



# Factors Influencing Participation Decision of Smallholder Farmers on Cluster Farming: The Case of Wheat Technologies in Dawoo District, South-West Shewa Zone, Oromia Region, Ethiopia

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**Abstract:** Wheat is the most widely grown cereal crop in the world, with an ever-increasing demand. It plays a fundamental role in food security, and a major challenge is to meet the additional requirements with new cultivars and improved cropping technologies. This research evaluated the determinant factors influencing participation decisions of smallholder farmers in wheat cluster farming at Dawo District South-West Shewa Zone Oromia region. Dawo District was purposefully selected from the South-West Shewa Zone due to its wheat potential agro-ecological area and implemented wheat cluster farming. Based on the proportion of PAs that undertake cluster farming, four PAs were selected. Then using stratified random sampling PAs stratified into two strata: These are Wheat cluster farming and wheat non-cluster farming participants. In total, 138 (participants 92 and non-participants 46) respondents were selected using systematic random sampling. The binary logistic regression results revealed that the education level of the household head, wheat farming experience of the household head, landholding size, distance to extension services, membership to cooperative, and access to credit services were the variables that significantly affected participation decision of smallholder farmers in wheat cluster farming. Therefore, the research results recommend the need for continued and broad public and private awareness creation in agricultural innovations participation to address vital development challenges and the need for policy support for improving extension efforts and access to the full package for cluster implementation among smallholder farmers that stimulate participation decision on cluster farming of improved agricultural technologies.

**Keywords:** Agricultural innovations, Full package, Policy support, Smallholder farmers.

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## Research Paper

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## 1. INTRODUCTION

Bread wheat, with an annual global production of 772.6 million tons, is a staple food for more than 35% of the world's population (CSA 2021). Globally, China, India, and Russia are the largest wheat producers, while South Africa and Ethiopia are the largest wheat producers in sub-Saharan Africa (USDA 2019). Ethiopia's annual production is about 5.8 million tons with a mean productivity of 3 tons per hectare ( $tha^{-1}$ ) (CSA 2021), which is relatively lower than the attainable yield of the crop, reaching up to 5  $tha^{-1}$  (Zegeye *et al.*, 2020). Wheat accounts for about 17% of total grain production in Ethiopia making it the third most important cereal crop after teff and maize (CSA 2021). The most suitable altitude range for wheat production is between 1900 and 2700 asl (Hunde *et al.*, 2000). It is the most widely grown cereal crop in the world, with an ever-

increasing demand. It plays a fundamental role in food security, and a major challenge is to meet the additional requirements with new cultivars and improved cropping technologies.

Therefore, improving the yields of this crop is very important since the diets of human beings on every continent rely on this staple crop. As per FAOSTAT (2014), wheat production has shown an increasing rate due to an increase in area coverage but, productivity in a unit area of land is not as expected.

The idea of the Agricultural cluster was introduced in Ethiopia together with the Agricultural commercialization cluster as a means of integrating different prioritized interventions in the transformation Agenda, within specific geographies targeting a limited

number of high-value commodities during the first Growth and Transformation Plan (GTP) of Ethiopia (ATA 2019). The cluster farming concept was adopted by farmers in the Oromia region farmers' groups in the Arsi and Bale zones. It also involves smallholder farmers, but not necessarily in contiguous farms. The South-West Shewa zone highland areas are relatively suitable for wheat production in clusters due to their cooler temperatures and high rainfall conditions.

Dawo district is one of the major wheat-growing areas in the South-West Shewa zone of Oromia region. They are known for the cultivation of many crops which include, among others, cereals such as teff, wheat, Maize, barley, pulses, etc (District Annual Report 2021). Of the total regional wheat production, most of it is coming from South-West Shewa and other zones of the region. Even if the province and specifically the district is endowed with potential area for wheat production the lower production hinders the living standard of the household. Therefore, to improve the living standard of smallholders sustainably, introducing improved methods of agricultural practice, and advising smallholders to use improved wheat varieties, fertilizers, and chemicals are the basic ones. Agricultural cluster in general and teff cluster farming in particular in the study district have been conducted since 2018 (Districts annual report, 2021) and this farming approach has great contribution to the productivity of the farmers in the district, but there was no empirical information so far on why smallholder farmers did not participate in agricultural technologies in general cluster farming in particular. Therefore, the objective of the study was to evaluate the determinants that affect the participation decision of smallholder farmers in wheat cluster farming in selected districts to fulfill the existing knowledge gap.

## 2. MATERIALS AND METHODS

### 2.1 Description of Dawo District

Dawo district is one of the 12 districts in the South-West Shewa Zone of Oromia region, Ethiopia. It is located about 96 km South-West of the Capital city of Ethiopia Addis Ababa and 50 km East direction of Wolliso town. Geographically, the city is located at 8°47'43" N latitude and 38°07'39" E longitude with an

average elevation of 2207 meters above sea level. This district is bounded by Ilu District in the East, Dandi District in the West, Dandi District and Ejersa lafo District in the North, and Bacho District and Walliso District in the South. The district has an annual rainfall of 900-1400mm. The annual temperature ranges from 14-25 °C. Administratively, the district is made up of 24 kebeles (22 rural and 2 urban kebeles). The total population number of the study area is 86705 (44018 males and 42687 females). There are 12804 households with 10786 male and 2018 female-headed households, respectively in the district. The land use pattern of the district shows that from the total of 45546.83 ha, 34234ha is cultivated land; 1263ha is covered with forest, 5739.94 ha is grazing land, and 733.3ha with used for other social purposes. The major crops produced in the district are Teff, wheat, Maize, barley, and pulse crops (District Office of Agriculture 2021).

### 2.2 Data Types and Methods of Data Collection

A formal survey was employed to gather primary and secondary data for this study. As part of the formal survey, interviews were done with a select group of wheat producers and Farmers using a previously evaluated structured and semi-structured questionnaire. Secondary data was gathered from online resources, including published materials and unpublished documents.

### 2.3 Sampling Techniques and Sample Size

A multistage sample procedure was used to collect the data. In the first stage, Dawo District was purposefully selected from the South-West Shewa Zone due to its wheat potential agro-ecologic and implemented wheat cluster farming. In the second stage, based on the proportion of Peasant Associations (PA) that undertake cluster farming, four PAs (Bashi Kiltu, Sedere Harbu, Gombisa Kusaye, and Tute Qunche) were selected. Then using stratified random sampling PAs stratified into two strata: These are Wheat cluster farming and wheat non-cluster farming participants. In total, 138 (participants 92 and non-participants 46) respondents were selected using systematic random sampling. The total sample size of smallholder farmers is determined using the simplified formula provided by Yamane (1967).

**Table 1: Distribution of sample households in the district**

No.	Sample PAs	Farm households	Sample size		Total sample size
			Participants	Non-participants	
1	Bashi Kiltu	946	42	21	63
2	Sedare Harbu	372	17	9	26
3	Gombisa kusaye	289	13	6	19
4	Tute Qunche	441	20	10	30
	<b>Total</b>	<b>2048</b>	<b>92</b>	<b>46</b>	<b>138</b>

*Source: Own data. 2021*

### 2.4 Method of Data Analysis

Descriptive statistics and inferential statistics along with econometric models were used to analyze the data. Descriptive statistics such as mean, standard

deviation, frequency, and percentage were employed to analyze the data collected on socioeconomic, institutional, and agroecological characteristics of the sample households while inferential statistics such as t-

test and chi-square ( $\chi^2$ ) tests were used to undertake statistical tests. The econometric analyses followed the following processes. Binary logistic regression was incorporated to analyze relationships between a dichotomous dependent variable and explanatory variables. This model was chosen because it has the advantage that it reveals the relative influence on the probability of participation decision of the smallholder farmers in teff cluster farming.

**The dependent variable ( $Y_i$ ):** The dependent variable of the model (binary logistic analysis), is dichotomous representing the farmer's participation decision in wheat

cluster farming. The variable takes the value of 1 for the households that participated in cluster farming during survey time and 0 for households that did not participate in wheat cluster farming.

**Independent variables:** It is hypothesized that the decision to participate in cluster farming is influenced by a set of independent variables. The explanatory variables of importance in this study are those variables, which are thought to influence the participation decision of wheat cluster farming. These include personal and socio-economic characteristics, technical and institutional variables ( $X_i$ );

**Table 2: Summary of definition and Measurement of variables**

Variables	Type, Definitions, and measurement of variables	Their expected sign
<b>Dependent variable</b>		
Participation decision	Dummy (Yes/No)	
<b>Explanatory variables</b>		
Gender of household head	Dummy: Male/Female	+
Experience in growing wheat	Continuous: no. of years	+
Education level	Categorical: attended formal education	+
Age of farm household	Continuous: no. of years	+/-
Distance to extension service	Continuous: in Km	+/-
Family size	Continuous: No. of family members	+
Landholding size	Continuous: Cultivated land in ha	+
Cooperative membership	Dummy: members or otherwise	+
Access to credit service	Dummy: Yes/No	+
Oxen ownership	Continuous: TLU	+
Parti. decision on demonstration	Dummy: Yes/No	+
Training on improved crop mgt	Dummy: Yes/No	+
Exchange visits participation	Dummy: Yes/No	+

*Source: Own definition, 2021*

### 3. RESEARCH RESULT AND DISCUSSION

#### 3.1 General household demographic characteristics

In the current study farmers who did not participate in cluster farming of wheat is considered as

non-participants while the farmers who participated at least one year and more on cluster farming were taken as participant (Table 3).

**Table 3: Rate of Participation Decision**

Rate of participation decision	Non-Participant		Participant		Total Sample	
	N=46	%	N=92	%	N=138	%
	46	33.33	92	66.67	138	100

*Source: computed from survey data*

#### 3.2 Rate of participation decision on Wheat cluster farming in the study district

In the selected district all the sampled respondents were smallholder farmers practicing mixed crop livestock farming. Table 3: shows the household rate of participation decisions on wheat cluster farming. As shown in the table the rate of participation decision is 66.7 %. In this research, the intensity of participation

decisions is assessed based on the proportion of participation in wheat cluster farming in the study district. In Dawo District wheat technologies have been popularized through a pre-scaling up approach as a result the most productive varieties like Kingbird, Wane, and Liban were among the varieties that were clustered and made available to farmers through the Ambo Agricultural Research Center (Table 4).

**Table 4: Number of varieties popularized in the study district (from 2018-2020)**

District	Varieties	Area coverage (ha)	No. of participants
Dawo	Wane	32	121
	Liban	23	88
	Kingbird	16	62
<b>Total</b>		<b>71</b>	<b>92</b>

*Field survey, 2021*

### 3.3 Farmers Demographic characteristics

The descriptive analysis for determinants on participation decision of smallholder farmers for dummy, categorical, and continuous variables results reveal that there are significant differences between both participants and non-participant groups in terms of education level, availability of credit, capacity building/training on crop management, wheat farming

experience and landholding size. However, no significant differences were observed between participants and non-participants in cluster farming in terms of the gender of household heads, membership to cooperative, access to participate in the demonstration, exchange in field visits, age, distance to extension services, family size, and oxen ownership (Table 5 and 6).

**Table 5: Socioeconomic characteristics of respondents (Continuous variables)**

Descriptions of variables	Participants		Non-Participants		Total		P-value
	Mean	SD	Mean	SD	Mean	SD	
Experience in growing wheat	14.326	4.550	11.782	4.0106	13.478	4.526	0.02
Age of farm household	47.163	7.903	47.152	7.375	47.159	7.704	0.99
Distance to extension service	2.141	1.236	2.130	1.045	2.137	1.172	0.96
Family size	5.015	1.253	4.895	1.220	4.975	1.239	0.59
Landholding size	1.118	0.192	0.8032	0.189	1.013	0.242	0.00
Oxen ownership	2.945	1.447	2.9130	1.261	2.934	1.383	0.89

Source: Survey data 2021

**Table 6: Socioeconomic characteristics of respondents (Dummy and Categorical variables)**

Descriptions of variables	Non-Participants		Participants		Overall		X <sup>2</sup>	P-value
	N	%	N	%	N	%		
<b>Gender of hh</b>								
Female	17	12.32	31	22.46	48	34.78	0.143	0.705
Male	29	21.01	61	44.2	90	65.22		
<b>Education Status</b>								
Illiterate	23	16.7	21	15.22	44	31.88	12.08	0.007***
Primary	15	10.86	39	28.26	54	39.13		
Secondary	8	5.79	27	19.56	35	25.36		
Certificate/Dip	0	0.00	5	3.62	5	3.62		
<b>Cooperative membership</b>								
No	5	3.62	4	2.89	9	6.52	2.14	0.14
Yes	41	29.71	88	63.76	129	93.48		
<b>Access to credit</b>								
No	25	18.11	30	21.74	55	39.85	6.05	0.014**
Yes	21	15.21	62	44.93	83	60.14		
<b>Part. in a demonstration</b>								
No	22	15.94	38	27.54	60	43.47	0.53	0.47
Yes	24	17.39	54	39.13	78	56.52		
<b>Training on improved crop mgt</b>								
No	35	25.36	47	34.06	82	59.42	7.95	0.005***
Yes	11	7.97	45	32.6	56	40.57		
<b>Exchange visits participation</b>								
No	25	18.12	39	28.26	64	46.37	1.76	0.184
Yes	21	15.22	53	38.4	74	53.62		

Source: Survey data result 2021

### 3.4 Econometric Results: Binary Logistic Regression: Factors Affecting Participation Decision on Wheat Cluster Farming:

In this section, selected explanatory variables were used to estimate the binary logistic model to analyze the factors affecting the participation decision of smallholder farmers in wheat cluster farming in the study area. The estimates of parameters of the variables

expected to influence the participation decision of smallholder farmers are displayed in Table 7. Finally, a set of thirteen independent variables (6 continuous and 7 dummy variables) were included in the analysis model. These variables were selected based on theoretical explanations, personal observations, and the results of the survey studies.



**Table 7: Results of the Logit regression model**

Variables	Coef.	SE	t	p
Age of household head	0.00020	0.00461	0.05	0.964
Education level	0.10710	0.03718	2.88***	0.005
Experience in growing wheat	0.02025	0.00733	2.76***	0.007
Gender	-0.06905	0.06973	-0.99	0.324
Landholding size	0.85658	0.13153	6.51***	0.000
Oxen ownership	-0.00868	0.02306	-0.38	0.707
Family size	0.01529	0.02807	0.54	0.587
Cooperative membership	0.229363	0.08203	2.8***	0.006
Distance to extension service	-0.00171	0.03003	-0.06*	0.954
Access to credit	0.24098	0.06908	3.49***	0.001
Exchange visits participation	-0.00721	0.06309	-0.11	0.909
Training on improved crop mgt	0.00759	0.06405	0.12	0.906
Part. in a demonstration	0.04376	0.06393	0.68	0.495
_cons	-1.02939	0.25466	-4.04	0.000

Source: own survey data, 2021. \*\*\*, \*\*, \* Significant at 1, 5, and 10 % probability levels respectively

This model result shows the existence of two separate decision-making stages during participation decision processes. This result provides an empirical result of farmers' independent decision-making regarding the determinants of participation decisions of smallholder farmers in wheat cluster farming. In general, the estimated results for the binary logistic model shows some variables appearing in both equations have opposite influence in terms of both signs and level of significance. The impression of these variables on the dependent variable is discussed below.

#### Landholding

It was found that land size had positively and significantly influenced the probability of participation decision of smallholder farmers on wheat cluster farming at less than 1% significant level. The implication is that farmers with large farm sizes are more likely to decide to participate in wheat cluster farming than those farmers who have small land sizes. The result of this study confirms the earlier findings of (Dawit 2020).

#### Distance to extension service

Sample households were located at a mean distance of 2.14 kilometers away from the nearest main market. Participant farmers were a mean of 2.14 kilometers away from their extension service while non-participant farmers were 2.13 kilometers away. A mean difference in extension service between Participant farmers and non-participant farmers was statistically significantly different at a 1 percent significance level. The negative association suggests that the likelihood of deciding to participate in cluster farming declines as the distance from the extension service increases. This implies that farmers who are close to the extension service are more likely to participate in wheat cluster farming than those who reside far from the extension service (Alemitu M, 2011).

#### The education level of household heads

Was positive and statistically significant at a 1 percent level. All other variables remain constant the

model result clearly shows that as farmers' year of schooling increases the level of awareness and hence farmers can easily decide to participate in cluster farming for further management practices. The more educated a farmer is, the more he is to diagnose and observe the benefits. This result is consistent with Birilie (2017 cited in Gadisa *et al.*, 2021) and Temesgen (2019).

#### Access to credit

Had a positive and significant coefficient, suggesting that agricultural credit in the two groups can have a significant impact in facilitating the participation decision on wheat cluster farming in the study area. One possible reason for this could be that access to credit is a key determinant of participation decisions on most agricultural innovations as this increases farmers' financial capacity to purchase seeds and other related inputs. From this result, it can be stated that those farmers who have access to formal credit from any governmental or non-governmental organization are more likely to decide to participate than those who have no access to formal credit. This result is consistent with Temesgen (2019), Habtewold, (2018), and Dawit *et al.*, (2018).

#### Cooperative membership

Farmers' participation in cooperative groups has increased farmers' ability to decide participation in agricultural innovations and also creates favorable conditions for farmers in exchanging information and participating in different agricultural training. The coefficient for group participation was statistically significant at a 1 percent level. The model results imply that being a member of a cooperative group favors the participation decision of wheat cluster farming among smallholder farmers. The significant relationship between being a member of a cooperative society and participation decision is an indication of the importance of rural financial institutions in supporting agricultural production, particularly cereal farming. The findings from the studies by (Dawit 2020) are consistent with this result.

### Teff farming experience

Farmers with longer farming experience are supposed to have better competence in assessing the characteristics and potential benefits of new technology than farmers with shorter farming experience. Teff farming experience was positive and statistically significant at a 1 percent level of significance. This implies that the more years of experience in farming, the higher the likelihood of deciding to participate in cluster farming. It is assumed that farmers who have more farming experience can adopt cluster farming earlier than farmers with shorter farming experience.

### 4. CONCLUSION AND RECOMMENDATION

This study evaluated the determinant factors influencing participation decisions of smallholder farmers in wheat cluster farming at Dawo District South-West Shewa Zone Oromia region. Selection of Districts, PAs, and sampled household heads was done using multistage sampling methods. Dawo District was purposefully selected from the South-West Shewa Zone due to its wheat potential agroecology and implemented wheat cluster farming. Based on the proportion of PAs that undertake cluster farming, four PAs were selected. Then using stratified random sampling PAs stratified into two strata: Wheat cluster farming and wheat non-cluster farming participants. In total, 138 (participants 92 and non-participants 46) respondents were selected using systematic random sampling. The descriptive result showed that the education status of the head, access to credit services, training on crop management, wheat farming experience of the household head, and landholding size were the variables that showed significant relation with the dependent variable. Correspondingly, the binary logistic regression results also revealed that the education level of the household head, wheat farming experience of the household head, landholding size, distance to extension services, membership in a cooperative, and access to credit services were the variables that significantly affected participation decision of smallholder farmers in wheat cluster farming.

Therefore, from the research results the authors suggest the need for continued and broad public and private awareness creation in agricultural innovations participation to address vital development challenges and the need for policy support for improving extension efforts and access to the full package for cluster implementation among smallholder farmers that stimulate participation decision on cluster farming of improved agricultural technologies.

### DECLARATION

#### Competing Interest:

The authors state that they have no known rival financial interests or individual relationships that could have seemed to influence the work reported in this paper.

### Author's Contribution Statement:

Both authors contributed to the study's conception and design. Material preparation, data collection, and analysis were performed by Dawit Milkias Kebede and Gemechu Beri Abdeta. All the authors have read and approved the final manuscript.

**Competing Interest:** The authors have declared that no competing interest exists.

**Data Availability:** Data will be made available on request

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