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Original Paper

Comparative Analysis of the Productivity and Efficiency of Cluster and Individual Farming in West Arsi Zone of Oromia

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Abstract

The main objective of this study was to compare the productivity and efficiency of clustered and individual farming; to identify factors affecting clusters farming practice and to know the view/perception of farmers for clustered farming approach in West Arsi zone. To conduct the study, primary data was collected from 152 randomly selected household heads through semi-structured questionnaire. Secondary data were also collected from different sources including CSA, ZOANR, DOANR, and from published and unpublished sources to supplement primary data. In this study both descriptive statistics and econometric analysis were employed. The primary data was analyzed using descriptive statistics and stochastic efficiency decomposition method to decompose TE. Stochastic Frontier Approach (SFA) was used for its ability to distinguish inefficiency from deviations that are caused by factors beyond the control of farmers. The productivity of wheat per hectare was 47.17 and 39.042 quintal for cluster and individual farming respectively which is statically significant at 1% level. The study result revealed that the mean of wheat TE was about 78.46%, for cluster farming and 69.25%, for individual farming as the Cobb-Douglas functional form indicate that. As the result of research analysis indicates that, the cumulative sum of farmers' perception towards the compatibility of cluster farming with the socio-economic situational circumstances was 4.093 suggesting farmers perceive positively that it was compatibility with their socio-economic situational circumstances. The likelihood of farmers to practice cluster farming positively influenced by Sex of HH, age of HH, nearest market center, distance to FTC, participation on field visit and participation in social organization in West Arsi zone. The study suggested that farmer adoption decisions are affected by above mentioned factors and policies addressing each decision process and cross-cutting issues are required to improve farmer participation in cluster farming. In addition, the study suggested the need for policies to discourage land fragmentation and promote, participation in field visit, and strengthening social *network of farmers, to increase participation of farmers in cluster farming in the zone.*

Keywords

cluster and individual farming, productivity, technical efficiency, stochastic frontier approach, probit model

1. Introduction

1.1 Background and Justification

Ethiopia is one of the fastest growing non-oil economy countries in Africa. The country is heavily reliant on agriculture as a main source of employment, income and food security for a vast majority of its population. In GTP-II period, agriculture will remain the main driver of the rapid and inclusive economic growth and development. It is also expected to be the main source of growth for the modern productive sectors. Therefore, besides promoting the productivity and quality of staple food crops production, special attention will also be given to high value crops, industrial inputs and export commodities (NPC, 2016).

Agriculture is the foundation for Ethiopian economy, and the overall economic growth of the country is highly linked to the success of the agriculture sector. Agriculture accounts for about 36% of the country's Gross Domestic Product (GDP) in 2018.Our country has undertaken various measures to improve food security situation of the rural community. One of the strategies that the country has undertaken to reduce food insecurity and enhance rural development in the rural area is the establishment and strengthening agricultural clusters. Agriculture is the backbone of Ethiopia's economy. It contributes 36.2 percent of the country's Gross Domestic Product (GDP) and 72.7 percent of employment and 70 percent of export earnings (Getachew et al., 2018).

Vegetables are sources of vitamins, minerals and income for those involved in production and marketing (Reddy and Kanna, 2016). According to Degafe (2013), Ethiopia has a good potential for the production of high-value export vegetable product. The vegetable production ranges from home gardening, smallholder farming to commercial farms (ATA, 2014). Ethiopia has comparative advantage in vegetables production due to suitable and favorable climate and cheap labor (EIA, 2012). Vegetables are grown by commercial farms and small-scale farmers for food and market since vegetables have a huge domestic market in Ethiopia (EHDA, 2011; Mebrat, 2014).

Along the same line, lately the Government of Ethiopia has started to implement a cluster-based approach to agricultural development, which holds an impressive potential for transformation. By providing an innovative contribution to the definition of the Ethiopian way to agrarian transformation, the analysis of the cluster-based initiatives provides insights into: the peasantry's changing role in fostering development and structural transformation, the leverage of historical legacies and international influences on the adoption and implementation of the strategy, the developmental state's practice and state-peasant relation (Marcell, 2018).

The country industrial strategy necessitates the establishment of industrial zones for agro-processing industries. Agro-industry can link up or integrate the agricultural sector which is the source of livelihood for the majority of Ethiopians. It can also create sustainable market link by establishing Rural Transformation Centers (RTC) that can improve production and productivity. One of the objectives of GTP-II is establishing Integrated Agro-industrial Parks (IAIPs) to link up the agricultural sector and add value to basic agricultural products (Abiy, 2016).

Agricultural transformation in Ethiopia is deeply embedded in these global trends: the government-led process is mainly outward-oriented and aimed at integrating agro-industrial value chains to spur the conversion of the country into a global leader in manufacturing goods by 2025.One of the most significant strategies designed to achieve this goal is the agglomeration of agricultural and industrial producers into poles, hubs, or clusters, in order to benefit from the service-delivery concentration. The main importance of clustered farming is to transform substance agricultural production in to commercialized and mechanized farming.

The term "cluster farming" usually refers to agglomeration of producer farmers engaged in similar and/or related activities. The production of small scale or individual farming was mainly not demand driven, commercial and mechanized but it was based on producers need for consumption only which is low productivity. Productivity is the output produced per unit of resource used, and it is accordingly a measure of the efficiency with which producers use available resources. Productivity measures are at the core of the discussion of the impact of *reforms* in transition countries, as efficiency improvement was the main motivation for the transformation of agriculture.

National Framework for Agriculture Commercialization Clusters in Ethiopia announced that 21 clusters and 12 commodity types had been chosen, and this information was confirmed by Zegeye Teklu in July 2016. Each cluster is expected to have one primary commodity, and one or two additional rotation crops. The 2011-15 progress report announced the designation of 31 and that an additional 16 were in the works for interventions during 2015 (ATA 2016). The most recent official paper reported that 26 clusters and 10 commodities had been selected, but since a federal strategy has been issued for only 7 commodities, just 14 clusters are being implemented (ATA, 2017).

Nine clusters over 114 woreda and 10 commodities have been picked out in the Oromia Region, amounting to a targeted total of 4.6 million hectares and 1.3 million farmers. In 2015-16, five clusters and commodities were given top priority: the maize cluster in the Horro Guduru Wellega, East Wellega, and West Shewa areas; Malt barley cluster in the Arsi and West Arsi areas; Bread wheat cluster in the Arsi, West Arsi and Bale areas; Durum wheat cluster in the Bale area; Teff cluster in the West Shewa, East Shewa (where the Bulbula Park is located), South West Shewa areas (ATA, 2017). Out of a total of

739,727 ha of land that had been allocated to these five clusters, 134, 235 ha is the actual surface that they occupy, as reported by the MoANR in August 2016. Oromia apparently reported the highest results for the period: the clusters supplied around; 700,000 qt of crops (durum wheat and malt barley) to agro-industries such as the Asela Malt Factory; 800,000 qt of bread wheat have been channeled to the EGTE through unions; five unions delivered 130,000 qt of maize grain to the WFP, the Mama Injera and Consumer Association in Addis Ababa, and other buyers through contractual agreements (ATA, 2017).

In general clustered farming or medium farming has the advantage over small scale farming or individual farming on; *economies of scale* of crop cultivation, generate better marketable surplus, release of workers for industries because of since its mechanized farming nature, credit worthiness, administrative convenience, social arguments and technological transfer. Meanwhile the report of ATA indicates only the clustered farming returns greater productivity than individual farming but their efficiency of comparative advantage and partial analysis for each individual input (i.e. output/land and output/labor) was not done suggesting as there is dearth of current information. In addition factors that influence farmers' decision to practice cluster farming, and their needs were not conducted.

Agricultural Commercialization Clusters (ACC) strategies predominantly featured by; top-down, output-oriented and control-biased characters of the political practice carried out by the numerous local administration structures, and may lead to capital expropriation, a bad attitude towards work, vulnerability, dependence, off-farm activity reduction, and other negative consequences. There are no previous studies conducted in the area regarding the importance of cluster farming and factors affecting its practice by farmers and its comparative advantage over individual farming. This study, therefore, aims at identifying factors affecting cluster farming practice by farmers and its importance over individual farming. So, the study aimed to fill the above knowledge gap.

1.2 Objective of the Study

- ✓ To compare the productivity and efficiency of clustered and individual farming
- ✓ To know the perception of farmers for clustered farming approach in the study area.
- ✓ To identify factors affecting clusters farming practice in West Arsi zone

1.3 Expected Output

- ✓ The productivity and efficiency of clustered and individual farming identified;
- ✓ Farmers perception towards clustered farming approach identified
- ✓ Factors affecting clusters farming practice in the study area identified

2. Research Methodology

2.1 Description of the Study Area

These studies were conducted in selected districts of West Arsi Zones. West Arsi Zone found in the south part whereas East Shewa Zone is found in central part of the Oromia National Regional State. West Arsi Zone lies between 6^0 00' N to 7^0 35'N and 38^0 00'E to $40^0$00'E and demarcated by Bale Zone in west direction, Arsi Zone in East direction, Southern Nation Nationality and People Regional State in South direction, and East Shewa Zone in north direction. The Zone has 12 districts. Shashemene is the capital city of West Arsi Zone and located at 250 km from Addis Ababa/Finfinnee towards South direction on Addis Ababa/Finfinnee - Hawassa main asphalt road. West Arsi Zone encompasses different agro-ecologies namely high land, midland and lowland. In the Zone the high land agro-ecology (47.92%) took more coverage followed by midland (42.50%) and lowland (9.82%) agro-ecologies. The Zone lies within altitude of 1500-3800 meter above sea level (ZoARD, 2016). The total population in the Zone was 2,290,280 of which 45.50% are male and 50.50% are female. The Zone receives 600mm-2700mm annual rain fall and has a bimodal pattern of rain fall. It also receives 12^oC-27^oC annual temperature per year. The Zone has a total of 1,286,277.50 hectare of land. From the total land, 0.36% is arable land, 29.27% cultivated land, 19.50% forest land, 17.05% grazing land, 4.58% used for construction and 29.26% used for other purposes (ZoARD, 2016).

2.2 Data types, Sources and Methods of Data Collection

Both primary and secondary data were used for this study. Primary data generated through cross-sectional survey during 2020/2021 production season using semi-structured questionnaire, key informant interviews, and focus-group discussions. The questionnaire were designed and pre-tested in the field for its validity and content, and to make overall improvement of the same and in line with the objectives of the study. To complement the primary data, secondary data were collected from both government and Non-Government Organizations (NGOs). The major sources of secondary data was from both published materials and online resources such as CSA, ATA, FAO data base and West Arsi zone agriculture office.

2.3 Sampling Procedure and Sample Size

Another criteria required of the households is that they have to grow similar crop i.e. Wheat at least once during the last five years. This is crucial since member homogeneity is the prerequisite for successful cooperation (Hansmann, 2000). The respondents sample selection was focuses on households who have expressed willingness to be part of an agricultural clustered farming without any government intervention. **Two**-stage sampling techniques were employed for this study. **1st** households stratified into members and non-members of clustered agricultural farming and **2nd** from each stratum equal proportion of sample respondents were selected by using simple random sampling techniques. In general a total of **152** sample respondents were selected from the zone.

2.4 Methods of Data Analysis

Both descriptive and inferential statistics was used to analyze the data. Descriptive statistical tools such as average, ratios, percentages, frequencies, etc. were applied to describe household and farming characteristics of the study areas. While inferential statistical such as $\chi 2$, and t-tests will be used to compare households in the two groups in terms of household farming characteristics. Both partial and total factor productivity was used, in addition technical efficiency which is often used to evaluate farm performance was also applied. Factors affecting clustered farming practice and the view of farmers for clustered farming approach was modeled using a two-limit probit model.

2.4.1 Selection of Production Function

The limitation of SFM is to pre-determine a functional form and assume the distribution for technical inefficiency (half-normal, gamma, truncated and exponential) for the evaluation of technical inefficiency. Among the possible algebraic forms of production function, Cobb-Douglas and trans log functions have been the most popularly used models in the most empirical studies of agricultural production analysis. A number of researcher stated that Cobb-Douglas functional form has advantages over the other functional forms in that it provides a comparison between adequate fit of the data and computational feasibility. It is also convenient in interpreting elasticity of production and it solves problems with respect to degrees of freedom. According to Coelli (1995), the Cobb-Douglas functional form has most attractive feature which is its simplicity. But, the Cobb-Douglas functional form imposes severe restriction on the technology by restricting the production elasticity to be constant and the elasticity of input substitution to be unity. Likewise, translog production function imposes no restrictions upon returns to scale or substitution possibilities. However, the function is more complicated to estimate having serious estimation problems. A among these estimation problems, if number of variable inputs adding, the number of parameters to be estimated raise rapidly and also additional terms require cross products of input variables, thus, making a serious multicolinearity and degrees of freedom problems. Even through, Cobb-Douglas production function assumes unitary elasticity of substitution and constant production elasticity; it has adequate representation of technology and insignificant impact on measurement of efficiency (Coelli et al., 2005).

3. Results and Discussion

3.1 Descriptive Analysis

The most dominant crop produced in West Arsi zone was wheat. Analysis of the member of cluster farming practice result showed that from the total 152 sampled households head, 45.39% were member of cluster farming practice while the remaining 54.61% was not member West Arsi zone. The probability of households to practice cluster farming was 44.7%.

Table 1. Member of Cluster Farming

Member of cluster farming	Frequency	Percent (%)
No	83	54.61
Yes	69	45.39
Total	152	100

3.2 Demographic Characteristics of Sampled Households

Aged Household Head (HH) has the source of good farming experience and able to participate risk involving farm activity than older farmers. The average age of the sample households during the survey period, was about 43.64 years which was less than 65.97 year of average life expectancy for both sex in Ethiopia (WPP, 2017). Based on Strock et al., 1991 (as cited in Ermiyas, 2013) this average value of age included in the most economically active age group of 17-50 year.

The average education level of literate sample household heads during survey period was about 6 years with the minimum of zero years (illiterate) and maximum of 12 years. Family size plays an important role in crop production and most farmers depend mainly on family labor. The average family size of the sample households was 9 persons per household (Table 2) which is greater than 4.6 person per household as Ethiopia, based on household size and composition around the world in 2017.

The mean cultivated land holding of the sample household was 1.612 ha. On average, sample household owned livestock of 7.67 TLU. This indicates that the farming system in Ethiopia is mainly based on plough by animal draught power that has created complementarity between crop and livestock production (Table 2). In general independent sample t test result indicates that there were no significant difference between member of cluster farming and individual farming in all variables except for age and land cultivated implying the absence of significant relationship of above listed variables with membership decision of cluster farming.

Table 2. Socio-demographic Characteristics for Continues Variables

Demographic characteristics	Cluster member (n=69)		Individual (n=83)		Total Sample (n=152)		t-value
	Mean	**Std. Dev**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev**	
Age of HH head	42.072	1.1178	44.95	1.1045	43.64	.794	-1.8017
Land price/0.25ha	7413.04	804.2	7521.69	761.91	7472.37	780.66	0.8535
Family size	9.2028	4.327	9.228	3.613	9.217	3.939	0.0404
TLU	7.397	4.8126	7.889	5.225	7.6658	5.0316	0.5985
Grade level	6.50	3.52	5.6987	3.3339	6.059	3.4318	-1.4245
Land cultivated/individual	1.511	.8306	1.696	.9468	1.612	.8977	1.26
Total cost of production/ha	77,002.18	61498.22	195,738	22626.8	141,838.4	74155	16.32

3.3 Productivity of Wheat in Cluster and Individual Farming

There was variability in technical inputs and output among wheat producing farmers (Table 3). Land, fertilizer, labor, seed, and chemical were included in production function to produce wheat output. This is economic process of producing output from these inputs or uses resources to create output that are suitable for users. On average sample households produced 47.175 and 39.042 quintals of wheat in cluster and individual farming respectively.

Table 3. Productivity of Wheat in Cluster and Individual Farming

No	Factor of production	Cluster	Individual	t-value	Remark
1	Yield-wheat/quintal	47.1747	39.042	14.7307	

3.4 Wheat Stochastic Production Function for Cluster and Individual Farming

The appropriateness of the stochastic frontier model over the convectional production function can be tested using the statistical significance of the Stochastic Production Frontier Ordinary Least Square parameter gamma, Ý. The positive coefficient of input used implies that as each of these variables is increased, ceteris paribus, wheat output increased, whereas negative sign suggest a situation of excessive (and, hence, inefficient) use in the production in the study area. Statistically significant input suggests that factors explaining cluster and individual farming in study the area.

The estimated value of gamma is equal to 1E+00 for individual farming which is statistically significant at 1% level of significance suggesting that 100% of the variation in output is due to the variation in technical inefficiency among the farmers.

The coefficients of the production function are interpreted as elasticity. The highest coefficient of output to land (0.809) following fertilizer (0.142) in cluster farming whereas its 0.681 and 0.146 for land and fertilizer in individual farming suggesting that land and fertilizer are the main determinants of wheat production in the study area. If there is a one percent increase in the size of land and amount of fertilizer would increase wheat production by 0.809%, 0.142%, in cluster farming whereas its increases by 0.681%, 0.146%, in individual farming respectively for land and fertilizer. In other words, the increase of these inputs were increase output of wheat production significantly which similar to the returns to scale analysis can serve as a measure of total factor productivity and indicated that there is increasing returns to scale. This implied that there was a potential for wheat producer to continue to expand their production. In other words, a percent increase in all inputs proportionally would increase the total production by 1.21 in cluster farming whereas its 0.79 in individual farming.

Table 4. **Estimated Wheat Stochastic Production Function for Cluster and Individual Farming**

Variables	**Cluster Production frontier**		**Variables**	**Individual production frontier**	
	ML estimate			ML estimate	
	Coefficient	Std.Err		Coefficient	Std.Err
Intercept	3.781***	0.1992	**Intercept**	3.96***	0. 2023
Ln (land)	0.809***	0.0868	***Ln (land)***	0.681***	0.07501
Ln (labour)	-0.022	0.0412	***Ln (labour)***	-0.005	0.03573
Ln (seed)	0.019	0.0258	***Ln (seed)***	-0.011	0.02215
Ln (fertilizer)	0.142***	0.0420	***Ln (fertilizer)***	0.146**	0. 0627
Ln (chemical)	0.084	0.0548	***Ln (chemical)***	-0.202	0.01858
	∑β or Return to Scale= 1.21		**Return to Scale= 0.79**		
γ (gamma)	0.74***			**γ (gamma)**	0.94***
Log likelihood	-7.388				
LR test	1.11			**Log likelihood**	-25.0532
					LR Test 11.68

***, Significant at 1% significance level, Source: Own computation, 2020/21

3.5 Estimation of Wheat Technical Efficiencies of Cluster and Individual Farming Smallholder Farmers

The results of the efficiency scores indicate that there were wide ranges of differences in TE among wheat producer households. The result indicated that farmers in the study were relatively good TE in cluster farming than individual farming as presented in table below.

The mean TE was found to be 78.46% and 69.25% for cluster and individual farming respectively, which indicated that, if sample households in the study area operated at full efficiency level, households would have increased their output by 21.54% and 30.75% using the existing resources and level of technology. In other words, it implied that on average sample households in the study area can decrease their inputs by 21.54% and 30.75% for cluster and individual to get the output they are currently getting. There is huge gap among farmers in sample study which ranges 43.59% to 92.49% for cluster farming and 24.30% to 94.79% individual farming. Some literature support that, they argue that larger farmer is more likely to employ improved agricultural technologies, used as a capital base and enhances the risk bearing ability of farmers and hence could be more efficient than small farms due to its advantage of the economic scale and scope associated with larger sizes (Beyene, 2004; Hussein, 2007). This result needs to extension intervention by arrange experience sharing between farmers to reduce the efficiency gap.

Table 5. Estimation of Wheat Technical Efficiencies of Cluster and Individual Farming Smallholder Farmers

Types of farming	Efficiency	Mean	St.dev.	Minimum	Maximum
Cluster	Technical Efficiency	0.785	0.1027	0.436	0.925
Individual	Technical Efficiency	0.693	0.1761	0.243	0.948

Source: Survey data, 2020/21

3.6 Analysis of Wheat Yield Gap of Cluster and Individual Farming

In the table below, it was observed that the mean cluster and individual yield difference between sample farmer due to technical efficiency variation was 13.30 qt per ha and 17.33 qt per ha respectively.

Table 6. Yield Gap due to Technical Inefficiency of Cluster and Individual Farming

Type of farming	Variable	Mean
Cluster	Actual qt per hectare	47.17
	TE (%)	0.785
	Potential qt per ha	60.47
	Yield gap (qt per ha)	13.30
Individual	Actual qt per hectare	39.042
	TE (%)	0.693
	Potential qt per ha	56.38
	Yield gap (qt per ha)	17.33

Survey Result, 2020/21

3.7 Returns to Scale Wheat Production

The Return to Scale (RTS) analysis, which serves as a measure of total resource productivity, is given under below Table. The Maximum Likelihood Estimates (MLE) of the Cobb-Douglas based stochastic production function parameter of 1.211 and 0.79 is obtained from the summation of the coefficients of the estimated inputs (elasticity) of cluster and individual respectively. It indicates that cluster farming practice in study area is stage I of increasing returns to scale for cluster farming whereas its stage II for individual farming where resources and production were believed to be efficient. This means an increase in all inputs at the sample mean by one percent will increase wheat by 1.211 % and 0.79 % respectively in the study area. Some literature support that, they argue that larger farmer is more likely to employ improved agricultural technologies, used as a capital base and enhances the risk bearing ability of farmers and hence could be more efficient than small farms due to its advantage of the economic scale and scope associated with larger sizes (Beyene, 2004; Hussein, 2007).

Table 7. Elasticity and Returns to Scale of the Parameters of Stochastic Frontier

	Production	
	Cluster	**Individual**
Variables	**Elasticities**	**Elasticities**
Ln (land)	0.809	0.681
Ln (labour)	-0.022	-0.0052
Ln (seed)	0.0198	-0.0108
Ln (fertilizer)	0.1418	0.1457
Ln (chemical)	0.084	-0.0202
Returns to scale	**1.21**	**0.79**

Source: Survey data, 2020/21

3.8 Results of the Econometric Model (Factors Affecting Participation of Farmers in Clustered Farming)

Before running the econometric models, the data was tested against econometric problems like multicolinearity using VIF, heteroscedasticity using Breusch-Pagan test and endogenetity using Durbin-Wu-Hausman chi-square test. The test results indicate that there is no problem of multicolinearity, heteroscedasticity and endogenetity in the model.

The probit regression model was used to analyze the smallholder farmers' cluster farming practices. The model chi square test indicates that the overall goodness-of-fit of the probit model was statistically significant at 1% probability level which in turn indicates the usefulness of the model to explain the relationship between the dependent and at least one independent variable. The result of probit model estimation shows that the factors affecting farmers cluster farming practices significantly influenced by sex of households, Age of Household, nearest market center, distance to FTC, Participation in social, and participation in field visit.

Table 8. Factors Affecting Farmers' Participation in Clustered Farming

Number of observation=152
LR $chi^2(12)$ = 29.59
Prob > chi2 = 0.0018
Pseudo R2 = 0.1413

Log likelihood = -89.919

	Coefficients	**Robust Std. Err.**	**P>z**	**Marginal effect**
Sex of HH	0.7599***	0.18977	0.000	0.20866
Age of HH	0.0249205*	.0143332	0.082	.00985
Family size	0.0400626	.0341621	0.241	.01584
Education level of HH	0.0363379	.0385125	0.345	.01437
Distance to the nearest market center	0.05304**	.0262586	0.043	.02097
Distance to FTC	0.18989***	0.06921	0.006	0.043
Access to credit	0.3166895	.4822601	0.511	.12581
Access to extension	0.369467	.3216062	0.251	.143815
Access to market information	0.2116207	.3053566	0.488	-.083868
Participation on field visit	0.705102***	.253598	0.005	.274701
Participation in off-farm income	0.4661411	.4260734	0.274	-.1749447
Participation in social organization	0.43257*	0.25815	0.094	0.1149996
Constant	-5.432973	1.468928	0.000	

***, **,*: implies statistical significance at 1%, 5%, and 10% levels, Log pseudo likelihood = --89.919, Pseudo R^2 = 0.1413, Wald chi^2 (12) =29.59, Prob> chi^2 = 0.0018, Predicted probability = 0.447, N = 152.

Sex of HH Head: As the probit model result indicates, being male household head had positive and highly significant influence on the likelihood of cluster farming practices at 1% significance level, suggesting male family heads practices cluster farming than female family head by 20.86%.

Age of HH: As the probit model result indicate that, as households age increases the likelihood of practicing cluster farming increase by 9.8%. This result is in conformity with the finding of Leake.*et al*., (2018).

Distance to the nearest market: Distance of households to the nearest market center was found to influence farmers cluster farming practices positively and statically significantly at 5% probability level. The result was found as per to the prior expectation. The result of probit model depicts that as distance from the home to the nearest market center decreases by one km, the probability of farmers' to practice cluster farming increases by 2.1%, keeping other factors constant. The result revealed that as farmers are located far from market center they are less likely to practice cluster farming. This is in line with the findings of Desale (2017).

Distance to FTC: Distance of households to FTC was found to influence farmers cluster farming practices positively and statically significantly at 1% probability level. The result was found as per to the prior expectation. The result of probit model depicts that as distance from the home to the FTC decreases by one km, the probability of farmers' to practice cluster farming increases by 4.26%, keeping other factors constant. The result revealed that as farmers are located far from market center they are less likely to practice cluster farming. This is in line with the findings of Desale (2017).

Participation in Field visit: As the model result revealed that, participation in different field visit had a positive impact on household's cluster farming practices at 1% level of statistical significance. This implies that the respondent's participation in field visit would increase the probability of household's cluster farming practices by about 27.47%, keeping other factors constant. The probable reason was that the respondent participation in field visit increase their awareness about technologies and create good network which increase practices of cluster farming. Participation in field visit assumes that farmers who have participated in different field visit are more likely to be aware of new practices as they are easily exposed to information. This implies those only participant farmers in different field visit exposure were more likely to practices cluster farming than non-participant farmers. This is in line with the findings of Desale (2017).

Participation in Social organization: As the model result revealed that, participation in social organization had a positive impact on household's cluster farming practices at 10% level of statistical significance. This implies that the respondent's participation in social organization would increase the probability of household's cluster farming practices by about 11.49%, keeping other factors constant. The probable reason was that the respondent participation in social organization increases their awareness about technologies and create good network which increase practices of cluster farming. Participation in social organization assumes that farmers who have participated in different social organization are more likely to be aware of new practices as they are easily exposed to information. This implies those only participant farmers in different social organization exposure were more likely to practices cluster farming than non-participant farmers. This is in line with the findings of Desale (2017).

3.9 Perception of Farmers Regarding to Compatibility of Cluster Farming in Line with Socio-economics Circumstances in the Zone

Positive attitude towards compatibility of cluster farming is one of the factors that can speed up the change process. Positive attitude formation is also a prerequisite for behavioral change to occur. Therefore, it was hypothesized that favorable attitude towards compatibility of cluster farming positively influences the likelihood of farmers to practice cluster farming. This was measured using a summated rating (Likert) scale.

Düvel (1991) associates perceptions with the way the attributes of innovations are perceived and he distinguishes between (a) awareness of relative advantages, (b) awareness or concern of disadvantages, (c) the overall prominence or relative advantage of innovation (practice), and (d) the compatibility with situational circumstances. In this study, weighted average of individual positive (advantages) was calculated. As the result of research analysis indicate that, the cumulative sum of farmers perception towards the compatibility of cluster farming with the socio-economic situational circumstances was 4.093 suggesting farmers perceive positively cluster farming was compatibility with their socio-economic situational circumstances.

Table 9. Perception of Farmers regarding to Compatibility of Cluster Farming in Line with Socio-economics Circumstances in West Arsi Zone

Compatibility of clustered farming with your socio-economic circumstances	Percent
Not compatible	4.35
Less compatible	24.64
Undecided	2.90
Compatible	66.67
Highly compatible	1.45
Total	**100.00**

4. Summary, Conclusions and Recommendations

This chapter summarizes the whole findings of the study and makes conclusions based on the results of the descriptive and econometric model. It also highlights some important policy recommendations to enhance farmers' productivity and efficiency in cluster and individual farming practice.

4.1 Summary and Conclusions

The overall objective of this study was to compare the productivity and efficiency of clustered and individual farming and to identify factors affecting clusters farming practice in West Arsi a zone. In the meantime knowing the view/perception of farmers for clustered farming approach in the study area was also the objective of this study. To conduct the study, primary data was collected from 152 randomly selected household heads through semi-structured questionnaire. Secondary data were also collected from different sources including CSA, ZOANR, DOANR, and from published and unpublished sources to supplement primary data. In this study both descriptive statistics and econometric analysis were employed. The primary data was analyzed using descriptive statistics and stochastic efficiency decomposition method to decompose TE. Stochastic Frontier Approach (SFA) was used for its ability to distinguish inefficiency from deviations that are caused by factors beyond the control of farmers.

The descriptive analysis frequency and mean was used to analysis demographic characteristics of sample households. The productivity of wheat per hectare was 47.17 and 39.042 quintal for cluster and individual farming respectively which is statically significant at 1% level.

The study result revealed that the mean of wheat TE was about 78.46%, for cluster farming and 69.25%, for individual farming. The mean technical efficiency scores were quite high for Cluster farmers than individual farming, however, the results Show that there is still some considerable level of inefficiencies in the use of inputs for the corresponding output levels. The relatively high levels of technical efficiencies among the small scale farmers/individual defies the notion that wheat production in the zone can only be efficiently produced by the Cluster/large scale farmers. The relationship between farm size and efficiency is one of the more persistent puzzles in development economics, even more so as many potential determinants have been put forward and tested without being able to provide a fully satisfying explanation.

In general the findings from this study suggest that gains from improving technical efficiency exist in all farm categories but they appear to be much higher on large/cluster than on small farms/individual. The relatively high levels of technical efficiencies among the small scale farmers/individual defies the notion that wheat production in the zone can only be efficiently produced by the Cluster/large scale farmers.

The relationship between farm size and efficiency is one of the more persistent puzzles in development economics, even more so as many potential determinants have been put forward and tested without being able to provide a fully satisfying explanation. In general the findings from this study suggest that gains from improving technical efficiency exist in all farm categories but they appear to be much higher on large/cluster than on small farms/individual.

The result of probit model revealed that, out of total 12 explanatory variables included in the model 6 (Sex of HH, age of HH, nearest market center, distance to FTC, participation on field visit and participation in social organization) variables was statically significant that influence the likelihood of farmers to practice cluster farming positively.

4.2 Recommendations

The findings of this study point to the need for implementing differential policies that separately target each factor which affect the zone, in order to address the specific determinants of farmers' decision to practice cluster farming. Therefore, to promote and improve farmers' participation in cluster farming, the following policy options are suggested to be addressed by various stakeholders including governments at all levels, research centers, executive bodies of cooperatives and concerned NGOs.

Productivity and efficiency of wheat greater when produced by cluster, so shifting farmers from individual/small scale to large scale/cluster farming is the only option to boost the production.

Cultivated land affects significantly and positively participation decision of farmers in cluster farming. Therefore, the result could reinforce the reason suggested for increaseing land for cultivation through the use of rent-in and share-in where the situation of economies of scale could operate. On the other hand, creating opportunities of providing access to credit used to rent in and shared in land is also another better option to increase household's land cultivated for crops, which has been discovered to be one of the contributing factors to low level of participation in cluster farming.

Age of the household head has positive and significant impact of level of participation decision in cluster farming. The result entails that age is important variables in enhancing farmers' level of participation in cluster farming. Older farmers are assumed to have gained knowledge and experience over time and are better able to evaluate technology information than younger farmers. Therefore older farmers tend to intensify the adoption of new technologies in their farming business as a result of more years of farming experience, and knowledge. Thus, it is important for research, extension organization and NGOs to target order farmers during on farm research and cluster farming promotion as they can easily understand about the cluster farming which, in turn helps for convincing the other to participate in the cluster farming.

Distance from farm/home to nearest market center has significantly influence participation of farmers in cluster farming. This is due to the fact that farmers who use new varieties of crop need to transport crop seed from market or distribution center of cooperatives and WoARD which involves high transaction cost. In this connection investment in the development of infrastructure, such as construction of new rural roads or improving the existing one and reorientation of the seed system will need the attention of the government in order to increase the level of farmers' participation in cluster farming decision. Also it could be that farmers located far away could face deprived access to technological information and to involvement in on-station trials are less likely to participate in cluster farming and could continue with the existing individual small scale farming practices. While the present effort of the government to extend the construction of whether road in rural areas is encouraging, improving the existing market center in the locality (which is informal and poor developed) should be given proper attention to enhance participation of farmers in cluster farming. In the meantime as farmers far from market access to information, access to extension service also low. Therefore, improving the existing market centers in the locality should be given proper attention to enhance participation of farmers in cluster farming.

Respondent's participation in social organization has significant and positive impact on participation of farmers in cluster farming. The probable reason was that the respondent participation in any social organization increase their awareness about technologies and create good network which increase access to input used for crop production. Hence, we need to encourage establishment and strengthening of participation in any kinds of social organization to enhance farmer's participation in cluster farming through providing different kinds of incentive to farmers and use other suitable mechanism which increase producer farmer in participating of any community/social organization.

In general the following policy implication was recommended to increase participation of farmers in cluster farming in West Arsi zone.

- Improve farmers participation in field visit
- Strengthening social network of farmers
- Development of human capital and
- Development of physical capital

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