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Determinants of Participation Decision of Smallholder Farmers on Cluster Farming: The Case of Teff in West Shewa Zone of Oromia Region, Ethiopia

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Abstract: This research was conducted in Liban Jawi district West Shewa zone of the Oromia region to evaluate the determinants that affect the participation decisions of smallholder farmers in teff cluster farming. A multistage sample procedure was used to collect the data. Liban Jawi District was purposely selected from the West Shewa zone due to the potential teff production and implementation of teff cluster farming. Next, based on the proportion of peasant association that undertakes cluster farming, four PAs were selected. Then using stratified random sampling PAs were stratified into two strata: cluster farming and non-cluster farming participants. Finally, 133 respondents were selected using systematic random sampling methods. Binary logistic regression was used to analyze relationships between a dichotomous dependent variable and explanatory variables. The results of this study indicated that among the selected variables used in the model, nine of them were found to have significant effects including the age of household head, gender, experience, land holding size, income, walking time to farmland, credit accessibility, participation in the demonstration, and access to training were statistically significant on participation decision of smallholder farmers decisions in teff cluster farming. Therefore, the Federal and or the regional government ought to enhance farmer associations to have the potential to significantly influence the participation decision-making process. In addition, to support farmers in adopting new varieties and increase their productivity, the government should give training, and increase extension linkages to enhance the participation decisions of farmers in cluster farming.

Keywords: Cluster farming, binary logistic model, Teff, Liban Jawi, Extension linkages.

Research Paper

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1. INTRODUCTION

Agriculture accounts for the lion share of Ethiopian overall economic growth and development. Agriculture cluster farming is defined as a concentration of agricultural activities that generate income and job opportunities in and around specific locations (Eva Galvez and Martin, 2017). It is further described as a joint operation and concentration of producers, agricultural businesses, and institutions operating in the agricultural or agro-industrial sub-sector, which connects and creates value networks, addressing common challenges and seeking common opportunities. (Galvez-Nogales, 2010). Agriculture clusters are increasingly being identified as a green manner to expand and stabilize agriculture and agro-enterprise and to create surroundings that improve the competitiveness of agribusiness, specifically small- and medium-scale companies (FAO, 2017).

The AC idea was launched in Ethiopia with the Agricultural Marketing Cluster to integrate the different priority interventions of the transformation program in specific geographical areas targeting a limited number of high-value commodities during the GTP-I plan of Ethiopia (MoFED, 2010). This strategy was originally developed by the government of Ethiopia to access government funding and the cluster farming concept was adopted by farmers in the Oromia region farmers' groups at Arsi and Bale zones. The main objectives of agricultural clusters are to plant similar crops, cultivate quality products, combine production to achieve higher volume and supply input and output in bulk to save transport costs and increase income. In Ethiopia, an agricultural cluster requires about 300-200 smallholder farmers with adjacent plots who voluntarily pool part of their land to benefit from targeted government support and cluster farming urbanization (Tabe-Ojong and Dureti, 2022).

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According to reports (ATA, 2019), Farm households participating in the clusters are required to contribute at least 0.25 ha of land, and the cumulative land per cluster must be at least 15 ha to harness the full benefits of participation. In those clusters, farmers decide to cultivate cluster precedence crops and cling to the first-class farm agronomic recommendations. AC especially makes a specialty of ten precedence commodities in a geographically clustered and incorporated method presently carried out in 4 regional states including Amhara, Oromia, SNNP, and Tigray. The AC initiative identified ten priority commodities Maize, Wheat, Malt Barley, Sesame, Teff, Onion, Tomato, Avocado, Mango, and Banana.

From the priority crop, Teff is the most preferred staple food by the majority of the Ethiopian population and its center of origin is in Ethiopia. The economic contribution of teff shows that teff production accounted for an average of 6.1% of GDP, while real teff production growth was 6.4% of total GDP growth or 0.67% of GDP growth of 10.7% (Fantu *et al.*, 2015). However, the current teff production scheme cannot satisfy the current consumer demand due to low production and lack of modern technologies. Agricultural cluster in general and teff cluster farming in particular in the study district have been started since 2018 and this farming approach has greatly contributed to the productivity of the farmers in the district. However, many problems hinder the participation decision of farmers in teff cluster farming. Therefore, this research aims to identify the factors that affect the participation decision of smallholder farmers in teff cluster farming in Liban Jawi districts.

2. RESEARCH METHODOLOGY

2.1 Description of the Study Area

Liban Jewi district is one of the twenty-two districts in the West Shewa zone of the Oromia region, Ethiopia. It is located about 161 km west of the Capital city of Ethiopia Addis Ababa and 47 km west direction of Ambo Town. Geographically, the city is located at 8° 58′ 19″ north latitude and 37° 32′ 37″ east longitude, and the average height above sea level is 2293 meters. This area is bordered by Toke Kutaye in the east, Chelia in the west, Midakegni in the north, and Jibat in the south. The area receives 900-1800 mm of rain per year. The annual temperature varies from 16 to 28 ^{0}C. The district consisted of 16 (15 rural and 1 urban) kebeles. The total population of the district is 70,820 (35,376 males and 35,444 females). There are 9155 households in the district, of which 8339 are male-headed and 816 are female-headed. The cultivation model of the area shows that 18,537 hectares out of 32,837 ha are cultivated land; 8548 ha is forest cover, 5467 ha is pasture, and 285 ha is for other social use. The most important cereals produced in the area are Teff, wheat, Maize, barley, and pulse crops (District Office of Agriculture, 2019 cited in Dawit *et al*., 2020).

2.2 Data Types and Methods of Data Collection

For this study, a formal survey was employed to collect data from primary sources, and secondary data sources were also used. Interviews with a few chosen teff producers were conducted as part of the formal survey. Farmers use a structured and semi-structured questionnaire that has already been evaluated. 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, Liban Jawi District was purposefully selected from the West Shewa Zone due to its teff potential agroecological and implemented teff cluster farming. In the second stage, based on the proportion of Peasant associations (PA) that undertake cluster farming, four PAs were selected. Then using stratified random sampling PAs were stratified into two strata: cluster farming and non-cluster farming participants. In total, 133 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	Chacidu Masara	564	14	11	25
2	Mugno Kashambal	862	24	19	43
3	Kombolcha Sadan	574	15	12	27
4	Liban Gamo	768	21	17	38
	Total	**2768**	**74**	**59**	**133**

***Source**: Own computation, 2020*

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 agro-ecological characteristics of the sample households while inferential statistics such as t-test and chi-square (χ^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 (YI)

The dependent variable in this study for the binary logistic model is dichotomous representing the farmer's participation decision on teff cluster farming. The variable takes a value of one for the household that participated in cluster farming and 0 for the household that did not participate in cluster farming.

The Independent Variables (Xi)

The explanatory variables hypothesized to affect the decision to participate in cluster farming are identified based on the review of different literature, past research findings, and considering the information from the informal survey, among the large number of factors that were expected to influence farmers' participation decisions, only thirteen (13) potential explanatory variables were considered for this study and examined for their effect in farmers' participation decision on teff cluster farming. These are presented as follows.

The explanatory variables in this study are those variables hypothesized to influence the participation decision of smallholder farmers in teff cluster farming. Those comprise household demographic and socio-economic characteristics, financial and institutional variables (Xi); *X_1= Age of household head (years), X_2= Sex of household head, X_3= Educational level, X_4= Experience in teff farming, X_5= Household size (Man equivalent), X_6= Total land holding (ha), X_7= Number of oxen owned, X_8= Distance to the farmland (Km), X_9= Access to Credit, X_{10}= Income of farmers /ETB/, X_{11}= Participation on demonstration, X_{12}= Participation on Field Day and X_{13}= Access to training*

3. RESULT AND DISCUSSIONS

3.1. Improved Teff Varieties Cultivated by Cluster Farming in the Study Area

Teff is a warm-season grain crop and the smallest size on the planet. It is nutritious and well adapted to growing conditions in Ethiopia, but little investment has been made to expand its potential to domestic or international markets. Teff continues to be the most important cereal in the study areas in terms of area, total production, and direct consumption role. In the study area, teff varieties were popularized with extensive access, resulting in the highest-yielding varieties such as Dagim, Quncho, and Boset were the teff cultivars grouped and made available to farmers through the Ambo Agricultural Research Center (Table 2).

Table 2: Tef varieties popularized in the study areas

Varieties	Area coverage (ha)	Participants farmers
Dagim	31	34
Quncho	20	27
Boset	17	13
Total	68	74

***Source**: Own data computations, 2020*

3.2. Results of Dummy and Categorical Variables

The results of the descriptive statistics reveal that participation and non-participation decisions of smallholder farmers on teff cluster farming are statistically significantly different in terms of age of household head, sex of household head, farming experience, education level, total land holding, income of the household, household size, distance to farmland, oxen ownership, training access, participating in the demonstration, field visit and access to credit. Out of 133 sample household heads, 84.96 % were male-headed and account for and 15.04% were female-headed households. The majority of households in the sample are headed by males. Among female-headed households, 17.56% and 11.86 % are teff cluster participants and teff cluster non-participants respectively, while 82.43 % and 88.14 % of males are teff cluster participants and teff cluster non-participants, respectively (Table 3).

In terms of the education level of household heads about 33.08%, 39.07%, 23.3%, and 4.52 % of household heads are illiterate, primary education, secondary, and above education level. Of this, about 23 % and 45.76% are illiterate teff cluster participants and teff cluster non-participants, respectively. In addition, 47.3% and 28.81% of adult education stage are teff cluster participants and teff cluster non-participants, respectively. Concerning participation in the demonstration, about 66.92% of the farmers participated in the demonstration while 33.08 % did not participate in the demonstration. Table 3 indicated that 43.24% and 96.62% of the sampled household heads participated in the demonstration from teff cluster participants and non-participants, respectively. On the other hand, of non-participant households, 3.38% were non-participants in the demonstration. Participation in demonstration enhances the information exchange and experience sharing among farm households on the use of improved agricultural technologies and agronomic practices.

Table 3: Cluster farming participants and non-participants results (Dummy variables)

Variables	Participants		Non-participants		Total		X^2
	N	%	N	%	N	%	
Education level							
Illiterate	17	23	27	45.76	44	33.08	8.39
Primary	35	47.3	17	28.81	52	39.07	
Secondary	18	24.32	13	22.03	31	23.3	
College	4	5.4	2	3.38	6	4.52	
Sex of hh							0.84
Female	13	17.56	7	11.86	20	15.03	
Male	61	82.43	52	88.14	113	84.97	
Feild demonstration							42.23
No	42	56.76	2	3.38	44	33.08	
Yes	32	43.24	57	96.62	89	66.92	
Credit accessibility							39.49
No	44	59.45	4	6.78	48	36.09	
Yes	30	40.54	55	93.22	85	63.9	
Training							
No	51	68.91	48	81.35	99	74.43	2.67
Yes	23	31.08	11	18.64	34	25.57	
Participation in Field Day							
No	26	35.13	14	23.73	40	30.07	2.03
Yes	48	64.86	45	76.27	93	69.93	

***Source**: own survey data, 2020.*

The results of the study also indicated that in terms of training access, among the total respondents, 25.57% had access to training. About 31.08% and 18.64% of those who have training access were accessed from teff cluster participants and teff cluster non-participants, respectively. In addition, among respondents who had no access to training 68.91% and 81.35% are among teff cluster participants and teff cluster non-participants, showing teff cluster participants have more access to training. The result indicated there were 10% statistically significant differences between teff cluster participants and non-participants in terms of training access (Table 3). Credit access is also another factor under consideration in this study. Among the total respondents, 63.9% had access to credit, and the rest 36.09% had no access to credit. Of those accessed with credit, 40.54% and 93.22 % were teff cluster participants and teff cluster non-participants, respectively. In addition, about 59.45% and 6.78% of those who do not have access to credit were teff cluster participants and non-participants, respectively. The result indicates a significant difference in terms of access to credit at a 1% significant level.

The study results indicated that in terms of participation in a farmer's field day about 64.86% and 76.27% of those who have had the chance to participate in field day from both teff cluster participants and non-participants, respectively. In addition, among respondents who had no access to participate in field day 35.13% and 23.73 % are among teff cluster participants and teff cluster non-participants, showing teff cluster participants have more access in terms of field day participation chances.

3.3. Household Demographic and Socioeconomic Characteristics (Continuous Variables)

The descriptive statistics results in Table 4 provide the mean values of households who were classified as participants and non-participants of teff cluster farming. The result indicates that participants and non-participants of teff cluster farming were statistically significantly different in terms of experience in teff cluster farming, the income of household head, and walking time to farmland while other household characteristics such as the age of household head, total land owned, active labor force, and oxen ownership, were not statistically different between cluster farm participants and non-participants. The mean age of sample household heads is 48.12 years with the average age distribution of teff cluster participants and non-participants being 48.97 and 47.52 years, respectively. The average active labor force for the study area is 4.86 per household; with 4.5 and 5.15 being the mean family size of teff cluster participants and non-participants respectively.

Teff cluster farming reveals in the full pattern implies it 3.6 years ago. The average years of cluster farming experience of farm households is 5.2 years and for non-participants is 2.32 years. The statistical evaluation confirmed that there may be significant distinction among farming studies of cluster farming participant heads and non-participants. The implied oxen possession of the sample households is 2.02. From this, the teff cluster farming contributors and non-contributors' mean oxen owned is 1.83 and 2.16 TLU, respectively (Table 4). The average landholding size of households is 1.56, ha for selected sample households.

The mean landholding for teff cluster participant and non-participant is 0.681 and 2.24 respectively. The average land holding by teff cluster participants is lower than non-participants but the result showed the absence of a significant mean difference between landholding owned by cluster farm participants and non-participants. Concerning with important variable used in the study is the walking time to the farmland of the sample respondents. The average household distance from farmland is 2.75 km and the distribution of teff cluster participants and non-participants is 3.4 and 2.24, respectively. The result shows a 1% statistical significance difference between the cluster participants and non-participants.

Table 4: Characteristics of participants and non-participants (Continuous variables)

Variables	Participants		Non-Participants		Total		t-value
	Mean	SD	Mean	SD	Mean	SD	
Age of household head	48.97	9.49	47.52	0.95	48.12	8.76	0.174
Experience	5.203	0.298	2.32	2.75	3.6	2.92	0.00***
Landholding	0.681	0.44	2.24	1.82	1.56	0.75	0.749
Income	8444.0	2781.9	6828.4	3279	7545	3161.8	0.002***
Active family force	4.495	1.23	5.15	1.23	4.86	1.27	3.06
Walking time to farmland	3.389	1.65	2.24	1.04	2.75	1.46	0.00***
Oxen ownership	1.83	1.72	2.16	1.44	2.015	1.58	1.207

Source: Computations from field survey, 2020

Symbol: *** indicates statistically significant at 1% significance levels respectively

This income households were estimated based on sales of crops, livestock, and livestock products. The average annual household income is 7,545.11 ETB per year. Of this, the average income of those who participated in teff cluster cultivation is 8444.02 and the average income of non-participants is 6828.42. Statistical analysis showed a significant mean difference of 1% between participants and non-participants in cluster farming. This means that the higher the household income, the higher the probability of deciding to participate in teff cluster farming. This result is supported by the findings of (Sulo T. *et al.*, 2012).

3.2. Determinants of Participation Decision of Smallholder Farmers on Cluster Farming

In this study all explanatory variables hypothesized to potentially influence the participation decision of teff cluster farming were fitted into a binary logistic model (Table 5) and their fitness to the model was assessed based on changes in deviance and the main effect and interactions were further investigated. The model analysis implies, the existence of a relationship between the dichotomous dependent with the explanatory variables for the continuous, dummy, and categorical variables for the study. For this study, thirteen explanatory variables were hypothesized as the determinants influencing smallholder farmers" participation decisions in cluster farming in the study district. The logit model results used for this research are shown in Table 4. Among the selected variables used for this research in the model, none of them were significantly different for participation decisions in teff cluster farming at different significance levels. Whereas the rest variables were found to have no significance on the participation decisions of smallholder farmers in teff cluster farming. The effect of these variables on the dependent variable is discussed below.

The age of the household head was hypothesized to negatively affect households' participation decisions in teff cluster farming. Accordingly, the **a**ge of the household head determines sample household participation decisions in cluster farming statistically significant and negatively at a 1 percent probability level. The possible reason is that older household heads are less likely to participate in agricultural technologies compared to younger and more educated farmers. This result is consistent with the findings reported by Gadisa and Dawit (2021).

As expected, the sex of the household head positively and significantly affected household participation decisions in teff cluster farming at a 10 percent probability level. Possible reasons could be physical, socio-cultural, and time constraints of female household heads that prevent them from participating in cluster farming of teff in the study area. This result is consistent with the findings of Wakene (2018). The experiences of the household were measured by the number of years stayed in teff cluster farming and this variable was found as hypothesized to affect the participation decision in teff cluster farming positively and significantly at a 10% significance level. The result in Table 5 indicates that for this variable, as experience in teff farming increased by one year, the decision to engage in cluster farming improved holding the other variables constant. This was because experienced farmers in teff production have better knowledge of technology adoption, information acquisition, timely sowing, cultivation, and harvesting than those who are less experienced farmers this result is consistent with the findings of Dawit (2020).

The total land holding size as expected the land owned had a positive and significant effect on the participation decision in cluster farming at a 10 percent probability level. The result of the finding highlighted

that land is a significant determinant of crop production. Larger farm size was correlated with the farmer being more likely to participate in popularizing technologies in comparison with farmers with a small portion of land. The result is confirmed by (Dawit, 2020). Land is the single most important resource, as it is a base for any economic activity especially in the rural and agricultural sectors Temesgen (2019). Credit availability was found to influence the participation decision in cluster farming significantly and positively at less than a 1 percent significance level. The result shows that those farmers who have access to formal credit from any governmental and non-governmental organization are more likely to decide to participate decision in cluster farming than those who have no access to formal credit (Dawit and Abduselam, 2018).

Table 5: Results of the Binary logistic regression model on determinants of cluster farming part.

Variables	Coefficients	P-Value
Age of household head	-0.1098***	0.005
Education level household head	0.2948	0.428
Gender of household head	0.1526*	0.093
Experience in tef farming	0.0282*	0.054
Landholding holding size	0.0045*	0.080
Oxen ownership	-0.0167	0.759
Income of the household	-3.5E-06*	0.018
Active labour force	-0.0598	0.165
Distance to farmland	-0.0738***	0.001
Credit accessibility	0.2801***	0.005
Part. in Demonstration	0.3831***	0.000
Parti. in field day	0.0904	0.180
Access to training	0.1672**	0.027
Constant	-0.6156	0.018

***Source**: Computation own survey data, 2020.*

Symbol: ***, **, * Significant at 1, 5, and 10 % significance levels respectively

Availability of credit was expected to significantly and positively affect the decision to participate in cluster farming at less than a 1% significance level. The result shows that those farmers who have access to formal credit from any government or non-governmental organization are more likely to choose to engage in grape growing than those without formal credit (Dawit and Abduselam, 2018). Participation in agricultural training was positively and significantly related to influencing the participation decision of smallholder farmers in teff cluster farming positively at a 5 percent significance level. The result of the model showed that smallholder farmers who participate in training will be more likely to participate in cluster farming than otherwise. This is because those farmers who have access to credit services are more capable of purchasing agricultural inputs like seeds, fertilizers, and land. This result is consistent with Gadisa (2021) and Temesgen (2019).

The income of household heads was found to have a positive and significant relationship with the participation decision of smallholder farmers in teff cluster farming at a 5 percent probability level. The model result implies that a farmer who got income from selling agricultural products could invest his proportion of income to participate in cluster farming. The distance from **f**armers residing at a farther distance from the cluster farm was found not to be better participate in cluster farming compared to those residing at a distance located closer to the cluster farm. A kilometer increase in farmers' homes in walking time to farmland results in a decrease in the rate of participation decision of smallholder farmers negatively and statistically significant at a 5 percent level. The result is consistent with the findings of (Dawit, 2020 and Yishak, 2005). This further shows that as the nearest farmland decreases, the participation decisions of smallholder farmers rise.

Participation in field demonstrations leads the **s**mallholder farmers to acquire new knowledge through participation in demonstrations to improve their production performance through the use of improved agricultural technology. The output of the model showed that the probability of participating in cluster cultivation was positively and significantly influenced by participation in the demonstration at a 1% significance level. The result of the model showed that the probability of the decision to participate in grape cultivation was significantly and positively influenced by participation in the demonstration at a significance level of less than 1%. This implies that, if the smallholder households participated in agricultural technology demonstration, the households' participation decision in cluster farming would be increased. The finding of this research is similar to Saka and Lawal (2009).

4. CONCLUSIONS AND RECOMMENDATIONS

This research was conducted in the Liban Jawi district, West Shewa zone of the Oromia region. The study aimed to identify the determinants of smallholder farmers' participation in tef cluster farming and thirteen explanatory variables were hypothesized as the factors

influencing smallholder farmers' participation decisions in cluster farming in the study areas. The results of the study indicated that among the selected variables used in the model nine of them (Age of household head, sex of the household head, experience in tef farming, total land holding size, the income of the household, distance to farmland, credit accessibility, participation in demonstration and access to training were found to have a statistically significant effect that affects participation of smallholder farmers in tef cluster farming with different signs.

The research output indicates that participating in teff cluster farming could help to eliminate poverty and boost smallholder farmers' incomes. Encouraging cluster farming activities enables the farmers to strengthen community institutions, and extension service delivery to smallholders. Therefore, to encourage farmers to adopt new agricultural production technologies and increase crop productivity, governmental and non-governmental organizations should provide technical training and improve the extension linkages to enhance the participation decisions of farmers. In addition, it is beneficial to deliver services to assist vulnerable and impoverished households to escape their existing challenges. Smallholder farmers gain from strengthening the extension and outreach system by having a better grasp of agro-clusters and being encouraged to participate.

REFERENCES

- ATA (Agricultural Transformation Agency). (2019). Agricultural Transformation Agenda: 'Annual Report 2016–17. Addis Ababa, Ethiopia: Ethiopian Agricultural Transformation Agency. Available online at www.ata.gov.et.
- Eva, N. N., & Martin, W. (2017). Territorial tools for agro-industry development – A Sourcebook (eds.). *Food and Agriculture Organization* (FAO), Rome, Italy.
- Fantu, N. B., Bethelhem, K., & Alemayehu, S. T. (2015). Summary of ESSP Working Paper 89, Productivity and *efficiency of small holder Teff farmers in Ethiopia*.
- FAO (Food and Agriculture Organization). (2017). Defining small-scale food producers to monitor target 2.3. Of the 2030 agenda for sustainable development. *Clara Aida Khalil, Piero Conforti, Ipek Ergin and Pietro Gennari*.
- Galvez-Nogales, E. (2010). Agro-based clusters in developing countries: staying competitive in a globalized economy. *Agricultural Management, Marketing and Finance Occasional Paper (FAO)*.
- Jr Tabe-Ojong, M. P. & Dureti, G. G. (2022). Are agro-clusters pro-poor? Evidence from Ethiopia. *Journal of Agricultural Economics*, 1–16.
- Mikias, D., & Beri, G. (2020). Assessing farmer's perception towards improved Quncho teff varity in gindeberet district, west shoawa zone, oromia region Ethiopia. *Journal of Plant Sciences*, *8*(5), 106-111.
- Milkias, D. (2020). Factors affecting high yielding teff varieties adoption intensity by small holder farmers in west showa zone, Ethiopia. *International Journal of Economy, Energy and Environment*, *5*(1), 6-13.
- Milkias, D., & Abdulahi, A. (2018). Determinants of agricultural technology adoption: the case of improved highland maize varieties in Toke Kutaye District, Oromia Regional State, Ethiopia. *Journal of Investment and Management*, *7*(4), 125-132.
- MoFED (Ministry of Finance and Economic Development). 2010. Growth and Transformational Plan (GTP 2010-2015). Addis Ababa. Ethiopia.
- Muleta, G., & Milkias, D. (2021). Small Scale Irrigation and its Determinant Factors in Central Ethiopia: Empirical Evidences from Walmara District. *International Journal of Research Studies in Agricultural Sciences*, *7*(4), 27-36.
- Sulo, T., Koech, P., Chumo, C., & Chepng'eno, W. (2012). Socioeconomic factors affecting the adoption of improved agricultural technologies among women in Marakwet County Kenya: *Journal of Emerging Trends in Economics and Management Sciences. 3*(4), 3-5.
- Temesgen, B. T. (2019). Determinants of Small-Scale Irrigation Use and Its Implication on Poverty Reduction: *Empirical Evidence from Bogena River Catchment in Awabel District, East Gojjam, Ethiopia* (MSc Thesis, Addis Ababa University).
- Wakene, B. U. (2018). Determinants of Smallholder Farmers' Participation in Small-Scale Irrigation: *The Case of Deder District of Eastern Hararghe Zone, Ethiopia* (MSc Thesis, Haramaya University), Ethiopia.
- Yamane, T. (1967). Statistics: An Introductory Analysis, 2nd Ed., New York: Harper and Row. Zodpey, S P, Sample size and power analysis in medical research, *Indian J. Dermatol. Venereol. Leprol*, *70*(2), 123-128.
- Yishak, G. (2005). Determinants of Adoption of Improved Maize Technology in Damote Gale Woreda, Wolaita, Ethiopia. Msc. Thesis. *Presented to the School of Graduate Study of Alemaya University*, Ethiopia.