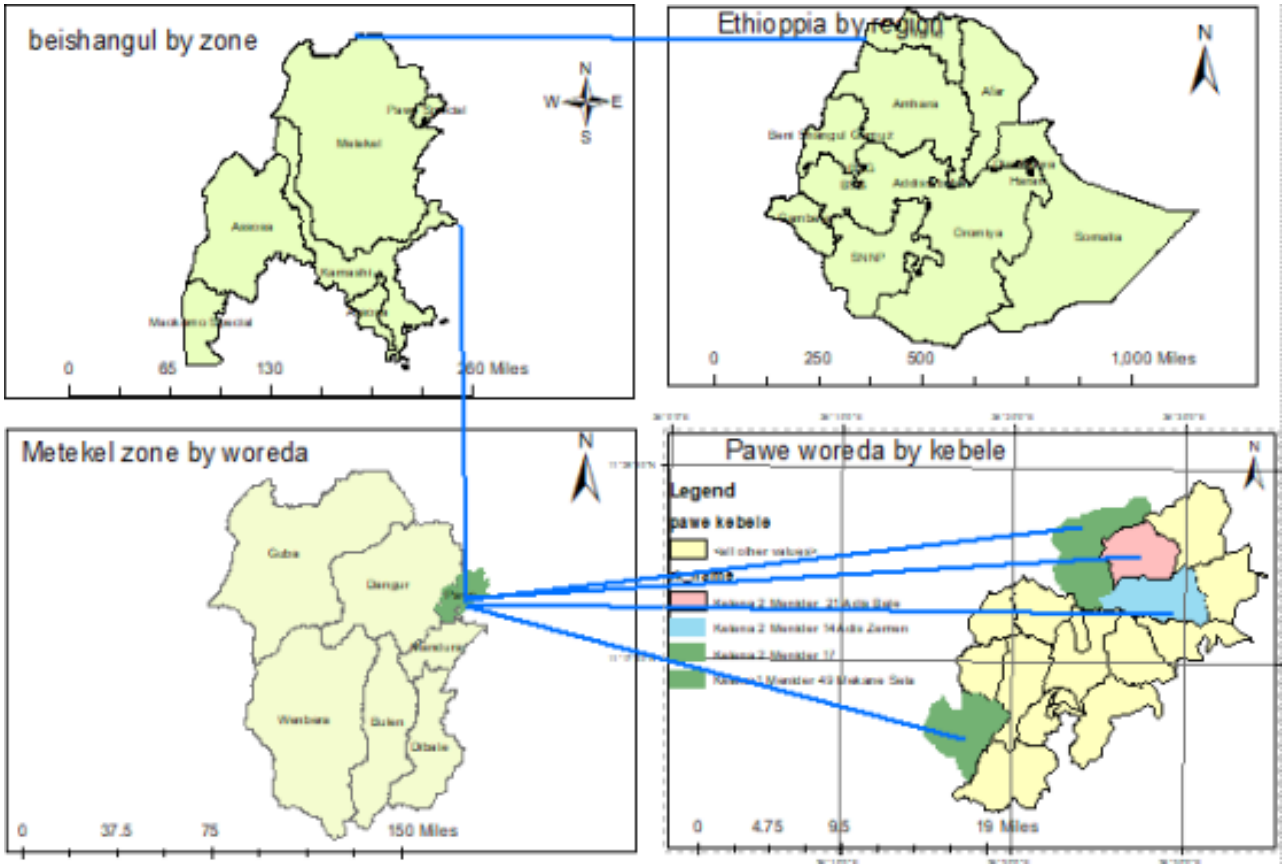


Figure 1. Map of the study area 2.2. Sampling Techniques and Procedures.

2.1. Description of the Study Area

The study was carried out in the Pawe districts of Metekel zone. The district is located 575 kilometers away from Addis Ababa. The District is located at 11^0 09' N and 36^0 03' E. The average elevation is 1120 meters above sea level. In the previous 30 years, Pawe had 1582 mm of annual rainfall and an average temperature of 32.7 ℃; also, the area covered 64,300 hectares in total. Of this, 50.4% is arable land. In addition to rice, the district farmers cultivate maize, sorghum, groundnut, sesame, and soybeans as their main crops. Aside from grain cultivation, the sale of live animals and animal byproducts such as dairy milk, cheese, and butter provided additional revenue for farmers.

Farmers in the district have a number of opportunities for rice production, including the existence of the Pawe Agricultural Research Center, which releases a number of adapted and suitable improved rice varieties for the area; 60% of the arable land is suitable for rice production; and the crop becomes well-known for both consumption and income generation due to its market value when compared to other cereal crops in the area.

The study was carried out in Metekel zones of north western Ethiopia in 2021 cropping year. The district was selected purposively to carry out the study due to the suitability of agro-ecological and great potential for rice production. The samples for this study were selected from rice producer kebeles of the district. To select sample households in the study a multistage sampling technique were engaged. In the first stage, out of 20 kebeles in the district, 18 kebeles were identified as rice potential kebeles for selecting the required sample kebeles. In the second stage, 4 kebeles were selected by simple random sampling technique from 18 kebeles. Finally, 185 sample respondents were selected from randomly selected kebeles based on proportional size to the population by using simple random sampling techniques.

2.2. Sample Size Determination

By using [12] formula, the required sample sizes were selected with the accuracy/precision level of 7% from each sample kebele. Since almost all farmers in Pawe district are rice producers, have similar farming system, agro ecology and there is no high degree of variability regarding rice production among farmers. This is the reason that the precision level lies on 7%. There for by using the above formula the required sample size was calculated as follows;

$$n = \frac{N}{1+N(e^2)} = n = \frac{2056}{1+2056(0.7^2)} = 185$$

Where, n= the required sample size N= the total population size e = the level of precision.

Table 1. *Sample size distribution in the studied kebeles.*

Village	Total household	Sample Size	Proportion
Village 14	565	51	27.57
Village 16	365	33	17.84
Village 21	425	38	20.54
Village 24	701	63	34.05
Total	2056	185	100

Source; own computation from survey, 2022

A simple random selection process was used in the sample frame to choose 185 farm families using the preceding formula. The study collects data on socioeconomic factors such as education, rice cultivated land, access to credit, rice production and management system training, lagged price, rice productivity, participation in off/on farm income activities, frequency of extension contact, market distance, access to market information, and cooperative membership. Additionally, market data were gathered from rural collectors, wholesalers, and retailers.

2.3. Method of Data Collection

In the study, both qualitative and quantitative data were collected utilizing several data gathering approaches. To triangulate the results, focus group discussions were held in each sample kebeles. Farmers were carefully selected for the focus groups based on their expertise producing and marketing rice. In this study, both primary and secondary data were obtained. Published and unpublished data were examined. Each sampled respondent was interviewed face-to-face.

2.4. Method of Data Analysis

The quantitative data were analyzed through SPSS and STATA software packages and Likert scale and narratives for the qualitative ones.

2.4.1. Descriptive Statistics

Descriptive statistics such as mean, standard deviation, frequency distribution, and percentages were used to provide a clear image of the characteristics of sample units. Similarly, tables and graphs were employed to convey the information. The mean statistical difference between the continuous dependent variable and the independent variables was determined using inferential statistics such as the t-test. In addition, one-way ANOVAs were employed to show the mean difference between each set of categorical variables and the de-

pendent variable. The use of one way ANOVA in this study is due to the presence of more than two groups of education level and extended contact. The occurrence of a multicollinearity problem for continuous and dummy variables was investigated using variance inflation factors and the contingency coefficient.

2.4.2. Marketing Margin Analysis

To calculate the marketing margin, the responses were categorized, and descriptive analysis was performed using SPSS and Excel. The formula for estimating the marketing margin is shown below:

$$\text{TGMM} = 1 + \frac{consumer\ price - producer\ price}{consumer\ price} * 100\%$$

Where TGMM refers total gross market margin.

To compute the marketing margin first total gross marketing margin will be calculated. That is the difference between the price of producer and consumer price. So that the marketing margin of a given stage will be computed by the following way;

$$\text{GMMi} = \frac{spi - ppi}{TGMM} * 100$$

Where Spi = is the selling price of the commodity at ith stage.

Ppi = is the purchase price of the commodity at ith stage.

The trade margin of this study will be calculated with the average prices of the commodity at each level of market chain and the various cost experienced by each actor in the marketing channel.

Total Gross Profit Margin will be conducted as follows;

$$\text{TGPM} = \text{TGMM} - \text{TOE}$$

Where TGPM = is refers total gross profit margin.

TGMM = refers total gross marketing margin.

TOE = refers total operating expenses.

2.4.3. Econometric Analysis

Various models can be employed to analyze the determinants of market supply of different crops. The commonly used model is multiple linear regression, Tobit and Heckman's sample selection models. Since all sample farmers supplied rice to the market, the ordinary least squares model (OLS) was used to assess the determinants influencing rice market supply. If not all of the sample homes are rice market suppliers, using multiple linear regression causes selectivity bias. If we want to analyze the chance of selling a certain commodity, Tobit or Heckman models are used to analyze market supply [13]. In our instance, every sample home produces and sells the chosen crop. The statistical techniques used to evaluate the connection between dependent and independent variables are known as the ordinary least squares model.

The specification for this supply function is given below;

$$Y_i = X_i\beta + U_i$$

Where Y_i = quantity of rice that sample households supply to the market.

X_i = independent variables that affect rice market supply.

i= 1, 2, 3……, n^{th}.

β = the coefficient of the variable.

Ui = the disturbance term that affect rice market supply.

Diagnosis testing

Before running the multiple linear regression models, the Variance Inflation Factor (VIF) was used to determine whether there was significant multicollinearity among the independent variables. As a general rule, a VIF larger than 10 indicates that the variable is strongly collinear. In this study, the result of the variance inflation factor ranges in b/n 1.06 and 2.81 which have an average result of 1.63. This result shows that there is no multicollinearity problem between the explanatory variables that were included in the model. The other assumption in multiple linear regressions is that, the error term variances are constant (homoscedastic). If this assumption is not met, the OLS estimators will either fail to be the Best Linear Unbiased Estimator (BLUE) or become inefficient. The regression estimate will also be inefficient due to heteroscedasticity, which might be attributed to outliers in the sample. Hypothesis tests are no longer valid due to inconsistencies in the covariance matrix of the predicted regression coefficients. Therefore, a test for heteroscedasticity is necessary. For this study, the approach used to detect heteroscedasticity is Breusch–Pagan test. This test is designed to detect any linear form of heteroscedasticity in a linear regression model and undertakes that the error terms are normally distributed. It compares the null hypothesis that the error variances are all equal with the alternative that the error variances are a multiplicative function of one or more variables. The overall fitness of the regression model was measured by the coefficient of determination (R^2). The value of R^2 was 0.86 or it lies between 0 and 1, which is closer to one that shows better fit of the model [14].

Among the different variables affect market supply, the most common variables according to the reviewed literature and from preliminary observation include; Age, sex, education level, household size, farm experience, rice cultivated land, productivity, off/non-farm income, frequency of extension contact, credit, training, lagd price, market information and market distance [15, 16]. The dependent and independent variables, their definitions, and hypothesized signs are shown in Table 2 below.

Table 2. Symbol, definition and hypothesized sign of variables.

Variables	Type	Measurement	Expected sign
Quantity of rice supply	Continuous	The quantity of rice supplied to the market/quintal	
Age	Continuous	number of years of respondents	-/+
Sex	Dummy	1= male and 2 = female	-/+
Education level	Categorical	1 illiterate, 2 read and write 3 primary school, 4 secondary school 5 preparatory 6 above	+
Household size	Continuous	Total households members	-/+
Farm experience	Continuous	Total number of years in farming	+
Rice cultivated land	Continuous	Total land allocated for rice/hectare	+
Productivity	Continuous	Productivity of rice /quintal	+
Off/non-farm income	Dummy	1= yes and 2= no	-/+
Frequency of extension contact	Categorical	1 rarely, 2 once a month, 3 twice a month, 4 weekly, 5 daily	+
Credit	Dummy	1= yes and 2= no	-/+
Training	Dummy	1= yes and 2= no	+
Lagd price	Dummy	1= yes and 2= no	+
Market information	Dummy	1= yes and 2= no	+
Market distance	Continuous	Distance to nearest market in walking minutes	-

3. Results and Discussion

3.1. Demographic and Institutional Characteristics of Sample Households

The demographic features of the households include age, sex, family size, and farming experience. The sample household in the research had an average age of 46.72 and a standard deviation of 9.43. This indicates that the majority of sample households were determined to be in the working stage. In the other way, the sample household head had an average household size of 4.82 with a standard deviation of 1.71. The respondents' mean total farming experience was 17.74 years, with a standard deviation of 8.8. In the area there are a few institutions that are crucial for supporting the farming activities of the local households. Some of the institutions are; agricultural extension offices, marketplaces, and cooperatives. The descriptive data revealed that the average walking distance between FTC and sample household heads was 29.58 minutes, with a standard deviation of 19.94. Because of the availability of improved seeds via community-based seed multiplication, sample households in the region purchase seeds from a variety of sources. At the same time, fertilizers were obtained from several co-operatives in the village. On average, the respondents traveled 47.70 minutes on foot to buy improved seeds from their nearby markets. Moreover, the average walking distance from the household buying fertilizer was 47.21 minutes. On the other hand, the mean distance of the nearest market where the household sells their produce was found to be 54.41 minutes with a standard deviation of 45.35. The study involves both male and female sample households. 76.2% of the 185 sample households were headed by men, with the remaining 23.8% led by women.

Table 3. Demographic and institutional characteristics of households.

Variables N=185	Mean	SD.
Age	46.72	9.43
Family size	4.82	1.71
Farm experience	17.74	8.87
Distance_FTC	29.58	19.94
Distance to buy seed	47.79	44.7
Distance to buy fertilizer	47.21	49.68
Nearest market distance	54.41	45.35
Category	Frequency	Percent
Sex Male	141	76.2

Variables N=185	Mean	SD.
Female	44	23.8

Source; own computation from survey, 2022
SD=standard deviation

The results illustrated in Table 4 below showed that the average quantity of rice supplied to the market by the households who participated and did not participate in non/off-farm income activity was 12.48 and 23.64 quintals respectively. The result of the t-test (-4.77, $p < 0.01$) indicated that there was a significant mean difference between the two groups in terms of the quantity of rice market supply at a 1% significant level. The negative sign of the t-value implies that farmers who participate in non/off-farm income activity supplied fewer products to the market than those households that are not participating in non/off-farm income activities. This might be due to those households who have non/off income alternatives cannot be involved in rice production intensively which causes the limited supply of rice by those groups. The result agrees with [17] who found that participation on non/off-farm income has a negative relation with the quantity of maize market participation to the market.

In the 2021/2022 production season, the average quantity of rice supply to the market by families that received training in rice production and management practices was 37.55 quintals, compared to 11.09 quintals for those who did not. The t-test result (12.78, $p < 0.01$) shows that there was a significant mean difference between the two groups in terms of rice market supply at a level of significance less than one percent. This might be because households with access to training can have up-to-date information and awareness on the application of rice technology with the required packages, producing considerably more than their competitors and supplying more rice to the market.

During the 2021/22 cropping season, 36.75% of households accessed market information, and the rest 63.25% of the household didn't access the information. The results depicted that the mean value of rice supplied by those households who accessed market information and those who didn't access market information was 32.03 and 9.22 respectively. The result of the t-test (11.83, $p<0.01$) is evidence for the presence of a significance mean difference between the groups in terms of the quantity of rice market supply. The Positive sign of t-value implies that households who accessed market information can supply more rice to the market as compared to those households who didn't access market information. This is because informed households can supply more products according to the information they gain by considering the situation of the market price.

From the total of 185 sample households, 55.67% were cooperative members, while the remaining 44.33% were not. Rice was delivered to the market by both cooperative members and non-members in the area. According to the study's findings, the average quantity of rice given to the market by cooperative members was 22.56 quintals, while non-member families contributed 11.38 quintals. The t-test result (4.77, $p<0.01$) indicates that there is a statistically significant difference in the amount of rice provided to the market between cooperative members and non-members. The positive sign of the t-value suggests that cooperative members of the household supplied more rice to the market as compared to non-cooperative members. The possible reason for this is that households in a cooperative can get agricultural inputs easily, which can help to produce more outputs, they can access information and share experiences from their relatives about rice production to supply more rice to the market. More than half of the respondents were cooperative members however; most of the households use the cooperative for buying inputs like fertilizer and improved seeds. They sell their rice crops to different traders like local traders, wholesalers, retailers, and consumers since rice crops are not sold and purchased at co-operative levels like that of oil crops in the area.

The average quantity of rice supplied to the market by households who accessed for credit and didn't access to credit in the 2021/22 cropping season for rice production and management was 28.73 and 10.68 quintals respectively. The result of the t-test (8.35***) indicates that there was a significant mean difference between the two groups in terms of the quantity of rice market supply at a 1% level of significance. The possible reason for this is that those households who accessed credit can buy agricultural technologies like improved seeds and fertilizers to maximize their rice production and productivity to supply more product of rice to the market. The finding agrees with [16].

Table 4. *Relations of quantity rice market supply with categorical variables.*

Variable N=185	Category	Response	Percent	quantity of rice supply to the market		
				Mean	SD	t-value
On/off farm participation	Yes	100	54.05	12.48	9.32	- 4.77***
	No	85	45.95	23.64	21.06	
Training	Yes	46	24.86	37.55	21.75	12.78***

Variable N=185	Category	Response	Percent	quantity of rice supply to the market		
	No	139	75.14	11.09	6.57	
Access to market information	Yes	68	36.76	32.03	20.08	11.83***
	No	117	63.24	9.22	4.35	
Cooperative member	Yes	103	55.68	22.56	19.25	4.77***
	No	82	44.32	11.38	9.98	
Access to credit	Yes	71	38.38	28.73	16.05	8.35***
	No	114	61.62	10.68	13.07	

Source; own computation from survey result, 2022

3.2. Extension Contacts and Education Level of Rice Producer

From the total 185 sample households, 5.4% of rice producers contact extension agents daily, and (31.4%) of the sample households get extension contact rarely. The ranges of the extension contacts lies between daily, weekly, twice a month, once a month, and rarely. According to table 5, the result of the analysis of variance ANOVA (F = 13.114, p = 0.000) is evidence for the presence of a statistical mean difference between the groups regarding the volume of rice supplied to the market. The finding by [18] confirmed that, the frequency of extension contact positively and significantly affects the quantity of beef cattle market supply at less than 5% significant level. Research findings can be changed into practice by farmers through the help of extension professionals working in the area. Development agents are the major providers of extension services for farmers and they are expected to assist farmers in their application of improved agricultural technologies. Farmer's education was essential for every aspect of life. The education level of sample households ranges from illiterate up to college and above. Out of 185 sample households (7.6%) were illiterate, (41.1%) could read and write, (23.2%) had primary school completion, (12.4%) secondary, (9.2%) preparatory and the rest were above. According to the results of the analysis of variance (ANOVA) indicated in table 5, the value of (F=26.819, p=0.000) indicates that there was a statistically significance difference between the groups in terms of the quantity of rice supplied to the market. The possible reason for the significance difference in education level in terms of the quantity supplied to the market is that to understand the use and application of agricultural technologies education is essential. As the education level of the household increases the awareness and understanding of the household also becomes increase in the production and marketing aspects of rice crop.

Table 5. *The ANOVA results of Extension contacts and education level of rice producer.*

Source of variation	Sum of square	Df	Mean square	F	Sig.
Extension contact					
Between group	11646.67	4	2911.668	13.114	0.000
Within group	39965.31	180	222.029		
Total	51611.98	184			
Education level					
Between group	22104.97	5	4420.995	26.819	0.000
Within group	29507.01	179	164.844		
Total	51611.98	184			

Source: own computation from survey result, 2022

3.3. Rice Market Channel

In the study area, producer farmers sold their grains to various purchasers. The sum they sold varied depending on the customer. Producers, local traders, wholesalers, and retailers are the primary participants in rice buying and selling, whereas investors and consumers only buy rice for seed and consumption purpose respectively. According to the survey results, sample smallholder producers produced a total volume of 5,801 quintals of rice during the 2020/2021 production season. From this production volume, 56.17% (3,258 qt) was delivered to the market via various marketing channels. The remaining 36.52% and 7.31% are used for household consumption and stored for seed purpose for the next crop season, respectively.

Channel I: Producer ----- consumer: it is the shortest from the other channels that producers sell their products directly to consumers without the involvement of other actors. Producers sold their rice products to end users for consumption. In this channel 8.8% of the produce from the total quantity was sold.

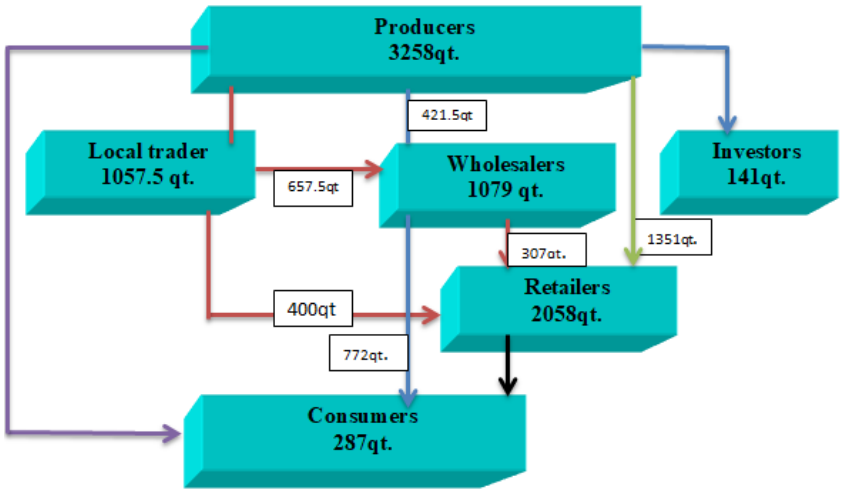
Channel II: Producer ---investors: investors are those engaged in rice cultivation activities in large areas. As the first channel this also the shortest channel that farmer sold their paddy rice products directly to investors for seed purpose. From the total volume of rice supplied to the market, this channel accounts (4.35%).

Channel III: producer-------wholesaler------consumer: in this channel producers sold their rice products to the wholesalers. Of the total 3,258 quintals marketed product 23.69% was passed through this channel. This is the second channel in terms of quantity sold.

Channel IV: producers-------retailers-------consumers: The majority of produced rice was sold in this channel and covers 41.47% of the total quantity of rice sold among all marketing channels. In this channel, producers sell their rice produce to their nearby retailers, and the retailers distribute it to the consumer.

Channel V: producers-----local traders-------retailors-----consumers: this is the second-longest channel in terms of marketing channel. 12.28% of rice was sold along this channel.

Channel VI: producers------local traders------wholesalers-----retailors-----consumers: this is the longest marketing channel in the study area in terms of quantity sold this channel is the third channel. A total quantity of 307 qt (9.42%) was sold through this channel.



Source: own computation from survey 2022

Figure 2. *Rice marketing channels of the study area.*

3.4. Marketing Margin Analysis

Identifying the production cost of rice producers is an essential task in describing marketing margin. Thus the cost of production and profit share of actors were described below. The survey results in Table 6 below showed that, the total production cost of rice producers was 23,162.86 birr/ha and 21,665.01 birr/ha both in the case of milled and paddy rice production respectively. From the total sample households, 74.59% sold their rice produce in milled form, and 25.41% of the producer sold in paddy form. Those households sold their rice in the form of paddy, obtained a total of 26,676 birr/ha and when households sold milled rice, received a total of 30,581.45 birr/ha this implies that 3,905.45 birr additional income was received due to sold in the form of milled rice. As a result of the survey, households got a gross profit of 5010.99 birr/ha and 7423.17 birr/ha in case selling of paddy and milled rice respectively. 2,412.18 birr/ha were the gross profit losses when they sold paddy rice. On the other hand households

without including cost of family labor can receive better income. When Households sell paddy rice their income with and without including family labor was 5010.99 and 10962.04 birr/ha respectively. The highest cost was incurred during the time of weeding followed by fertilizer purchasing and harvesting with the respective cost of 3993.03, 3190.74, and 2571.64 ETB/ha.

Table 6. Rice production cost.

Expense type	Cost/ha	Share (%)
Purchasing of seed	1794.23	7.75
buying of NPS and UREA	3190.74	13.78
Purchasing of herbicides	1083.54	4.68
Land rent	1200	5.18
Land preparation	400	1.73
Sowing	1200	5.18
Fertilizer application	400	1.73
Herbicide application	400	1.73
Rented ox	1777.7	7.66
Weeding	3993.03	17.24
Harvesting	2571.64	11.10
Skein collection	750	3.24
Threshing	600	2.58
Packaging material	293.88	1.27
Milling service	1497.85	6.47
Transportation to the house	577.98	2.50
Market transportation	1432.27	6.18
Total production cost	23162.86	100

Source; own computation from survey result, 2022

According to the survey results, labor was the major factors for production of rice. From family labor and daily labor, the highest cost which is 5,957.05 birr/ha was incurred for family labor and 3,607.62 birr/ha was incurred for daily labor. In relation to this, weeding cost including purchasing of herbicide took the highest share than the other cost type which is 5,076.57 birr/ha.

Table 7. Cost of family and daily labor.

Cost type	Cost of family labor birr/ha	Cost of daily labor birr/ha
Fertilizer application	400	-
Sowing	600	600
Herbicide application	400	-
Land preparation	400	-
Weeding	2267.06	1725.97

Cost type	Cost of family labor birr/ha	Cost of daily labor birr/ha
Harvesting	1289.99	1281.65
Collecting skein	600	
Total	5957.05	3607.62

Source; own computation from survey result, 2022

In the production season households produced an average of 2.223 t/ha paddy rice. From this paddy rice 1.667 t/ha milled rice is obtained. On the other way from 100 kg paddy rice 75 kg milled rice is obtained. From one ha 6,210.99 birr/ha and 8,623.14 birr/ha was the gross profit of the household from paddy and milled rice including the cost of family labor. Producers received a gross profit of 279.39 birr/qt and 583.34 birr/qt from both paddy and milled rice respectively including family labor.

Table 8. *Gross profit of households with and without family labor.*

Rice sold	Production cost/ha	Yield qt/ha	Selling price/qt	TR/ha	GP/100 kg		GP/ha	
					With family labor	Without family labor	With family labor	Without family labor
Paddy	21665.01	22.23	1200	26,676	225.41	493.34	5010.99	10962.04
Milled	23162.86	16.67	1834.52	30,586.03	445.29	802.65	7423.17	13380.22

Source; own computation from survey result, 2022

The survey results showed that in case of paddy rice market, producers received the highest marketing margin which is 821 birr/100 kg followed by local traders and retailors with gross marketing margin of 683.34 and 683.34 Birr/100 kg. Retailors received the least marketing margin than the other market actors. Even producers received the highest marketing margin and the gross profit received by them was 225.42 birr/qt which is fewer amounts than retailors. In the rice market retailors received the highest gross profit than rice producer farmers' 289.25 birr/100 kg or 30.6%. This result is similar with [19] who confirmed that profit margin of traders is more than that of red pepper producers.

Similar to paddy rice, in the case of marketing milled rice, producers receives the highest marketing margin 1185.41 Birr/100 kg followed by local traders and retailor with gross marketing margin of 850 and 758.33 Birr/100 kg. Wholesalers receive the least marketing margin than the other market actors in milled rice market. Even producer receives the highest marketing margin the gross profit received by those producers was 445.03 birr/100 kg which is less amount than retailors and local traders. In the case of milled rice market retailor and local traders receives the highest gross profits of 580 birr/qt and 530 birr/10 kg respectively. Followed by producers and the least gross profit was received by wholesalers.

Table 1. *Profit share of rice market actors in the area.*

	Actors	Selling price/100 kg	Total cost	GMM	% share GMM	GP	% share
Paddy	producers	1200	974.58	821.04	30.70	225.42	23.85
	local traders	1816.67	1557.33	683.34	25.55	259.34	27.43
	Wholesalers	1825	1653.67	558.33	20.87	171.33	18.12
	retailers	1837	1547.75	612	22.88	289.25	30.60
Milled	producers	1834.52	1389.49	1185.41	33.38	445.03	22.20

Actors	Selling price/100 kg	Total cost	GMM	% share GMM	GP	% share
local traders	2630	2100	850	23.94	530	26.43
Wholesalers	2650	2200	757.14	21.32	450	22.44
retailers	2700	2120	758.33	21.36	580	28.93

Source; own computation from survey result, 2022
GMM=gross market margin GP= gross profit

3.5. Factors Affecting Rice Market Supply

Factors' affecting the quantity of rice market supply was analyzed by using multiple linear regression (OLS) models. On the model result, the coefficient of determination (R^2) 0.8674 shows that 86.74% of the variation on the dependent variable is due to the change in the listed independent variables. Off the total 14 explanatory variables included in the model, 9 variables significantly influenced the quantity of rice market supply. The result of multiple linear regression (OLS) indicated that education level, household size, farming experience, rice cultivated land, productivity, frequency of extension contact, training, lagged price and market distance are the significant independent variables of the factors affecting rice market supply.

3.5.1. Education Level

According to the results of the OLS model, this study showed that the education level of the household heads has a positive and statistically significant influence on the quantity of rice marketed supply. An increase in the education level of the household would increase the quantity of rice market supply by 3.32 quintals. This is due to that, more educated farmers can understand and apply technologies that can boost rice production and productivity, allowing them to offer more products to the market. This result is similar with [20] which shows that, as the level of education attending become increases market supply of wheat increases. Similarly, [21] confirmed that educated households have a larger supply of marketable produce.

3.5.2. Household Size

It refers to the number of family members residing in each home. The multiple linear regression models revealed that family size has a negative and substantial effect on the quantity of rice market supply at the 1% significant level. The negative and significant association confirmed that families with a larger number of family sizes supply less rice to the market than households with fewer family sizes. This is due to the fact that a greater proportion of rice produced is consumed by households. According to the model's results, increasing the number of family members by one reduces the amount of rice delivered to the market by 0.80 quintal. This result is in line with [22], He confirmed that when the family size of the households increased by one, maize market supply decreased by 3.54 qt. The result is also consistence with [23]. On the contrary, [24] founds that, family size has a positive influence on onion quantity of market supply. On the result household with one more increase in number, can produce more and supply more products to the market due to labor availability.

3.5.3. Farm Experience

It is a continuous variable that represents the number of years that respondents have participated in agricultural producing activities. Household farm experiences have an encouraging and considerable impact on the quantity of rice supplied to the market. The OLS model results showed that when the household's farming experience grew by one year, the quantity of rice delivered to the market increased by 0.18 quintal, while all other factors remained constant. This study shows that more experienced farmers obtain greater information about agricultural production technology, allowing them to boost crop productivity and quantity. This increased productivity allows households to deliver a greater volume of rice from their crops than those with less agricultural expertise. The study result is agreed with [25] which showed that farming experience has a positive and significance influence on sesame market supply. The result of OLS estimation in their study indicates that, when sesame farm experience increased by a year the quantity of sesame market supply also increased by 1.6%. The result is also consistent with [19, 26] that showed, farming experience has a positive and significance influence on red pepper and pepper market supply respectively.

3.5.4. Land Allocated for Rice

It refers to the area that the family has allotted for rice production in the 2020/2021 cropping season, and it is measured in hectares. As expected, land size has a significant impact on the amount of rice delivered to the market. When a household has additional land dedicated for rice cultivation, the quantity of rice given to the market increases. According to the studies model results, increasing rice cultivation land by one hectare increases the quantity of rice provided to the market by 15.38 quintals. When the household produce more products, there is a possibility that more excess product will be supplied to the market. The result of this study is similar

with [27] who found that quantity of groundnut supplied to the market is increased by 6.055 quintal as the land size allocated for groundnut is increased by a hectare. The result is also in line with [11] who founds, the size of land allocated for teff affects the volume of teff market supply positively and at 5% significant level. As the area of land allocated for teff increased by one hectare, the quantity of teff supplied to the market increase by 17.8 percent. Similarly, [28] showed that, land size has a positive and significance influence on the quantity of soybean supply to the market.

3.5.5. Productivity

It is the average quantity of rice produced in tone per ha in 2020/21 production year. Productivity has a significant and positive influence on the volume of rice supplied to the market. In this study the result of multiple linear regression models showed that quantity of rice supplied to the market is increased by 0.46 quintal as the productivity of rice crop increased by 1 quintal. The implication of the result is that, productivity increments can encourages households to produce the crop more by giving priorities to the crop. More productive crops can produce in a better way than that of less productive one and this more productivity can bring more output supplied to the market. The result is consistent with [29] In his study, the result of OLS model indicated that, the volume of soybean market supply is increased by 0.415 quintal when the productivity of the crop is increased by 1 quintal.

3.5.6. Frequency of Extension Contact

It is a categorical variable that describes the frequency with which sample households contact extension workers throughout the 2020/21 farming season. Extension workers are anticipated to have a direct impact on the production and marketing environments of households. Households who often contact extension workers have a better understanding of the crop and its entire production package, including agronomic practices, and are more likely to implement and employ the technologies. These benefits farmers by increasing their production and productivity, as well as the volume of rice delivered to the market. The frequency of extension contacts has a positive and 10% significant impact on the amount of rice provided to the market. The multiple linear regression models revealed that increasing the frequency with which households contact the extension agent increases the quantity supply of rice to the market by 4.5 quintals. The data suggests that the frequency of repeated extension contact helps the family gain up-to-date production and market information, which boosts the marketable supply of the rice crop. The result of the study was similar [16] which found that, weekly contact of the producers increases the volume of soybean market supply by 0.154 tons. The result is also agree with [30] who found that quantity of avocado market supply is increased by 2.85 quintal as the extension contacts of the household increased by one more additional contact. In similarly way [31], and [32] confirmed that, number of days of extension contacts has a positive influence on the quantity of honey market supply.

3.5.7. Training

Training has a positive and significance influence on the volume of rice supplied to the market. The result of multiple linear regression model predicted that, quantity of rice supplied to the market on those households which has an access for training was increased by 2.7 quintal than those households which has not an access for training about rice production. The result implies that giving training to farmers/household on rice production and marketing can help the producers to acquire better understanding and fill the gaps of awareness on the way of production and can increase the probability of supplying more products to the market. This result is similar with [33] who found that, households who had access to training increases the quantity of Sorghum market supply by 18.04% compared to those who did not have access to training. Also the result is in line with [34] and [32] who confirmed that training has a direct and significant influence on the quantity of honey market supply.

3.5.8. Lagged Price

At 5% level of significance, lagged pricing has a positive and significant effect on rice market supply. The OLS model results showed that while the lagged price of rice increased by 1 birr in the previous year, the amount of rice provided to the market increased by 0.002 qt. The results imply that the previous year's rice price can induce or inspire households to produce more by increasing land area or by employing inputs that can aid to maximize production, resulting in increased household supply to the market. This finding is consistent with [35] on factors affecting chickpea market chain. The study indicated that, when the previous year price of chickpea increased by 1 birr, quantity of chickpea supplied to the market is increased by 0.0013 quintal. Additionally [19] confirmed that lagged price has a positive and significant influence on the quantity of red pepper.

3.5.9. Market Distance

market distance has a negative effect on the quantity of rice delivered to the market at the 5% level of significance. The study found that when the market distance rose by one minute, the amount of rice delivered to the market reduced by 0.02 quintal. This might be owing to the fact that when households go further away from the nearest market, the cost of transporting their produce for sale raises, including personal travel expenses. This suggests that as the distance from the nearest market raises, so do the transportation expenses and losses associated with managing their products. This may discourage farmers from selling large amounts of rice. The study is consistent with [36] and [31] showed that, distance to the nearest

market have a negative and significant influence on quantity of kocho and honey market supply respectively. On the contrary of this study [37] founds that market distances have a positive and significant effect on the volume of red pepper supply. This is due to price and demand availability. In the near market place it generate lower price due to this reason producers go to distance market and sell their produces.

Table 2. *Determinants of rice market supply (results of multiple linear regression).*

Quantity supply of rice	Coef.	St. Err.	t-value	p-value
Age of household head	-0.066	.048	-1.39	0.167
Sex	-1.673	1.619	-1.03	0.303
Education level				
Read and wright	0.605	1.379	0.44	0.661
Primary (1-8)	1.647	1.728	0.95	0.342
Secondary (9-10)	1.884	2.159	0.87	0.384
Preparatory	4.712	3.197	1.47	0.142
Above	3.329*	1.892	1.76	0.08
House hold size	-0.89***	.283	-3.14	0.002
Farm experience	0.188***	.065	2.92	.004
Rice cultivated land	15.384***	2.808	5.48	0.000
Productivity	0.46***	.142	3.23	0.001
Off_non farm income	-0.635	.646	-0.98	0.327
Frequency of extension contact		.	.	
Once a month	0.626	1.116	0.56	0.575
Twice a month	0.71	.902	0.79	0.432
Weekly	4.504*	2.597	1.73	0.085
Daily	0.124	1.881	0.07	0.948
Credit service	-3.954	3.441	-1.15	0.252
Training	2.703**	1.187	2.28	0.024
Lagd price	0.003**	.001	2.09	0.038
Market information	1.375	1.076	1.28	0.203
Market distance	-0.021**	.01	-2.18	0.03
Constant	-15.079	5.893	-2.56	0.011
Mean dependent var	17.611	SD dependent var	16.748	
R-squared	0.867	Number of obs	185	
F-test	72.802	Prob > F	0.000	

***, **, * are significant levels at /%, 5% and 10% respectively.
Source; own survey computation, 2022

4. Conclusion and Recommendations

The amount of rice's produced in a unit plot makes the crop more acceptable than other crops even its productivity is not as expected. As a result, the crop is the primary choice for consumption and income generating for producers. Rice marketing operations are mostly carried out by producers, local traders, wholesalers, retailers, investors and consumers. In this consumers and investors are serving as the sole buyers of milled and paddy rice respectively in the area. In the production processes of rice crop, labor and input costs were the greatest production costs. Family labor accounts for the majority of labor costs. Most of rice producers in the area sells milled rice and receive better price. The result of multiple linear regressions reveals that household size and market distance has a negative association on the quantity of rice supplied to the market. This might be due to households with large number uses more proportion of the production for consumption purpose. Market distance has also a negative effect on the quantity of rice market supply. On the other hand education level, farming experience, productivity, land allocated for rice, frequency of extension contact, training and lagged price has a positive influence on the volume of rice supplied to the market.

Since rice productivity affects the quantity of rice delivered to the market, most farmers in the area do not employ the appropriate amount of inputs such as improved seed, fertilizers, and herbicides, and their agronomic practices are inadequate. As a result, it is preferable to develop and implement appropriate agronomic practices and input rates in order to maximize production and supply quantity.

Producers, local dealers, wholesalers, retailers, and consumers are all active participants in the rice market. Producers do not profit from other traders'. This circumstance reduced the producers' benefits and made them price takers. As a result, creating better marketing conditions is critical for obtaining a reasonable price for those market participants.

Based on the findings, improving the productivity of the crop can benefit the producers to maximize the quantity of rice supplied to the market. In addition to this, strengthening the link between extension workers and farmers, increasing farmers' education level, strengthening the producers' bargaining power through training is better for producers to improve the supply of rice to the market. Moreover, stakeholders should focus on building different infrastructures including the road to facilitate the exchange of rice on the market.

Abbreviations

ETB	Ethiopian Birr
FTC	Farmers Training Center
GMM	Gross Market Margin
GP	Gross Profit
ha.	Hectare
KG.	Kilo Gram
OLS	Ordinary Least Square
Qt.	Quintal
SD	Standard Deviation
TR	Total Revenue
VIF	Variance Inflation Factor

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Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] A. K. Mishra *et al.*, "Helping feed the world with rice innovations : CGIAR research adoption and socioeconomic impact on farmers," *Glob. Food Sec.*, vol. 33, no. March, p. 100628, 2022, https://doi.org/10.1016/j.gfs.2022.100628

[2] L. Tang *et al.*, "Food security in China: a brief view of rice production in recent 20 years," *Foods*, vol. 11, no. 21, p. 3324, 2022.

[3] J. Rodenburg and K. Saito, "Field Crops Research Towards sustainable productivity enhancement of rice-based farming systems in sub-Saharan Africa," *F. Crop. Res.*, vol. 287, no. September, p. 108670, 2022, https://doi.org/10.1016/j.fcr.2022.108670

[4] F. Unsal, J. Spray, and C. Okou, "Staple Food Prices in Sub-Saharan Africa: An Empirical Assessment," 2022. https://doi.org/10.5089/9798400216190.001

[5] A. Ibrahim *et al.*, "Seizing opportunity towards sustainable rice cultivation in sub-Saharan Africa," *Environ. Sustain. Indic.*, vol. 15, p. 100189, 2022.

[6] T. Belayneh and J. Tekle, "Review on Adoption, Trend, Potential, and Constraints of Rice Production To Livelihood in Ethiopia," *Int. J. Res. -GRANTHAALAYAH*, vol. 5, no. 6, pp. 644–658, 2017, https://doi.org/10.29121/granthaalayah.v5.i6.2017.2097

[7] A. Assaye, E. Habte, S. Sakurai, and D. Alemu, "Impact assessment of adopting improved rice variety on farm household welfare in Ethiopia," *J. Agric. Food Res.*, vol. 10, no. October, p. 100428, 2022, https://doi.org/10.1016/j.jafr.2022.100428

[8] D. Alemu, A. Tesfaye, A. Assaye, and D. Addis, "A HISTORICAL ANALYSIS OF RICE COMMERCIALISATION IN ETHIOPIA : THE CASE OF THE FOGERA PLAIN," 2018.

[9] D. Wondim, T. Tefera, and Y. Tesfaye, "Determinants of maize market supply, production and marketing constraints: The case of Dembecha district, West Gojjam zone, Ethiopia," *Int. J. Econ. Energy, Environ.*, vol. 5, no. 5, p. 83, 2020.

[10] S. Usman, J. Haji, and E. Brachi, "Determinants of Wheat Market Supply in Sinana District," 2021.

[11] H. Deksiso and G. Gebru, "Factors Affecting Teff (Eragrostis tef) Market Supply in Woliso and Becho Districts of South West Shoa Zone Oromia Regional State, Ethiopia," *Agric. Sci.*, vol. 13, no. 4, pp. 555–565, 2022.

[12] T. Yamane, "Statistics: An introductory analysis," 1973.

[13] K. Tarekegn, J. Haji, and B. Tegegne, "Factors affecting market supply of honey in Chena district, Kaffa zone, Southern Ethiopia," *J. develpment Agric. Econ.*, vol. 10, no. 3, pp. 99–109, 2018, https://doi.org/10.5897/JDAE2017.0888

[14] P. Krause, D. P. Boyle, and F. B äse, "Comparison of different efficiency criteria for hydrological model assessment," *Adv. Geosci.*, vol. 5, pp. 89–97, 2005.

[15] T. Abrha, B. Emanna, and G. G. Gebre, "Cogent Food & Agriculture Factors affecting onion market supply in Medebay Zana district, Tigray regional state, Northern Ethiopia Factors affecting onion market supply in Medebay Zana district, Tigray regional state," *Cogent Food Agric.*, vol. 6, no. 1, 2020, https://doi.org/10.1080/23311932.2020.1712144

[16] T. A. Delele, A. G. Adugna, and B. M. Gelaw, "Determinants of soybean (Glycine max.) market supply in Northwestern Ethiopia," *Cogent Econ. Financ.*, vol. 10, no. 1, pp. 0–21, 2022, https://doi.org/10.1080/23322039.2022.2142313

[17] K. Haile, E. Gebre, and A. Workye, "Determinants of market participation among smallholder farmers in Southwest Ethiopia: double-hurdle model approach," *Agric. Food Secur.*, vol. 11, no. 1, p. 18, 2022.

[18] A. Dinku, B. Abebe, A. Lemma, and M. Shako, "Beef cattle value chain analysis: Evidence from West Hararghe Zone of Ethiopia," *Int. J. Agric. Sci. Food Technol.*, vol. 5, no. 2, pp. 77–87, 2019.

[19] M. Dessie, M. Jailan, H. Mosi, and G. Mekonnen, "Value Chain Analysis of Red Pepper: The Case of Mareko District, Guragie Zone, Southern Ethiopia," *Agric. Res. Technol. Open Access J.*, vol. 17, no. 2, pp. 31–39, 2018.

[20] A. Ayele, T. Erchafo, A. Bashe, and S. Tesfayohannes, "Value chain analysis of wheat in Duna district, Hadiya zone, Southern Ethiopia," *Heliyon*, vol. 7, no. 7, 2021.

[21] R. Dibaba and D. Goshu, "Factors affecting market supply of wheat by smallholder farmers in Ethiopia," *J. Nat. Sci. Res*, vol. 19, no. 8, pp. 56–64, 2018.

[22] D. Galtsa, K. Tarekegn, K. Kamaylo, and E. Oyka, "Maize market chain analysis and the determinants of market participation in the Gamo and Gofa Zones of Southern Ethiopia," *Adv. Agric.*, vol. 2022, 2022.

[23] E. Tadesa, "Determinants of commercialization of teff crop in Abay Chomen District, Horo Guduruwallaga zone, Ethiopia," *J. Agric. Ext. Rural Dev.*, vol. 12, no. 10, pp. 251–259, 2018.

[24] N. Tamirat and T. Zeleke, "Analysis of onion market value chain among smallholder farmers in rural Ethiopia: a case study of south bench woreda in bench maji zone, Ethiopia," *J. Smart Econ. Growth*, vol. 6, no. 1, pp. 49–74, 2021.

[25] A. W. Belayneh, E. G. Yesho, and K. H. Gemeyida, "Determinants of sesame market supply in West Omo and Bench Sheko zones, Southwest Ethiopia," *Int. J. Agron.*, vol. 2022, 2022.

[26] G. Wosene, M. Ketema, and A. Ademe, "Factors affecting market outlet choices of pepper producers in Wonberma district, Northwest Ethiopia: multivariate probit approach," *Cogent Food Agric.*, vol. 4, no. 1, p. 1558497, 2018.

[27] O. Sori, "Factors affecting groundnut market supply in Western Oromia, Ethiopia," *Heliyon*, vol. 7, no. 1, 2021.

[28] E. N. Hambisa and M. B. Geda, "Factors Affecting Soybean Producers Supply to the Market in Buno Bedele Zone, South Western Ethiopia," *Int. J.*, vol. 7, no. 1, pp. 245–249, 2020.

[29] T. Atnafu Delele, "Value chain analysis of soybean the case of pawe district, north western Ethiopia." Bahir Dar University, 2020.

[30] S. Mengesha, D. Abate, C. Adamu, A. Zewde, and Y. Addis, "Value chain analysis of fruits: The case of mango and avocado producing smallholder farmers in Gurage Zone, Ethiopia," *J. Dev. Agric. Econ.*, vol. 11, no. 5, pp. 102–109, 2019.

[31] T. Kasahun, "Value chain analysis and development: the case of bamboo and honey products from maraka woreda, dawuro, southern Ethiopia," 2020.

[32] N. Ababulgu, N. Abajobir, and H. Tizazu, "Analysis of the Economy of Beekeeping and Honey Supply in Horo Guduru Wollega Zone, Oromia, Ethiopia," 2021.

[33] T. Meleaku, D. Goshu, and B. Tegegne, "Determinants sorghum market among smallholder farmers in Kafta Humera district Tigeray Ethiopia," *South Asian J. Soc. Stud. Econ.*, vol. 8, no. 1, pp. 1–13, 2020.

[34] B. T. Borena, F. Mitiku, and C. Hailu, "Marketable supply of honey: evidence from farmers households in Ethiopia," *J. Agribus. Rural Dev.*, vol. 64, no. 2, pp. 161–168, 2022.

[35] G. Abebe and S. Debebe, "Factors Affecting Chickpea Market Chain: The Case of Dembia District, North Gondar Zone, Ethiopia," *Transp. P*, vol. 66, 2020.

[36] H. Tesfaye, L. Zemedu, and A. Ademe, "Factors Affecting Market Outlet Choice of Kocho Producers in Cheha District, Gurage Zone, Southern Ethiopia," *Dev. Ctry. Stud.*, vol. 9, pp. 1–9, 2019.

[37] N. Girmalem, S. Negussie, and G. Degye, "Determinants of Mangoes and Red Peppers Market Supply in Ahferom and Kola-Tembien Districts of Tigray Region, Northern Ethiopia," 2019.