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Determinants of Farmers' Participation in Farmers Research Groups: The Case of Fogera District, Amhara National Regional Sate, Ethiopia

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ABSTRACT

Farmers Research Group is one of the participatory agricultural research approaches aimed to improve the conventional top-down research approach that doesn't fully address the needs of subsistence and smallholder farmer. Based on this, Adet agricultural research center is implementing this approach at Fogera district of Ethiopia. Therefore, the main objective of this study was to identify factors determining farmers' participation decision in Farmers Research Group research approach. A multistage purposive and random sampling technique was employed to collect cross-sectional survey data from a total of 120 Farmers Research Groups approach participant and non-participant households in 2012/13 at four *kebeles* of Fogera district. The study employed the binary probit model and results of the study revealed that age, sex, education, access to research, access to training and access to credit affected positively and significantly the probability of farmer's participation in Farmers Research Groups approach while family size in adult equivalent was affected negatively and significantly probability of participation. Hence, facilitating and promoting basic agricultural services like access to training, access to credit and access to research and extension system would help to make farmers to participate more in Farmers Research Groups so as to improve their agricultural production techniques so that to enhance their income and food security status.

Key words: Farmers, Farmers Research Groups, Fogera, Participation, Probit,

INTRODUCTION

Agriculture is the main sector of the Ethiopian economy and contributes about 41% of the GDP, offers 70% of raw materials requirement of the country's large-and medium-scale industries, generates more than 85% of the foreign exchange earnings and employs about 80% of the population (CSA, 2011). A great proportion of cultivated land is held by subsistence farmers who produce about 90% of the national agricultural output (Devereux, 2000).

The smallholder farmers, however, produce a little 'surplus' over their requirement (2100 kilo calorie, which is estimated to be 225 kg of food (grain equivalent) per person per year, which was set by the government of Ethiopia as the minimum acceptable weighted average food requirement per person per day, Kifle and Yosef, 1999) and, hence, could not adequately feed the population out of the agricultural sector. Despite of high contribution of agriculture to the overall economy of Ethiopia, this sector is challenged by multitudes of factors such as climate related disasters like drought and flood, low level of technology adoption, lack of infrastructure and credit, poor institutional linkage, etc and resulted in low productivity of the sector.

The low productivity of the agriculture sector has made it difficult to attain food self-sufficiency at both national and household levels in Ethiopia. In order to avert this low productivity, the government of Ethiopia has put agriculture at the heart of its policies so that it accelerates economic growth and development. The Ethiopian government devotes considerable resources to research and extension in view of encouraging small-scale farmers to increase their productivity and to enable them achieves food self-sufficiency. In this regard, several improved agricultural technologies have been introduced, evaluated and made ready for users through the agricultural research system of Ethiopia. However, these improved agricultural technologies (improved crop varieties, agronomic practices, pre and post-harvest technologies, improved breeds of cows and improved farm equipments) are not widely adopted and used by farmers in different parts of the country as expected (Chimdo *et al.,* 2005). For instance, Epoug (1996), indicated that only 10% of farmers in Africa had adopted new technologies. This clearly shows that, technology generation and transfer is not an end by itself in any research endeavor unless it is demand-driven and client oriented and finally utilized by end users, in this case farmers.

Today farmers' involvement in research is not a new concept. Experience in Ethiopia and elsewhere has shown that innovations/technologies that are developed in research stations without participation of farmers are often refuted by farmers. This is due to the fact that, innovations which were developed without the involvement of farmers have little chance of meeting actual farmers' needs (Chimdo *et al*., 2005). In a nutshell, in the past, farmers were often overlooked in technology development process despite their rich experience and knowledge.

Participatory research approach emerged as a response to the limitations of earlier top-down conventional agricultural research approach that often failed to deliver significant improvements in levels of well-being for the poor in complex, risk prone environments (Chambers et al, 1989). One of the strategies currently adopted to form strong alliances with farmers in the process of making agricultural research and extension client oriented and demand-driven so that technologies would be adopted by farmers, is the application of participatory agricultural research approaches like the establishment of Farmers-Research-Groups (FRGs) approaches. FRG is one of the participatory research approaches that realize research output and it is a group of farmers who have common problems and are voluntarily willing to work in a group in collaboration with Research and Extension and others to solve their common problems (JICA, 2009).

Research institutions/centers mainly conduct their research activities on research testing stations/sites without much exposure of the farmers who are the best end users of the research output. However, to increase production and productivity as well as to conduct client oriented and demand-driven research, these conventional research and transfer-of-technology method would need some improvement. Farmers-the potential end-users of research output, should participate through the research process as much as possible.

These days, participation has become a widely accepted strategy for conducting research and development projects (Anandajayasekeram *et al*., 2008). According to Chimdo *et al*. (2005), increased household food security; increased income of farmers from high value crops; increased adoption of technologies; technical and financial empowerment of farmers; and an increase in farmers' participation in extension system (in spite of illiteracy levels) were some of the benefits of participatory research. Ashby and Lilja (2004), reviewed the efficacy of Participatory Plant breeding (PPB) compared to conventional breeding for over 150 projects and they concluded that the efficacy of participatory research compared to conventional breeding was demonstrated by increasing the overall level of benefit from the program, increased effectiveness of reaching women and the poor, improved research efficiency and varieties developed being more acceptable and adopted faster. Participatory agricultural research approach particularly of FRG is currently adopted in the research-extension system of Adet Agricultural Research Center, Ethiopia on the assumption that, it would improve and facilitate the one-way conventional research approach so that farmers needs and priorities will be properly addressed. Based on this, the research center establishes FRGs in Fogera district at *Quhar-Michael, Tihua, Kokit and Bura* kebeles of rice producing

areas. Empirical works on factors that influence farmers' participation in participatory research approaches like FRG is limited with respect to Ethiopia and North Western Region. There are no such empirical works to date with respect to the study district, Fogera, Ethiopia. Therefore, this study was initiated to identify the determinants of farmers' participation decision in FRG research approach in Fogera district of Amhara Region, Ethiopia. Describing the socioeconomic aspects and identifying determinant factors of FRG participation would have great support for researchers, policy makers and non-governmental organizations to intervene in a better way and towards the interest of farmers.

The specific objectives of the study were:

1. to describe the socioeconomic situations of farmers, and
2. to identify determinants of farmers' participation in FRG approach

RESEARCH METHODOLOGY

Description of the Study Area

The study was undertaken in Fogera district of South Gondar zone, Amhara Region, Ethiopia. The district is well known for its rice production and Fogera cattle breed. Fogera district is one of the 12 administrative districts (10 rural and 2 urban) of South Gonder zone of Amhara Regional State which is located about 625 km North of the country's capital Addis Ababa and 55 km North of regional capital, Bahir Dar (BoARD, 2009). Altitude of Fogera ranges from 1,750 to 2,500 meters above sea level with an average rain fall of 1284 millimeter and temperature ranging from 12 ^{o}C to 27^{o}C (Figure 1). Topographically, it is 76% plain, 13% gentle slope and 11% mountainous. Land use pattern of the district is 51,472 hectares (ha) cultivated; 26,999 ha grazing land; 2,190 ha forest and bush; 23,354 ha water bodies; 7,075 ha settlement and infrastructure; and 1,698 ha swampy areas (IPMS, 2005).

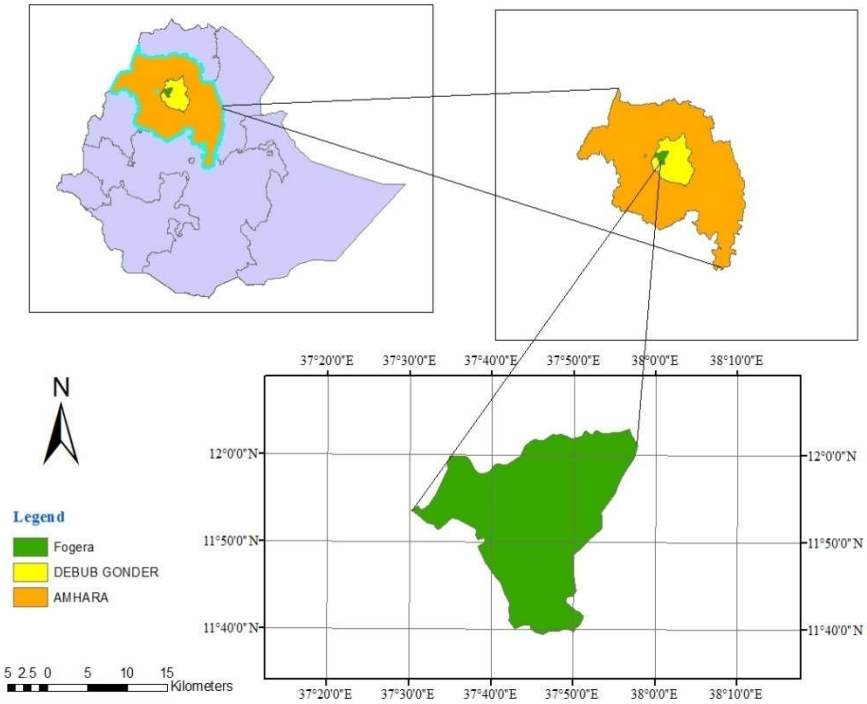

Figure 1. Location of the study district, Fogera. (Source: Environmental Systems Research Institute, 2010).

Data Types and Method of Data Collection

Data were collected both from primary and secondary sources. Primary data was collected about the whole situations of agricultural production (socioeconomic, demographic and institutional characteristics of respondents) from the sample farmers that are FRG members as well as non-FRG members using semi-structured questionnaire. The study used three stages purposive as well as random sampling technique to select sample households. In the first stage, Fogera district was selected purposively and then four kebeles were selected in the second stage. Finally in the third stage, 120 farmers (60 from FRG member and 60 from non-FRG member) were selected randomly in those four kebeles for the study.

Method of Data Analysis

The collected data was analyzed by descriptive followed by econometric analysis. Furthermore, test statistics such as t-test for continuous variables and chi-square (χ^2) test for dummy/discrete variables was used to supplement significance of results. STATA version 11 statistical package was employed for the process of data analysis.

Econometric analysis and model specification

The Probit regression model was applied to identify factors that determine the decision of farmers to participate in FRG research approach. Accordingly, the dependent variable assumes only two values: 1 if the farmer participates in FRG approach and 0, if it does not. Given the assumption of normality, the probability that y_i* is less than or equal to y_i can be computed from the normal commutative normal distribution as follows:

$$Pi = P\left(Y = \frac{1}{X}\right) \quad \ldots\ldots 1$$

$$Pi = P(yi < y) \quad \ldots\ldots 2$$

$$Pi = P(Zi < Bo + BjXij) = F(Yi) \quad \ldots\ldots 3$$

The probit model is given by:

$$P(Y = 1/X) = F(XB) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{XB} e^{\frac{-(XB)2}{2}} dx \quad \ldots\ldots 4$$

Where: X= (1, x_{1i}, x_{2i}, ..., x_{ki}) and ß'= (ß$_0$, ß$_1$, ..., ß$_k$)
yi^* is the critical level of the index, such that if y_i exceeds y_i*, the farmer participates in FRG approach, otherwise not. P=(Y=1/x) is the probability that the farmer participates in FRG given the values of the explanatory variables X, and Z is a random variable normally distributed with mean zero and unit variance.

The relative effect of each explanatory variable on the likelihood that a farmer will participate in FRG approach is specified as follows:

$$\frac{\partial Pi}{\partial Xij} = \beta ij * f(Zi) \quad \ldots\ldots 5$$

Where: f(Z_i) is the inverse of the commutative normal function and ß$_{ij}$ are the parameters to be estimated.
Empirically, the model for the determinants of farmer's participation in FRG is specified as:

$$Y = \beta o + \sum_{i=1}^{13} BiXi \quad \ldots\ldots 6$$

Where: ß$_o$ is the constant/intercept term and ß$_i$ are the parameters to be estimated.

Definition of Variables and Working Hypothesis

The study used the dummy participation decision in FRGs as dependent variable. This variable is dichotomous in nature measuring participation of a farmer in FRG approach that takes a value of 1 if the farmer is participated/member and 0, otherwise. The explanatory variables that are hypothesized to affect the farmers' participation decision in FRGs are combined effects of various household, socio-economic and institutional characteristics in the farming systems of farmers. Based on the past research findings and background information of the farming system of the study area, the following 16 potential explanatory variables were hypothesized to influence the participation decision variable. The summary of these independent variables is given in Table 1.

Table 1: Summary of variables and their measurements included in probit model

No	Variable name	Code	Expected sign	Measurement
1	Age of the household head	AGE	(+,-)	Age measured in years
2	Sex of the household head	SEX	(+)	1 if male and 0 otherwise
3	Education status	EDU	(+)	1 if literate and 0 otherwise
4	Family size in adult equivalent	FAML	(+,-)	Family size converted to adult equivalent
5	Off-farm income	OFFAR	(+,-)	1 if participated and 0 otherwise
6	Land own total	AREA	(+)	Owned land measured in ha
7	Radio ownership	RADIO	(+)	1 if owned and 0 otherwise
8	Total livestock ownership	TLU	(+)	Total livestock converted to TLU
9	Extension service	EXTEN	(+)	Extension contact frequency per year
10	Access to research system	RESRCH	(+)	1 if has access and 0 otherwise
11	Training participation	TRAIN	(+)	1 if has access and 0 otherwise
12	Access to credit	CREDIT	(+)	1 if has access and 0 otherwise
13	Distance from the main road	DIST	(-)	Measured in minutes of on-foot walk
14	FRG-participation	FRGmem		1 if participant/member and 0 otherwise

Note: C*=Continuous variables and D**= Dummy variables
Source: Own computation, 2013.

RESULTS AND DISCUSSION

Descriptive results of the socio-demographic characteristics of respondents

Table 2 shows household characteristics of respondents disaggregated by FRG participant and non-FRG participant ones. Head of the household is normally responsible for the coordination of household activities. Out of the total sample households, 95% were male-headed while 5% of them were female-headed households. The chi square test indicated absence of significant mean difference between FRG participants and non-participants respondents interms of sex of the household head (Table 2). The age of the household is considered a crucial factor, since it determines whether the household benefits from the experience of an older person, or has to base its decisions on the risk-taking attitude of a younger farmer. Average age of the household heads' for both participant and non-participant farmers in FRG approach was 45.48 years with a standard deviation of 12.40. The mean age for participant household heads was 45.48 years and that of non-participants was 45.47 years with standard deviation of 10.93 and 13.80 respectively and there was no significant statistical mean difference between them with respect to this variable (Table 2).

Education helps farm households to acquire and interpret information on agricultural technologies and rationally allocate existing farm resource to achieve their household farming objectives and goals. Out of the total 120 sample household heads, 45.8% and 54.2% were illiterate and literate, respectively. About 28.3% and 71.7% FRG participant respondents were illiterate and literate respectively while 63.3% and 36.7% of non-FRG participants were illiterate and literate respectively (Table 2). The Chi-square test showed that there was high significant mean difference in education status between the two FRG participant and non FRG participant farmers at 1% level of significance. The average family size of all sample respondents' was 6.57 persons with a standard deviation of 1.869. The average family size of participants and non-participant farmers' was 6.92 and 6.22 in number, with the standard deviations of 1.670 and 2.001 respectively. The mean comparison of family size between the two groups indicated statistically significant mean difference in the mean family size at 5 percent probability level (Table 2). The mean adult equivalent family size of respondents was 5.35 and there was statistical mean difference between the two groups.

Table 2: Household characteristics of sample respondents

Variables/Factors	Participants		Non-participants		χ^2	Total sample	
	N	%	N	%		N	%
Dummy variables							
Sex:							
- Male	57	95	57	95	0.000	114	95
- Female	3	5	3	5		6	5
Education							
- Illiterate	17	28.3	38	63.3	14.80***	55	45.8
- Literate	43	71.7	22	36.7		65	54.2
Continuous variables	Mean	St.dev	Mean	St.dev	t-value	Mean	St.dev
Age (in years)	45.48	10.93	45.47	13.80	0.007	45.48	12.40
Family size (no)	6.92	1.670	6.22	2.001	2.080**	6.57	1.869
Family size (AE)	5.63	1.39	5.08	1.62	1.970**	5.35	1.53

*** and ** show values statistically significant at 1% and 5% probability levels respectively. AE=Adult Equivalent.

Source: Own survey result, 2013.

The total owned cultivated land size of sample respondents varied from 0.00 to 3.00 hectares with an average holding of 1.23 hectares and the standard deviation was 0.64. The average size of own land for FRG participant and non FRG participant farmers was 1.35 and 1.11 with standard deviation of 0.61 and 0.65 respectively. There was statistical significant mean difference between participant and non participant farmers in own land size (Table 4).

`The use of good quality seed of adapted and improved varieties is widely recognized as fundamental to ensure increased crop production and productivity. Among the total respondents, 38.3% FRG participant and 25% non-participant farmers use improved rice varieties. The mean area allocated for improved rice varieties by respondent farmers was found to be 0.281 hectare with standard deviation of 0.184 (Table 3).

Livestock production is an integral part of the farming system in the study area that contributes a lot for rice production like source of draught power, food, cash, animal dung for organic fertilizer and fuel and means of transport. For standardization and understanding purpose, livestock number was converted to tropical livestock unit (TLU) (Storck et al., 1991). The overall average TLU of the households was 5.395 TLU units with a standard deviation of 2.485. The mean TLU possession of the FRG participant farmers' was 5.90 units and that of the non-FRG participant farmers was 4.89 and there was statistically significant difference between the participant and non-participant

farm households in livestock holdings at 5% significant level (Table 3).

Although agricultural production activities (crops and livestock integrated farming) are the main source of livelihoods of farmers, some farmers do participate in off-farm activities to supplement their income sources. Off-farm activities include weaving, petty trade, carpenter, casual laborer, remittances, etc. Out of the total sample households, 25% of them participated in off-farm activities and got an annual average income of Birr 4,848.6 with a standard deviation of 3814.4. About 20% of FRG participant and 21.7% non-FRG participant farmers participated in off-farm activities and got an average annual income of 5,214.5 and 4,482.8 Birr/annum respectively (Table 3).

Table 1: Farm characteristics of sample respondents

Variables/Factors	Participants		Non-participants		χ^2	Total sample	
Dummy variables	N	%	N	%		N	%
Improved rice variety use (%)	23	38.3	15	25	2.47	38	31.7
Off-farm activity participation(%)	12	20	13	21.7	0.051	25	20.8
Continuous variables	Mean	St.dev	Mean	St.dev	t-value	Mean	St.dev
Area allocated for improved rice varieties (ha)	0.304	0.211	0.245	0.126	0.898	0.281	0.184
Total Livestock Unit	5.90	2.361	4.89	2.522	2.259**	5.395	2.485
Income from off-farm (Birr/annum)	5214.5	4428.5	4482.8	3226.4	0.481	4848.6	3814.4

** show values statistically significant at 5% probability level.

Source: Own survey result, 2013.

Table 4: Farm characteristics of sampled households (land holding and oxen number)

Variables/Factors	Participants		Non-participants		t-value	Total sample	
	Min (Max)	Mean (St.dv)	Min (Max)	Mean (St.dv)		Min (Max)	Mean (St.dv)
Total land owned (ha)	0.5 (3.00)	1.35 (0.61)	0.00 (3.00)	1.11 (0.65)	2.068**	0.00 (3.00)	1.23 (0.64)
Total land cultivated(ha)	0.75 (3.75)	1.77 (0.67)	0.38 (3.00)	1.47 (0.63)	2.522***	0.38 (3.75)	1.62 (0.67)

*** and ** show values statistically significant at 1% and 5% probability levels respectively. Note: Min=Minimum, Max=Maximum, St.dv=Standard deviation.

Source: Own survey result, 2013.

It was assumed that, respondents who owned a radio can get more information about new agricultural technologies, marketing and other related issues. Among the sampled households, 64% owned radio. The statistical result showed that 75% of FRG participant and 31.7% of non-FRG participant farmers owned a radio and there was significant statistical mean difference among participant and non-participant farmers at less than 1% probability level in radio ownership (Table 5). Credit enhances farmers' financial capacity and plays an important role in increasing agricultural production and productivity of farmers. The survey result indicated that about 65% of the sampled farmers have accesses to credit and among which 17.5% have taken credit in 2012 comprised of about 3.33% of FRG participants and 6.675% of non-FRG participants (Table 5).

Training enhances farmers' local indigenous knowledge and believed to improve their method of agricultural production. Among the total sample households, 55.8% of them got training on average of 1.46 times per year for the last three years with standard deviation of 0.633 (Table 5 and 6). About 98.3% of FRG participant and 13.3 % of non-FRG participant farmers got training. There was significant mean difference in access to credit, research and training received between FRG participant and non-participant farmers (Table 5).

In the study area, the district office of agriculture experts and most importantly, Development Agents (DAs) are the main sources for agricultural extension services for farmers. All sample households received extension services/contacts with an average of 11.8 times per year. And it was 13.57 and 10.03 times per year for FRG participant and non-participant farmers respectively and there was statistically significant mean difference between the FRG participant and non-participant sample households in terms of extension contact (Table 6). Access to the research system is believed to widen farmers' attitude of adopting new agricultural technologies. Research system is also best source for agricultural knowledge and initial seeds of improved varieties. Among the sample households, 68.3% of them had research access in the last three years before FRG establishment through demonstration plots, field days, trainings and experience sharing activities (Table 5). About 80% and 56.7 % of FRG participant and non-participant farmers have research access respectively before the establishment of FRG approach and there was significant mean difference (χ^2 value of

22.19) between the FRG participant and non-participant respondents in terms of research access.

Table 5: Institutional characteristics of sample respondents (Dummy variables)

Variables/Factors	Participants		Non-participants		χ^2	Total sample	
	N	%	N	%		N	%
Radio ownership (%)	45	75	19	31.7	22.63***	64	53.3
Have credit access (%)	50	83.3	15	25	41.12***	65	54.2
Credit obtained 2012(%)	2	3.33	4	6.67	0.702	21	17.5
Training received:	59	98.3	8	13.3	87.89***	67	55.8
Research access:	48	80	34	56.7	22.19***	82	68.3

*** show values statistically significant at 1% probability levels.
Source: Own survey result, 2013.

Table 6: Institutional characteristics of sample respondents (continuous variables)

Variables/Factors	Participants		Non-participants			Total sample	
Continuous variables	Mean	St.dev	Mean	St.dev	t-value	Mean	St.dev
Trainings (no /year)	1.54	0.625	0.89	0.333	3.06***	1.46	0.633
Credit amount (Birr in 2012)	3909.1	2211.5	2187.5	798.10	2.09**	3184.2	1930.8
Extension services (no of times per year)	13.567	5.100	10.033	4.202	3.74***	11.8	5.452

*** and ** show values statistically significant at 1% and 5% probability levels respectively.
Source: Own survey result, 2013.

Determinants of farmers' participation decision in farmer's research groups

Potential explanatory variables that were expected to influence the decision to participate in the FRG research approach were estimated with the help of the maximum likelihood method. As shown in Table 7, a total of 13 potential predicted variables were selected and entered in to the probit model, out of which 7 variables were found significantly influencing the decision to participate in joining FRG research approach. As it is indicated, age (AGE), sex (SEX), education (EDU), access to research (RESRCH), training (TRAIN) and access to credit (CREDIT) were positively and significantly related while family size in adult equivalent (FAML) was negatively and significantly related to the probability of participation in FRG approach. The probit model was highly significant with a χ^2-value of 146.65 and correctly predicted 71.2% of the observed outcomes.

Age of the respondents had a positive and significant influence on the participation decision of farmers in FRG research approach at less than 5% probability level. This is due to the fact that, older farmers may accumulate more knowledge than younger ones from the extended period of life time that may help them to make productive decisions in their farming activities. It was found that, as farmer's age increased by one year, the probability of participating in FRG approach will increase by 0.84%, keeping other variables constant. Sex of the household head was positively and significantly associated with the probability of farmers to participate in FRG research approach at less than 1% probability level. The reason may be, male-headed households have more access to opportunities than female-headed household heads and would have greater probability of participation in FRGs membership and benefited in FRG research activities. This needs mechanisms to make female headed households participants and beneficiaries of the FRG approach. As the household head is being male, the probability of farmers' participation in FRG approach will increase by 66%, holding other variables constant.

As hypothesized, the educational status of the respondent was positive and significantly influenced the participation decision of FRG research approach at less than 5% probability level. The reason is that, exposure to education would increase a farmer's ability to obtain, process, and use information relevant to his farming activities. In this case, keeping other variables constant, as a farmer got educated, the probability of deciding and participating in the FRG research approach will be increased by 45%. Abdulmalik *et al.,* (2013) study on determining factors influencing crop farmers' participation in agricultural insurance scheme; Kidanemariam *et al.* (2012) study on examining the determinants of farm households' agricultural extension program participation decision and its effect on income level as well as income diversification situations in northern part of Tigray region, Ethiopia; and Tiwari *et al.* (2008) on determining factors affecting farmers' adoption of improved soil conservation technology in a Middle Mountain watershed of Central Nepal found also similar results. As hypothesized before, access to research has a positive significant effect on the participation of farmers in the FRG research approach at less than 5% probability level.
This implies that, farmers' access to research institutions in on-farm field experimentations, demonstrations, field days and trainings increases their awareness about new agricultural technologies so that the probability of joining the FRG research approach

will also increase. The result of marginal effect of the probit model showed that, as a farmer has access to the research system, the probability of being participated in the FRG approach will increase by 56.6%, ceteris paribus. This result is consistent with Yusuf *et al.* (2013).

Access to training has been found to relate to the probability of participating in the FRG research approach positively and significantly at less than 1% probability level. This implies that, as farmers have access to trainings, their probability of being participants in FRG research approach will also increase. The marginal effect of the probit model showed that, as a farmer has access to trainings, his probability of participation in the FRG approach will increase by 90.9%, keeping other variables constant. From this, we can conclude that, training of farmers on different agricultural issues make them aware of improved agricultural technologies and can join FRG approach to get closer to sources of those improved technologies. A similar result was obtained by Barnabas *et al.* (2012). The result of the probit model showed that adult equivalent of family size of the household increases, the probability of participating in FRG approach will decrease. The reasons of negative influence may be, on one hand, household with larger family size may have off farm employment and sufficient off farm income to secure the family's food need and may ignore in participating in FRG approach, and on the other hand, households with larger family size may be conservative in taking risk by participating grouping activities like FRG approach and they may try to avoid risk by not participating in new activities in their localities. The marginal effect of the probit model indicated that, when the family size increased by one adult equivalent, the probability of participating in FRG approach decreases by 18%, holding other variables constant. This result was contrary to the finding of Kidanemariam *et al.* (2012) and Akobundu *et al.* (2004).

farmers' access to credit sources has been found to be positively and significantly related to the probability of the participation of farmers as FRG members at 1% probability level. This implies that, as farmers have more access to credit, the probability of being an FRG participant will also increase. Credit is important for farmers and it enhances their capacity to buy the necessary agricultural inputs like seeds, fertilizer and chemicals that are required by improved agricultural technologies to be adopted by farmers. The result showed that, as a farmer has access to credit, the probability of participating in FRG approach will increase by about 64%, holding other variables constant. Yusuf *et al.* (2013) and Abdulmalik *et al.* (2013) also found similar results.

In contrary to the priory hypothesized effect, family size in adult equivalent was found to be negatively significant at less than 5% probability level in influencing the probability of farmers' participation in FRG approach. This means that, as the size of the

Table 2: Maximum likelihood estimates of Probit model

Variables	Coefficients	Robust std. errors	z-values	Marginal effect
DIST	-0.0439	0.0269	-1.63 (0.102)	-0.0164
AGE	0.0274	0.0136	2.01** (0.044)	0.0084
SEX	4.1669	1.0277	4.05*** (0.000)	0.6627
EDU	1.0009	0.4736	2.11** (0.035)	0.4502
FAML	-0.4741	0.2113	-2.24** (0.025)	-0.1810
OFFAR	0.5674	0.6831	0.83 (0.406)	0.1915
AREA	-0.8380	0.5707	-1.47 (0.142)	-0.2168
RADIO	0.3706	0.3932	0.94 (0.346)	0.1879
TLU	0.1690	0.1376	1.23 (0.219)	0.0553
EXTEN	-0.0264	0.0552	0.48 (0.631)	-0.004
RESRCH	1.9630	0.8088	2.43** (0.015)	0.5656
TRAIN	3.6856	0.8239	4.47*** (0.000)	0.9090
CREDIT	2.0459	0.5985	3.42*** (0.001)	0.6406

Number of observations 120
Log-likelihood function -17.607614 Restricted log likelihood = -1246.577
Chi-squared 146.65 Significance level 0.0000
Predicted Success 71.2%
Numbers in parenthesis are p-values.
*** and ** show the values statistically significant at 1%and 5% respectively.

CONCLUSION AND RECOMMENDATIONS

Results from descriptive statistics showed that the FRG participant/member and non-participant households differed significantly from each other in educational status, family size in adult equivalent, land, livestock, radio ownership, credit, training, extension and research service accesses.

Age, sex, education, access to research, access to training and access to credit were positively and significantly related to the probability of participation in FRG approach while family size in adult equivalent was negatively and significantly related to the probability of FRG approach participation. Therefore, implementing FRG research approach by improving the factors affecting farmers' participation in FRG approach would lead to smallholder farmers participation in research and development so that their productivity and production would increase. Moreover, it would quicken improved agricultural technology evaluation and dissemination activities through farmers by minimizing efforts and money that has great implication on the lengthy and less client-oriented/demand-driven conventional research system/approach. Therefore, promoting and facilitating access to credit, research, training and education services and strengthening and implementing the FRG research approach are some of the recommendations suggested for future research, policy and development intervention points.

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