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Determinants of Sorghum market participation in Gololcha and Shenen Kolu District, Arsi zone, Oromia Regional State, Ethiopia

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Abstract

Rural households participation in agricultural markets is vital important strategy for poverty alleviation and food security in developing countries. Sorghum has been considered as strategic crop by the Ethiopian government enhancing food security and essential source of income for farmers. Previous research has focused on adoption of sorghum however, there is no adequate studies in Ethiopia, particularly in Arsi zone focusing on determinants of smallholder sorghum commercialization. This study aimed at analyzing factors determining smallholder sorghum farmers decision to participate in output market in Gololcha and Shene Kolu Districts of Arsi zone. A three stage random sampling technique was employed to select a sample of 130 smallholder sorghum producer household heads. Primary data were collected using semi-structured questionnaire and focus group discussion while, secondary data were collected from offices, journal articles, books and central statical authority. Both qualitative and quantitative data were collected. Quantitative data were analyzed using descriptive and inferential statistics while pair wise ranking and narration were used for qualitative data analysis. Furthermore, probit econometric model were used. The result of probit model revealed that Gender of the household head, access to market information and volume of sorghum consumption influenced the decision to sell sorghum positively and significantly, while age of the household head and volume of sorghum consumption influenced negatively and significantly. Therefore government authority and other concerned bodies should take into consideration the aforementioned demographic, socioeconomic, and institutional factors to improve the performance of sorghum commercialization in Arsi zone of Oromia regional state.

Keywords: Sorghum; Smallholder; Commercialization; Market participation; Probit model

Introduction

The Ethiopian agriculture is dominated by smallholder farmers which accounts for 96% of the total area cultivated and more than 90% of agricultural output produced (Birhanu F, 2021). Studies indicated that, smallholder farmers are a key solution for economic growth, and for alleviation of poverty and food security problems in developing countries. Considering this issue, Ethiopian government has targeted smallholder farmers as the focal point for economic transformation and agricultural development, and for meeting the current growing food demand (Dorosh P et al., 2018). In the country, smallholder farmers are highly characterized by their shortage of resources, heavily dependence on subsistence agriculture, household labor dependability, exposures of reduction of yields and lower price of their products (Addisu, 2018) [1].

So, in the long run, this subsistence agricultural production may not be a viable production system to ensure food security (Pingali, 1997). Commercial transformation of subsistence agriculture is an indispensable pathway towards economic growth and development for many agriculture dependent famers in developing countries including Ethiopia (Mitku A.2014). As known, in Ethiopia, cereals are the major food crops both in terms of the area they are planted, marketing and volume of production obtained. Out of the total grain crop area, 81.97% (9,997,511.08 hectares) was under cereals and it contributed 88.69% (about 290,808,263.25 quintals) of the grain production (CSA, 2022).

In Ethiopia among the cereal crops, sorghum is the fourth most important cereal crop after tef, maize and wheat in terms of area coverage and total production (CSA, 2022). It accounts for 13.50 % of the area covered by cereals (CSA, 2022). Sorghum is a multipurpose crop with more than 35% of it grown directly for human consumption and the rest used primarily for animal feed, alcohol, and industrial products (Nangobi and Mugonola, 2018). The main sorghum producing regions are Oromia and Amhara, accounting for nearly 80 % of the total production. The leading sorghum producing zones are East and West Hararge in Oromiya and North Gondar and North Shoa in Amhara (CSA, 2021) [2].

The share of sorghum in total cereal consumption at national level has been tended to increase in recent years. Moreover, because of the high prices of teff in recent years, even middle class households increased sorghum consumption, mixing sorghum with teff to make injera (USDA, 2012). According to UN COMMTRADE data, the country which was a net exporter in the first three years of the study period (2005-07) was a net importer in 2008-10. However, the volume of import was relatively significant in 2008 and 2010 (113 000 tonnes) and this is mainly attributed to food aid import, originating mainly from the US (Demeke M and Di Marcantonio F., 2013).

The marketing system for sorghum in Ethiopia is poorly developed, and has limited industrial use. In the country, only 11.5 percent of the crop is sold 74.0 percent being consumed at the local level. The remaining 9.2 percent is retained as seed and the rest is used as payment of wages in kind (1.2 percent) and animal feed (0.9 per cent) (AATF, 2011). This result shows, majority of Ethiopia's smallholder farmers grow sorghum mostly for subsistence-oriented production. So, rural

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households' participation in agricultural markets is vital important strategy for poverty alleviation and food security in developing countries (Heltberg R, and Tarp F., 2001) [3].

Being cognizant of role of market participation, Ethiopia has taken agricultural transformation as a means to tackle poverty and food insecurity problems through empowering smallholder farmers and pastoralists with tools, knowledge, and support needed to transition from a traditional subsistence orientation to one that is market focused and more commercialized (ATA, 2015). Even if the government of Ethiopia focused on commercialization of subsistence agriculture as priority policy decision, market participation by smallholder farmers in Ethiopia is limited and agricultural markets are fragmented and not well integrated into wider market systems which increases transaction costs and reduces farmers' incentive to produce for the market (Mitku A., 2014) [4].

The reason for this is, specific study areas commercialization affected by institutional factors, infrastructural and market-related factors, resource factors, and household specific characteristics that marketing (Bekele A et al.,2010). Although there is a wealth of literature on smallholder commercialization in Ethiopia, it is mainly on grain crops and livestock and livestock product however market participation of the smallholder sorghum crops farmers in the country is still limited. However, the national marketed surplus ratio of sorghum which describes the commercialization level is 16.15%, which is perceived as low (CSA,2021).Therefore, it is vital to identify the determinant factors which influence sorghum producer farmers' decision to participate in the market in order to benefit smallholder farmers from the marketing of sorghum in the study area [5].

Research Methodology

Description of the study area

The study area Gololcha and Shene Kolu Districts are located in Arsi Zone Oromia regional sate of Ethiopia. Arsi zone is found in the central part of the Oromiya National Regional State. The zone astronomically lies between 60 45' N to 58'N and 38 32 E to 4050' E. It shares borderlines with the Regional State of Nations, Nationalities and People of Southern Ethiopia and also shares borderlines with East Shewa, Bale and West Hararge Zones. The Zone has the longest borderline of 450km with East Shewa Zone accounting about 43 percent of its total boundary length. It has the second longest line (350km) with Bale Zone. It shares the least borderline (43km) with the Regional State of Nations, Nationalities and People of Southern Ethiopia. Asela is the capital town of the zone. It is located at 175 km from Finfinne on Finfinne-Adama-Bale Robe main road. Also Asela is located at 75 km south of Adama town (Abdi, 2017) [6].

A brief description of study districts goes as follows. Shenen Kolu district is one of the district among 26 districts which are found in Arsi zone Oromia regional state, Ethiopia. The district is located at about 316 km from Addis Ababa, the capital city of Ethiopia and 241 km from Asella, which is the capital town of Arsi zone. The District is situated at northeast of Aseko and Anchar, Seru district in the south, Daro Lebu district in the east and Gololcha district in the west. The altitude of the district ranges from 1400 to 2000 metres. Generally, the district has a total area of 112,101 hectares and is classified into two agro-ecologies, highland (2%) the midland (28%) and the lowland (70%). The average temperature of the district is 32 °C and the average rainfall is 800 mm/year. The main rainy season of the district is in April, May, June, July, August and September. The soil type of the district is clay soil and sandy soil. Major crops produced in the district are coffee, maize, sorghum, teff and groundnut (SKWoA, 2022).

The second Gololcha district is bordered by Aseko district in the north, Amigna district in the south, Shenan Kolu district in the east and Chole district in the west. The altitude of the woreda is ranging from 1400 and 2500 meters above sea level. Generally, the district has a total area of 178,102 hectares and is classified into two agro-ecologies, the midland and the lowland with a share of 25% and 75% respectively. The average temperature of the district is 35˚C and the average rainfall is 900 mm/year. The main rainy season of the district is in April, May, June, July, August and September. The soil type of the district is silt and sandy soil. Major crops produced in the district include Coffee, Maize, Sorghum, Teff and Groundnut (GWoA, 2022) (Figure 1) [7].

Data type, source and method of data collection

This study used household survey data collected from Gololcha and Shene Kolu districts. Both primary and secondary data were used in

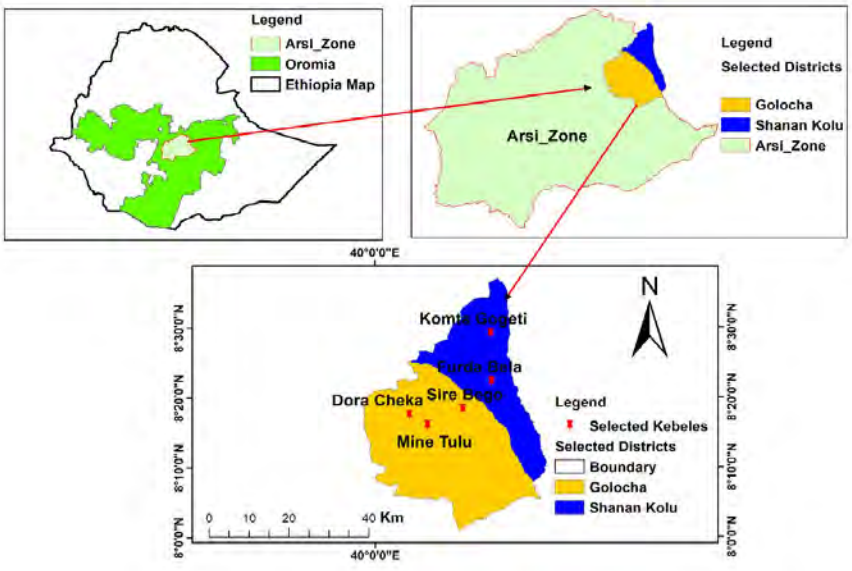

Figure 1: Skeck of study area; Source: GIS shape file of Ethiopian administrate map.

this study. Before a start of actual data collection, facilitative works such as training of enumerators on interview procedures, and preliminary assessment to sampled kebeles was made. Primary data were collected using semi-structured questionnaire by trained enumerators. Both open and close-ended questions in line with the objective of the study were included in the questionnaire. Semi-structured questionnaire was administered on selected households to collect data on household characteristics, resource ownership, access and institutional variables relevant to meet the objective of the study. Secondary data helpful to the study were gathered from statistical Breau of Agriculture of Gololcha and Shenen Kolu districts, journals, research findings and different reports [8].

Sampling techniques and sample size determination

Smallholder sorghum producers are the target population for this study. To draw representative sample the research study has followed a three stage random sampling technique to select the study area and representative sample households. In the first stage Gololcha and Shene kolu districts were selected by using purposive sampling based on the potential sorghum production and accessibility to market among Arsi zone districts. In the second stage, three kebeles from Gololcha district and two kebeles from Shene Kolu district were selected purposively. In the third stages a total of 130 sorghum producer farm households during 2021/22 production year were selected randomly from the selected sample kebeles by using simple random sampling technique (SRS) based on probability proportional to size (PPS) using sample size determination formula developed by Yamane, (1967) indicated in equation below. Several authors used this sample size determination approaches for instance (Haile et al., 2018) and (Ahmed et al., 2016) used this sample size determination formula. The sample size for the study was determined based on the following yamanes formula:

$$n = \frac{N}{1+N(e)2} = 129.54$$

Where; Where: n = is the desired sampled size, N = is the total population(N=) and e = is the desired level of precision(0.09) as suggested by (Haile et al., 2018) to get desired minimum sample size of households at 91% level of significance with variability of 9%. Finally, a total of 130 sample households were selected for interview using probability proportional to size from each kebeles as presented (Table 1) [9].

Method of data analysis

Both descriptive and econometrics methods of data analysis were employed to assess the determinants of Sorghum market participation.

Descriptive method of data analysis

Descriptive statistical analysis such as mean, percentages, and standard deviations was used in the process of examining and describing farm households' demographic characteristics, resource ownership, institutional and infrastructural service, production characteristics and farm input use. T-test and Chi-square test were used for the existence of any statistically verifiable differences among farmers participated and their counterfactuals.

Econometric analysis

This part of the analysis deals with identifying determining factors of sorghum market participation decision of households. So far, different limited models having their positive and negative part such as restrictive Tobit, double hurdle model, probit and Heckman two stage selection model have been used to study crop market participation. As to which type of model to use among these models depends up on the nature of dataset and underlying assumptions of the model. The dependent variable is dichotomous, representing farmers' decision to participate or not in sorghum marketing [10].

For such a dummy dependent variable, probit model is appropriate (Gujarati, 1995). Different authors used probit analysis on the decision to market participation (Egbetokun & Omonona, 2012; Mbitsemunda & Karangwa, 2017). Hence, to analyze the determinants of smallholder farmers' participation in the sorghum marketing probit model was used. In this model, the probability that Y = 1 (the probability that the household participates in sorghum marketing) was estimated using the cumulative standard normal distribution function. The researchers opted to use the probit regression model to identify the factors that determine the decision of smallholders to participate in the sorghum market hence the dependent variable is dichotomous [11].

Accordingly, the dependent variable assumes only two values; 1 if the household participates in the sorghum market and 0 if he/she does not. Assume that Y can be represented by market participation and the regression equation is representing market participation (dependent variable, Y) and we also have a vector of regressors X, which are assumed to influence the dependent variable (Y). The probit model is built on a latent variable with the following formula (Wooldridge, 2002):

$$Yi* = \beta iXi + ui \; Y = 1 \text{ if } Yi* > 0, Y = 0 \text{ if } Yi* \leq 0$$

Where: Yi *= is a latent variable representing farmers discrete decision whether to participate in sorghum market or not; Xi= is explanatory variables hypothesized to affect farmers decision to participate in sorghum market, βi= is a vector of parameters to be estimated which measure the effect of explanatory variables on household decision to participate in sorghum market. ui = is normally distributed disturbance term which captures all unmeasured variables that affect sorghum market participation decision of sample households. Y = is a dependent variable which takes the value of 1 if the farmers participate in sorghum market and 0, if otherwise [12].

Table 1: Sample size determination of smallholder sorghum farmers.

District	Sample Kebele	Total sorghum producing households	Number of sampled households	Proportion of sampled households(%)
Gololcha	Mine Tulu	985	23	18
	MineAdaye	1200	29	22
	Sire Bego	1019	24	18
Shenen Kolu	Furda Bela	1935	31	24
	KomtuGogt	1444	23	18
	Total	6583	130	100
Source: column 3 from agricultural office districts,(2021/22) and column 4 and 5 , Authors own computation from the data				

Variable definition, measurement and working hypothesis

To analysis determinants of sorghum market participation, exploring which factors significantly influence and how these factors are related with the dependent variables are required. Hence, the following dependent and independent variables were defined and hypothesized (Table 2).

Result and Discussion

Demographic and socio-economic characteristic of sample households

As statistical summary of continuous explanatory variables provided in table 3 below shows out of 130 households were surveyed in selective districts in which 51.5% were supplying their sorghum from their production in the production season while the remaining (48.5.94%) did not supplied to market; they simply used for home consumption and gift for their relative. In the study area average age of household head was 37.91 years with the youngest being 20 years and the oldest 65 years. This indicates that most of the household heads were within their productive age group. Regarding to educational status, the average schooling of household is grade 4 formal education whereas the range goes from those who did not attended formal education at all to those who attended eleven years of schooling [13].

The average number of household family size for the sample respondents were about 6.7 with standard deviation of 2.6. Large household size may ensure adequate supply of family labor force for crop production and could also absorb a significant portion of the produce to home consumption. The mean landholding of sample household is about 1.28 ha. Larger landholding could be seen as an incentive to produce surplus for market. Accordingly, as indicated the average annual sorghum production of the survey households is 1068.06 kilo gram. Larger amount of sorghum production leads households to higher amount of sorghum supply to market. The average land allocated for sorghum per sample households heads was about 0.77ha while the mean livestock Owen was about 4.24 (TLU).

The average farming experience and sorghum farming experience of sample respondents that an individual continuously engaged in agricultural production was 16.97 years with standard deviation of 9.48 and 13.8 and 9.9 respectively. The amount of output available in the stock and the marketed proportion of high value crops could critically affect the overall household output supply to market. Household in the study area has on average 1184.40 kg of sorghum supplied to the market before beginning of new harvest. In the study districts, from the total volume of sorghum produced, on average 1184.40 kg of sorghum was supplied to market by ample households with standard deviation of 147.00 kg [14].

Additionally the average amount of sorghum consumed by a sample household 821.67 kg. From the total sorghum produced in those selected sample households only 11.08% was supplied to output sorghum market and the remaining large amount 64.95% and 11.2% was used for home consumption and preserved for seed respectively. The major non- farm income generating activities in which sample households were participating in the study area includes; sales of fire wood, farm labor wages, sales of crop residues, Rental property (other than land and oxen) and . Other business Net income (shops, trade, tailor, sales of beverages etc).From the total of sample households 98 (75.4%) were participating in non-farm activities and 32 (24.6%) were not participating on non-farm income generating activities [15].

The mean cash income obtained from non-farm income by sample households was 3186.57 ET birr with standard deviation 3606.983 ET birr. Distance imposes transaction cost to households and determines the volume of output sold. For example, sample households are on average 6.61 km and 20 km away from nearest market and farmers' cooperative respectively (Table 3).

Group comparisons of market participants and non-participants for sorghum

The t-test result illustrates in table 4 below shows the significant mean difference for continuous variables among market participants and non-participants. The value of t-test shows that there is no significant difference between family size, household education in years of schooling, farming experiences, sorghum farming experiences, livestock owned (TLU) and household land holding of participants in sorghum market participants and non-participants. Therefore, it can be said that family size, household education in years of schooling, farming experiences, sorghum farming experiences, livestock owned (TLU) and the land holding size of the household will not affect the economy between the people involved in the commercialization

Table 2: Definition, Measurement and expected sign of the explanatory variables.

Variable name	Definition of variables	Measurements	Expected sign
Dependent variables			
Market participation decision	If households sell sorghum its represented by 1,0 otherwise	1 if yes,0 otherwise	
Independent variables			
Age	Age of household head	Number of year	+/-ve
Gender	Gender of the household head	Male=1,Female=0	+ve
Education(EDU)	Level of education completed the household head	years	+ve
Family size(Fmlysz)	Number of people in the households	Number	+/-ve
Farming experiences (Farmexp)	Households Farming experience	year	+ve
Farm size (Farmsz)	Households total land holding	Hectare	+ve
Non-farm income (NFI)	Household access to non-farm income	ETB	+ve
sorghum production(Sprdn)	Total amount quantity produced	Kilogram	+ve
sorghum price(SMS)	Market sorghum prices	ETB	-ve
sorghum consumption(Scon)	Sorghum home consumed	Kilogram	-ve
Credit access (CREDT)	Household access to credit	1 if user, 0 otherwise	+ve
Market information (MKTINFO)	Household access to market information	1=yes 0=otherwise	+ve

ETB = Ethiopian Birr
Source: Own, based on literature review, 2021/22

Table 3: General descriptive statistical characteristics of sampled households (continuous variables).

Explanatory Variable	Obs	Mean	Std. Dev.	Min	Max
HH family size	130	6.73	2.679	1	14
Sorghum quantity sold(kg)	130	118.4	147.003	0	600
Farming experience(year)	130	16.97	9.488	1	42
HH total land holding(ha)	130	1.28	0.643	0.25	3
Quantity of sorghum produced(kg)	130	1068.06	601.585	200	2950
Sorghum consumption(kg)	130	821.67	487.27	0	2100
Non-farm income(birr)	130	3186.57	3606.98	0	13050
HH education status(in year)	130	4.14	3.11	0	11
Distance to nearest market(km)	130	6.61	3.5	1	18
Distance to cooperative(km)	130	20	4.43	0	20
Land allocated for sorghum	130	0.77	0.77	0	2
livestock owned/TLU/	130	4.24	2.49	0.06	11
Household age in years	130	37.91	10.26	20	65
Sorghum farming experience	130	13.82	9.94	1	40
Source: Own survey result, 2021/22					

Table 4: Mean characteristics of sampled households by market participation status.

	Market participant(N=67)		Non-market participant(N=63)		
Variable	**Mean**	**Std**	**Mean**	**Std**	**T-test**
Household age in years	36.43	9.409	39.48	10.96	0.091*
Family size	6.91	2.58	6.54	2.78	0.432
HH education status(in year)	4.46	3.11	3.79	3.09	0.22
Non-farm income(birr)	3362.99	3551.75	2998.9	3683.97	0.567
Farming experience(year)	17.48	10.14	16.49	8.87	0.557
Sorghum farming experience	14.16	10.48	13.44	9.39	0.68
Land allocated for sorghum	0.8	0.32	0.74	0.33	0.058*
livestock owned/TLU/	4.37	2.29	4.11	2.7	0.555
HH total land holding(ha)	1.3	0.626	1.246	0.664	0.583
Note:*Represent significance of factors at 10%. Source: Research field Survey result, 2021/22.					

process and the non-market participants. This result contradicts with the findings of Kyaw et al,(2018).

The t-statistics value shows that the mean difference in the household and in years among the two groups, market participant and non-market participants, was statistically significant and positive at less than 10% level of significance. This reveals that there is an indirect relationship between the household and sorghum market participation decision. Hence, this study can conclude that the mean household age in years of household head for sorghum market participant was lower than non-non market participant. This means the older the age of the household the lower to involve in sorghum market.

Additionally, the T-test value shows that mean difference in land allocated for sorghum among market participants and non-participants households was statistically significant and positive at less than 10% significant level. Hence, this study can conclude that the mean land allocation by the household head for sorghum production for market participants was higher than non-participants. This reveals that there is a direct relationship between the land allocation for sorghum production and market participation decisions (Table 4).

In addition to T-test chi-square test is used to determine substantial variations between categorical variables among both market participant and non-market participants' households in the study area. The chi-square values of household head sex and household head status of categorical variables listed in the model of sorghum market participation indicate negligible variations in both groups. Male headed households dominate surveyed households, both in supplying sorghum to output marketing. Female have traditionally been heavily involved in agriculture, while men work off-farm to supplement the household income [16].

The result shows that 65 (97%) of sorghum market participants were male, while 2 (3%) were female. And also, 54 (85.7) of non-market participants were male, while 9 (14.3%) were female. Regarding cooperative membership, 31 (46.3%) of sorghum market participants were members of cooperative, while 36 (53.7%) were non-members. About 31 (49.2%) of non-market participants were members, while 32 (50.8%) were none-members. The distribution households for market information access of sorghum market participants were,62 (92.5%) for those who have market access and 31 (49.2%) household heads not have market information access, respectively.

On the other hand, 21 (33.3%) of non-market participants have access to market information, while 42 (66.7%) were do not have access to market information. Furthermore, about 25 (37.3%) of sorghum market participants were trained and 42 (62.7%) not participating on training. This indicated that the use of modern communication mass media like radio, television and printouts was lacking. Also according to survey result they lack reliable information and the power of deciding on the price of sorghum, price of inputs. This is because local traders mainly focus on their profit and they deliver low market price for sorghum and inputs that was not profitable for producers.

The chi-square values for access to market information, gender, and categorical factors extension services (training access) included in the model for selling sorghum to the market suggest major variations

in both groups. Therefore, it can be said that market information access is one of the determining factors in market participation households in sorghum and its products. In other words, the more people have access to the market information, the more they are willing to participate in sorghum output market and the more successful they will be. The chi-square statistics value shows that there is a significant difference at less than 1 percent, in access to market information by a sorghum market participants and non-market participants household. Hence, as market information makes a difference in decision to market participation [17].

The findings show that there is a statistically important gap about exposure to training by extension officers and other training providers at less than 10 percent, between those who participate and non-participants in sorghum market. Therefore, it can be said that the access of training by different training providers in the field of production can be very important in encouraging people to commercialize. The chi-square test of sex distribution between the market participant and non-participant was found to be significant at less than 5 percent significance level with chi square value of 0.021. Hence gender makes differences in decision to market participation (Table 5).

Sorghum production and supply to market in the study area

Crop production in the study area was not only for home consumption but also for meeting cash requirements of the producers. Particularly sorghum was produced for market and also used for home consumption in the study area. According to the survey result, in the study area sorghum average production was 1171.8 kg for market participant households and 957.69 kg for non-market participant households during 2021 cropping year. From the volume of the sorghum produced on average 224.88 kg with standard deviation of 134.06 kg sorghum was sold by market participant household and additionally on average 800.16 kg and 841.89 kg of sorghum were consumed by market participant and non-participant households at home respectively. This shows as production of sorghum is the major important sources of food and income in the study area [18].

The t-test revealed that market participants and non-market participants had statistical significant differences with regards to sorghum production and sorghum quantity sold to market by households in study area. However the t-test result depict that household sorghum consumption by market participant and non-participant has no significant difference. The result shows that amount of sorghum produced and sorghum quantity sold were statistically significant at 5% and 1% probability level respectively signifying that the mean sorghum quantity produced by market participants was greater than that of non-market participants. The higher production of sorghum by households leads to higher market participation (Table 6).

Result of econometric results

In a survey data set a researcher should expect to encounter many problems i.e. the problems of multicollinearity are very common in cross-section data. Data should be cleared before it is used for purposes of analysis. Outliers were checked using the box plot graph so that there were no serious problems of outlier and no data get lost due to outliers. While fitting important variables in the models a test for multicollinearity problem among all hypothesize explanatory variables was performed using VIF for each continuous variables were found to be less than ten thus, there is no multicollinearity problem among all the hypothesized continuous explanatory variables included in the model as indicated. Also the result of Contingency Coefficient (CC) revealed that there was no a serious problem of association among dummy explanatory variables as the contingency coefficient did not exceed 0.75 (Appendix 2).

Determinants of smallholder sorghum farmers market participation

Based on the results of probit model estimation of the determinants of the probabilities of the farmer's participation decisions in sorghum market.This table also contains the values of marginal effects which are evaluated at the means of all other independent variables. The model chi-square tests applying appropriate degrees of freedom indicated that the overall goodness of fit of the probit model was statistically significant at a probability of less than 1% (Wald chi2 (10) = 247.34 with Prob > chi2 = 0.0000) factor level. This showed that jointly the independent

Table 5: Proportion characteristics of sampled households by market status.

Variables description	Market participant(N=67)		Non participants(N=63)		Total (%)
	Category	N(%)	N(%)	N(%)	Chi-Square (χ2)
Gender	Male	65(97)	54(85.7)	119(91.5)	0.021**
	female	2(3)	9(14.3)	11(8.5)	
Cooperative membership	Yes	31(46.3)	31(49.2)	62(74.7)	0.738
	No	36(53.7)	32(50.8)	68(81.9)	
Market information	Yes	62(92.5)	21(33.3)	83(63.8)	0.000***
	No	5(7.5)	42(66.7)	47(36.2)	
Extension services(training)	Yes	25 (37.3)	33(52.4)	58 (44.6)	0.084*
	No	42(62.7)	30(47.6)	72(55.4)	

Note:***,**,*,represent significance of factors at 1,5 and 10% level respectively.
Source: Research field Survey result, 2021/22.

Table 6: Production and market supply of sorghum sampled households.

Variable	Market participant		Non market participant			
	Mean	Std.	Mean	Std.	T-value	Sig.(2-tailed)
Sorghum produced(kg)	1172	552.8	957.7	635.4	2.054	0.042**
Sorghum quantity sold(kg)	224.9	134.1	0	0	12.822	0.000***
Sorghum consumption(kg)	800.2	479.8	841.9	496.9	0.487	0.627

Note:***,**,represent significance of factors at 1 and 5%respectively
Source: Research field Survey result, 2021/22.

variables included in the probit model regression explain the variations in the farmer's probability to sorghum market participation decision.

The model result indicated that, out of 11 explanatory variables (8 continuous and 3 dummy) were included in the model, five were found to be significant in influencing farmers' decision to participate in sorghum market or not at 1%, 5% and 10 % significant levels. This variables include gender of the household, access to market information (MKTINFO), age of the households head, sorghum production and sorghum consumption of the households (Table 7).

Gender of the household head: Gender of the household head is one of the determinant factors of sorghum market participation decision. As it was hypothesized the probit estimation model indicates gender of household head was found to be a positive and significant factor in explaining probability of sorghum crop commercialization decisions at 5% significant level. This positive marginal effect coefficient shows being male headed households are more likely to participate in sorghum market than female one. Male headed households increases the probability of being to participate in sorghum marketing by 1.89% than that of female household heads. This can be due to male households have information access and more resource allocation i.e. labor, skill and good contacts with farming community in sorghum production. The result is consistent with the findings of Leykun and Haji,(2014) which found that male-headed households have a better access to information who would provide them with better ability to manage their farms and produce more output for market as compared to female headed households.

Access to market information (MKTINFO):As it was hypothesized access to market information has positive and significant effect of on sorghum producing households market participation decision at 10% significant level. Households who have better market related information have better position in marketing activities and supply their produce to market than households those have no or low market related information access. Household who participate in marketing activities of their produce this marketing involvement may raise market information as the same time increases the probability of market participation of active market participants in their surplus market. This implies that access to market information both on input and out market could help farmers to make production decision on the basis of market signal and this allows them to produce mostly for market.

The result of probit estimation coefficients of marginal effects confirms that it the probability of households to access to market information increases, the farmers intention to participate in sorghum market increases by 2.28%.This result in lines with the study made by Ahmed et al.,(2016) who found access to market information positively determines potato market supply to market.

Age of the household head: Age of the household head is another important variables which was found important factor determining households commercialization decisions. Age of the household head which was considered to have a positive or negative impact on households commercialization decision, has a negative sign and significant. This result indicate that as the household ages increases, the probability of households to participate sorghum market decreases and the result is statistically significant at 5% level of significance.

This is may be due to younger households are more likely to take risk associated with market and new technology than older households. In addition younger households have more updated information, access to mobile phone for information source and have long planning that motivates them to invest sorghum commercialization decisions. The result of model indicates one more unit increase in the age of the households decreases the probability of sorghum market participation by 1.61%.This result in lines with the study made by Workneh and Michael, (2002).

Volume of Sorghum production: Another explanatory variables that determine the market participation decision of the sorghum producing households was the volume of annual sorghum production. As hypothesized household volume of sorghum annual production show that increase in volume of annual sorghum production increases the households sorghum market partipation.as expected this variable had positive significant effect on the decision of households to sorghum market participation at 10% significant level. The marginal effect model result indicates as the volume of annual sorghum production increases the probability of the households to market participation decisions increase by 1.29% quintal for each additional quintal of harvest, keeping all other variables constant. This implied that Households with relatively large quantities of produce had not only more likely to participate in market, but also sell a higher proportion of their output. Therefore, generating and disseminating improved sorghum technologies would bring a positive effect in sorghum sector not only

Table 7: Probit Estimate of determinants of sorghum market participation decision.

Variables	Coefficient	Standard error	Marginal effect (dy/dx)	z-value	p-value(P>z)
Gender	1.894233**	0.865	1.8942**	2.19	0.028
MKTINFO	2.28954***	0.373	2.2895***	6.13	0
Age	-1.611463**	0.804	-1.6115**	-2	0.045
Scon	-1.100257***	0.405	-1.1003***	-2.72	0.007
Farmsz	0.053	0.314	0.053	0.17	0.867
Fmlysz	0.609	0.385	0.609	1.58	0.114
CREDT	0.256	0.338	0.256	0.76	0.45
Sprdn	1.598497***	0.454	1.5985***	3.52	0
EDU	-0.104	0.231	-0.104	-0.45	0.652
Farmexp	0.458	0.316	0.459	1.45	0.146
NFI	-0.045	0.045	-0.045	-0.99	0.321
_cons	-3.252	3.012		-1.08	0.28
/Mills lambda	0.413	0.115		3.59	0
rho	1				
*=significant at 10% level of significance, **= Significant at 5% level of significance, ***=Significant at 1% level of significance, Total observation=121, Wald chi2(10) = 247.34, Prob > chi2 = 0.0000					
Source: Model result of research field Survey, 2021/22.					

at the production sector but also at the marketing sector. This finding is Consistent with previous studies made by (Ahmed et al, 2016;Oteh and Nwachukwu, 2014) volume of total potato and casava harvest was positively affect market participation decisions of household.

Volume of sorghum consumption: As expected volume of sorghum consumption was significant and negatively associated with the probability to supply sorghum at 10% significant level. This means that as the consumption of sorghum increases in the households the probability of the farmers orientation towards market commercialization decision reduced. This implication is that households sorghum market participation decisions depends on households annual sorghum consumption requirements this is may be because of household size that could be fulfilled from the volume of sorghum production. Those households participate after they satisfy need of family home consumption. Thus the probit estimate of marginal effect result indicates that a unit increase in the consumption sorghum by households decreases the probability of households to participate in sorghum market by 1.10 % remaining other factors constant. This result is in line with the findings of Hailua et al, (2015) who found family size increase decreases the participation of households to market, since larger family size could potentially absorb a significant portion of the produce to home consumption [19].

Conclusion and Recommendation

There is need to deliberately improve the smallholder commercialization decision in order to facilitate stable income and sustainable livelihoods in Ethiopia. However, given the area coverages and high production of major food cereal crops such as sorghum by smallholder farmers, they face several constraints that make it difficult for them to participate in the agricultural output market. Motivated by the gap of previous studies and sorghum potential of Gololcha and Shene Kolu Districts this study was undertaken with the objective of analyzing household factors determining smallholder farmers decision to participate in output market. Primary data were collected from 130 representative sampled households by using three stage random sampling technique among sorghum producer households from randomly selected five kebeles through pre tested semi-structured questionnaire and six focus group discussions in the study area. Secondary data were collected from district office of agriculture, websites, books, journal articles, and central statistical authority.

Results of cross-sectional survey indicates that out of 130 total sample households interviewed, 67 (51.1%) and 63 (48.5) were market participant and non-participants of sorghum output markets in 2021/22 production year respectively. Furthermore, the result from probit model shows that gender of the household head, access to market information, households annual sorghum production significantly and positively affect household sorghum market participation decision, while age of household head and household sorghum consumption negatively and significantly affect household sorghum market participation decision in the study area.

In general understanding, the factors affecting households' market participation decisions and their extent are very important for policymaking to address the problem of market of farm households. From the result of this research, the following policy implications are forwarded based on the result of the study. Households sorghum annual production affected positively and significantly smallholder market participation. This indicates that higher levels of crop production enhanced smallholders' market participation , implying that strategies that aim at improving household capacity to produce surplus production per unit area of land through optimal allocation of resources enhancing productivity.

Access to market information was found positively affect the market participation decision through providing better information and thereby decreasing fixed transaction costs like searching and processing information, and etc. Commercialization requires market oriented production system and requires information about markets. However, smallholder farmers often face information asymmetry in the factor and product markets which forces them in to production for subsistence. Therefore, provision of market information facilities infrastructure to avoid information asymmetry should be given prior attention.

Sorghum consumption affected households market participation decision negatively and significantly. This indicates within limited production large family members in households used sorghum for home consumption rather than supply to market. Therefore, intervention should be provided on teaching households on family planning to rural community. It is obvious that most farmers do not balance their family size with their income from their livelihood activities. These situations aggravated the country's food insecurity problems. Therefore, strengthening family planning is required from the government side.

Age of the household affected households market participation decision negatively and significantly. The implication is that as the household head of the family gets old, the productivity and efficiency of the head tends to decrease resulting in declining labor productivity leading to low marketable surplus. This could be due to the better educational level and source of market information of younger farmers Therefore, intervention intended at raising the efficiency of youth to involve to sorghum agricultural production to obtain more agricultural production with the district is important.

Author contribution statement

The authors confirm contribution to manuscript as follow: in the conception and design of this study: Belay Roba, Mekonnen Sime (PhD) and Abebe Teshome; data collection: Belay Roba; Analysis and interpretation of results: Belay Roba, Mekonnen Sime (PhD); draft manuscript preparation: Belay Roba, Mekonnen Sime (PhD), and Abebe Teshome. All authors reviewed the results and approved the final version of the manuscript.

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Data availability statement

This manuscript contains all the data created during the study.

Declaration of interest of statement

Authors have declared that no competing interests exist

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References

1. Abdi RD (2017) Brucellosis and some reproductive problems of indigenous Arsi cattle in selected Arsi Zone's of Oromia Regional State , Ethiopia. Global Veterinarian 45-53.
2. Addisu GA (2018) Determinants Of Commercialization And Market Outlet Choices Of Tef: The Case of Smallholder Farmers in Dendi District of Oromia, Central Ethiopia (Doctoral dissertation, Haramaya University).
3. Ahmed YE, Girma AB, Arado MK (2016) Determinants of Smallholder Farmers Participation Decision in Potato Market in Kofale District, Oromia. International Journal of Agricultural Economics 1: 4044.
4. Bekele A, Belay K, Legesse B, Lemma T (2010) Effects of crop commercial orientation on the productivity of smallholder farmers in drought-prone areas of the Central Rift Valley of Ethiopia. Journal of Rural Development/Nong chon-Gyeongju 33: 105-11.
5. Birhanu FZ, Tsehay AS, Bimerew DA (2021) The effects of commercialization of cereal crops on multidimensional poverty and vulnerability to multidimensional poverty among farm households in Ethiopia. Dev Stud Res 8:378-95.
6. Demeke M, Di Marcantonio F (2013) Analysis of incentives and disincentives for sorghum in Ethiopia. Technical notes series, MAFAP, FAO, Rome.
7. Egbetokun A, Omonona BT (2012) Determinants of Farmers' Participation in Food Market in Ogun State. Global Journal of Science Frontier Research Agriculture and Veterinary Sciences 12:1.
8. Haile K, Jemal Haji M, Bosena T (2018) Technical Efficiency of Sorghum Production : The Case of Smallholder Farmers in Konso District, Southern Ethiopia. Journal of Agricultural Economics, Extension and Rural Development: 6: 772-793.
9. Hailua G, Manjureb K, Aymutc K (2015) Crop commercialization and smallholder farmers ` livelihood in Tigray region, Ethiopia. Journal OD Development and Agricultural Economics 7: 314-322.
10. Kyaw NN, Ahn S, Lee SH (2018) Analysis of the Factors Influencing Market Participation among Smallholder Rice Farmers in Magway Region, Central Dry Zone of Myanmar. Sustainability 10: 4441.
11. Leykun D, Haji L (2014) Econometric Analysis of Factors Affecting Market Participation of Smallholder Farming in Central Ethiopia Econometric Analysis of Factors Affecting Market. Munich Personal RePEc Archive 77024.
12. Mbitsemunda JPK, Karangwa A (2017) Analysis of factors influencing market participation of small-holder bean farmers in Nyanza district of Southern Province, Rwanda. The Journal of Agricultural Science 9: 99-111.
13. Mitku A (2014) Impact of smallholder farmers' agricultural commercialization on rural households' poverty. Int J Appl Econ Finance 8:51-61.
14. Nangobi R, Mugonola B (2018) Determinants of collective marketing and marketable surplus for smallholder Sorghum producers in Oyam district, Uganda. J Dev Agric Econ 10:213-224.
15. Oteh OU, Nwachukwu IN (2014) Effect of commercialization on productive capacity among cassava producing households in kuwanon local government area of Abia state, Nigeria. Management, Economic Engineering in Agriculture and Rural Development 14:213-220.
16. Pingali PL (1997) From Subsistence to Commercial Production Systems: The Transformation of Asian Agriculture. American Journal of Agricultural Economics 79: 628-634.
17. Ramalho EA, Ramalho JJS (2009) Strategies for fractional regression models Alternative estimating and testing empirical strategies for fractional regression models. Economic Development 19-68.
18. Wooldridge (2002) Wooldridge_Panel_Data_Chapters.pdf. In Econometric Analysis of Cross Section and Panel Data. Journal of Econometrics 19: 48-67.
19. Workneh Negatu MR (2002) Intensification and Crop Commercialization in Northeastern Ethiopia. Ethiopian Journal of Economics 11:84-107.