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Farmers' Participation in Farmers Research Groups and Its Contribution on Their Income from Rice: Empirical Evidence from Rice Production System of Fogera District, 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 rice producing district of Ethiopia. The main objective of this study was to assess the contribution of the Farmers Research Group approach on farmers' gross margin earning level from rice production and its determining factors of contribution. 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 Treatment effect model of Heckman two step procedure to measure contribution of the Farmers Research Group approach on gross margin earning level of participant farmers from rice production. The second stage estimation results of the treatment effect model showed that family size in adult equivalent, access to research, use of improved rice variety and dummy participation in farmers research groups approach have significant relation to gross margin earnings from rice. The gross margin analysis indicated that a farmer could generate additional gross margin of Birr 5,378.97 per hectare of rice being participating in the approach than being non-participant while this figure was Birr 5,772.06 in the econometric model analysis that indicates the profitability of the approach. Therefore, implementing FRG research approach could lead to the enhancement of farmers income from rice.
Key words: Rice, Farmers Research Groups, gross margin, Treatment effect, Fogera

Introduction

Ethiopia has a huge potential for rice production which is estimated at about thirty million hectares and the importance of the crop is increasing as the area under this crop is approaching 160,000 hectares within a short period of time (MoARD, 2010). According to this source, the area allocated has increased from about 18 thousand in 2006 to about 90 thousand ha in 2008 along with production increase from about 150 thousand tones in 2006 to about 286 thousand tones in 2008. The discovery of wild rice in the Fogera plain in the early 1970s was the basis for rice introduction in Fogera district as well as in Ethiopia and total of 9,213 ha of land was covered by rice and 41,774 ton rice was produced in Fogera district in 2008 (Astewul, 2010). And nowadays, rice has become dominant component of the farming systems of Fogera district and Fogera plain contributes 32% of rice production in the country.

Rice means life for Fogera farming community, being cultivated year after year, grown on waterlogged lands which are difficult for other cereals to be cultivated. Moreover, rice is one of the cereal crops that have got attention in research and development system of Ethiopia and efforts are continued to improve its productivity. Several improved rice technologies like improved rice varieties, agronomic practices and pre and post-harvest technologies have been evaluated and made ready for users through the research system. However, these improved rice technologies are not widely adopted and used by farmers as expected. 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 (Chimdo *et al.,* 2005). 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.

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 is the application of participatory agricultural research approaches like the establishment of Farmers-Research-Groups (FRGs) approaches. FRG approach is a research approach by which a multi-disciplinary research team, extension workers and groups of farmers jointly conduct participatory on-farm agricultural research through need-based technology generation, adaptation and dissemination with the

participation of other stakeholders on field days, visits, experience sharing and workshops (JICA, 2009). Farmers who have common problems and are voluntarily willing to work in a group would join the FRG approach.

These days, participation has become a widely accepted strategy for conducting research and development projects (Anandajayasekeram *et al*., 2008). Kidanemariam *et al.* (2012) found that, extension participation, positively and significantly influenced total income and income diversification of participant farmers; and participant households were found to earn 14.7% more compared to non-participant households. Barnabas *et al.* (2012), showed that participatory variety selection (PVS) positively and significantly influenced the likelihood of adoption of improved sweet potato varieties in central Uganda and farmers who participated in variety selection processes were 6.7 times more likely to adopt the improved sweet potato varieties than those who had not. Moreover, Getaneh, (2006) studied bread wheat contract farming participation of farmers and he found that farmers who participated benefited from this program.

Farmers research group research approach 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 income and other contributions of 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. Therefore, this study was initiated to assess the income contribution of FRG research approach in Fogera district. Measuring the income contribution of FRG approach 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 identify determinants of farmers' participation in FRG approach, and
2. to measure the contribution of FRG participation on farmers' gross margin earning/ income level from rice production.

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). Average altitude of Fogera ranges from 1,750 to 2,500 meters above sea level (masl) 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 with 12%, 20%, 65%, and 3% red, brown, black and grey soil colours respectively (IPMS, 2005). 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. Average land holding is about 1.4 ha with minimum and maximum of 0.5 and 3.0 ha, respectively (IPMS, 2005).

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 the households) from the sample farmers that are FRG members as well as non-FRG members using semi-structured questionnaire. In addition, Focus Group Discussion (FGD) with members and non-members and checklists for key informants from research, office of agriculture and NGOs was carried out for qualitative analysis and triangulation.

Three stages purposive plus random sampling technique was used to select sample households. In the first stage, Fogera district was selected purposively and then four kebeles where FRGs were found were selected purposively again in the second stage. In the third stage, 60 from FRG member farmers as well as 60 from non-member farmers were again selected randomly in the same kebele where FRGs are found for the study that sum up to total sample size of 120 households.

Method of Data Analysis

Cross-section data that was collected from sample farmers and key informants was analyzed by descriptive such as mean, standard deviation and percentage statistics 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 or testify significance of results for FRG participant and non-participant farmers. The net margin analysis was used to differentiate the income level of farmers who were participated and not participated in the FRGs approach. The term Gross Margin refers to the amount of money remaining once the variable costs have been deducted from the overall output of the enterprise (Buckett, 1988). It is one of the most convenient ways of finding out how successful an enterprise is, because it includes all the factors concerned in production. Variable costs (labor, fertilizer, seed, and herbicide) and the yield from rice crop production per hectare (grain and straw)

during the study time (2012) were considered for gross margin earning analysis. STATA version 11 statistical package was employed for the process of data analysis.

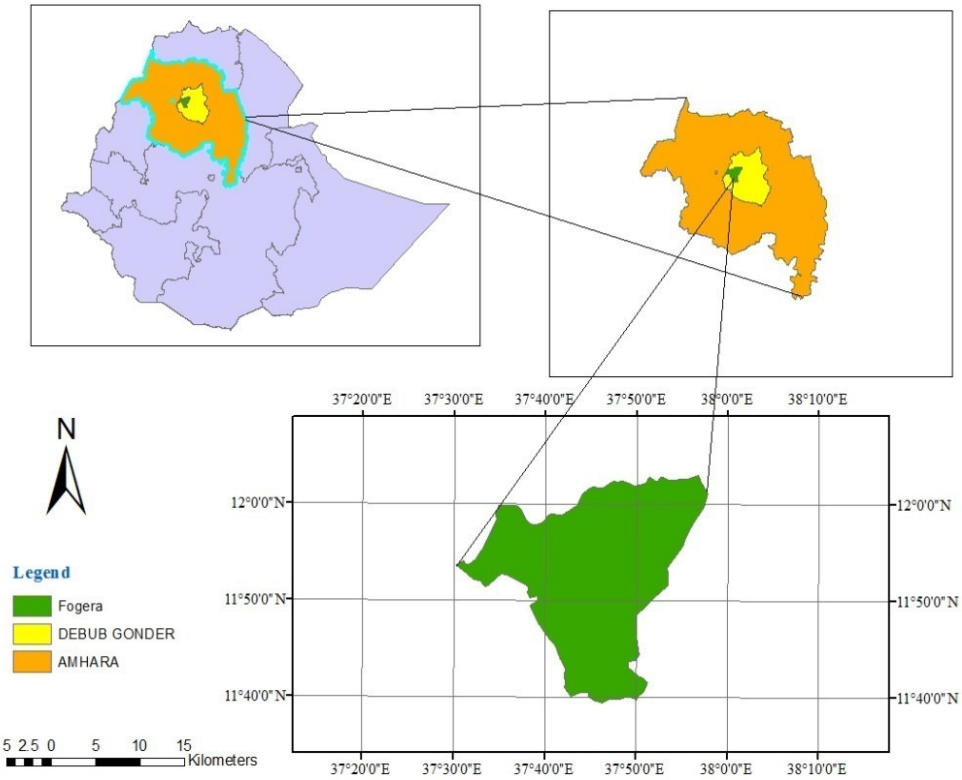

Figure 1. Location of the study district, Fogera. (Source: Environmental Systems Research Institute, 2010).

Econometric analysis and model specification

Heckman two step procedure of treatment effect model was used for this study to measure the income contribution of farmers who participated in FRG research approach and its contributing factors. This model is applied to check for self-selectivity bias in the estimation of the effect of participation decision in FRG research approach on the gross margin earning level of participant farmers (Greene, 2000; Key and McBride, 2003).

In the Heckman two step procedure of treatment effect model, two equations are estimated simultaneously through Heckman's two-step procedure (Heckman, 1979): a probit equation (selection equation) explaining the decision whether or not to participate and an equation explaining gross margin earning level (outcome equation) which includes dummy participation and inverse Mill's ratio among the explanatory variables (Heckman, 1979; Key and McBride, 2003). In the second step, the value of the inverse Mill's ratio is used as an additional explanatory variable in the gross margin equation of the selection model. This eliminates the potential sample selection bias and the result of the FRG approach evaluation equation can be used to make inferences about the FRG approach (participation) potential of FRG approach for all farmers; FRG approach participants and non-participants (Heckman, 1979).

Following Green (2000), the incidental truncation (treatment effect) model used to modeling FRG approach participation and its effect on gross margin earning level is specified as:

$I_i^* = \gamma C_i + v_i$ ……(1)

$Yi = \beta X_i + \delta I_i + \varepsilon_i$ ……(2)

Where,

I_i^* is the FRG approach participation model in the first-step (unobserved variable which has a dichotomous realization I_i that is related to it as $I_i = 1$ if $I_i^* > 0$, otherwise $I_i = 0$),

I_i is a dummy variable indicating the FRG approach participation decision (observed variable),

C_i are the independent variables determining participation in the probit model,

γ is unknown parameter to be estimated in the probit regression model,

Y_i is the value of gross margin earning level in the second-step,

X_i are the explanatory variables determining the gross margin,

β is unknown parameter to be estimated in the gross margin regression model,

δ is a parameter that shows the impact of participation on the gross margin earning level, and

v_i and ε_i are random error terms in the probit and regression (outcome) models respectively and are assumed

to be correlated.

By assuming the presence of the correlation between v_i and ε_i, the equations of the gross margin earnings of the participant and non-participant farmers are formulated as follows (Greene, 2000):

$$E[Y_i|I_i=1]=\beta X_i+\delta+E[\varepsilon_i|I_i=1]$$

$$=\beta X_i+\delta+\rho\sigma_\varepsilon\lambda(-\gamma Z_i) \quad \text{(For FRG participants).} \quad \ldots\ldots(3)$$

$$E[Y_i|I_i=0]=\beta X_i+\rho\sigma_\varepsilon\left[\frac{-\phi_i}{\Phi_i(1-\Phi_i)}\right] \quad \text{(For non-FRG participants)}\ldots\ldots(4)$$

Where,

$\phi(.)$ represents the probability density function,

$\Phi(.)$ represents the cumulative distribution function,

ρ denotes the correlation coefficient between v_i and ε_i

σ denotes the value of the standard deviation of ε_i , and

the factor $\lambda(-\gamma Z_i)=\frac{-\phi(\gamma Z_i)}{1-\Phi(\gamma Z_i)}$ is defined as the Inverse Mills' ratio.

At the end, the expected difference in gross margin earning level between FRG participant and non-participant farmers is evaluated by employing the following form:

$$E[Y_i|I_i=1]-E[Y_i|I=0]=\delta+\rho\sigma_\varepsilon\left[\frac{-\phi_i}{\Phi_i(1-\Phi_i)}\right]\ldots\ldots(5)$$

Where,

$E[Yi|Ii=1]$ is the expected gross margin earning level for FRG participant farmers, and

$E[Yi|Ii=0]$ is the expected gross margin earning level for non-FRG participant farmers.

Definition of Variables and Working Hypothesis

Net gross margin earning from rice is the dependent variable in this study. Explanatory variables that are hypothesized to affect the farmers' participation decision in FRGs and level of net gross margin earning/income from rice production 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 above mentioned two dependent variables. The summary of the model variables is given in Table 1.

Table 1: Summary of variables and their measurements included in the Treatment effect model

No	Variable name	Code	Expected sign	Measurement
1	Education status	EDU	(+)	1 if literate and 0 otherwise
2	Family size in adult equivalent	FAML	(+,-)	Family size converted to adult equivalent
3	Land own total	AREA	(+)	Owned land measured in ha
4	Radio ownership	RADIO	(+)	1 if owned and 0 otherwise
5	Total livestock ownership	TLU	(+,-)	Total livestock converted to TLU
6	Ox ownership	OXEN	(+)	Oxen numbers owned by the respondent
7	Access to research system	RESRCH	(+)	1 if has access and 0 otherwise
8	Leadership participation	MEMR	(+)	1 if has participated and 0 otherwise
9	Use of improved rice varieties	VART	(+)	1 if used and 0 otherwise
10	FRG-participation	FRGmem		1 if participant/member and 0 otherwise
11	Gross margin earning level	INCOMEnet	(+)	Gross margin/ha of rice measured in Birr

Note: C*=Continuous variables and D**= Dummy variables

Source: Own computation, 2013.

Results and Discussion

Socio-economic characteristics of respondents

The descriptive summary statistics of the socio-economic characteristics of participants and non-participants of FRG research approach is given in Table 2. Head of the household is normally responsible for the coordination of household activities. Out of 120 sample households, 95% were male-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. Average age of the household heads' for both participant and non-participant farmers in FRG approach was 45.48. The mean age for participant household heads was 45.48 years and that of non-participants was 45.47 years and there was no significant statistical mean difference between them with respect to this variable.

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. About 54.2% of respondents were literate among which 71.7% of FRG participant and 36.7% of non-FRG participants were literate. 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 significant. The average family size of all sample respondents' was 6.57 persons while the average family size of participants and non-participant farmers' was 6.92 and 6.22 in number 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. The mean adult equivalent family size of respondents was 5.35 and there was statistical mean difference between the two groups. The mean total owned cultivated land was 1.23 hectares (ha) and it was 1.35ha for FRG participant and 1.11ha for non-FRG participant farmers. There was statistical significant mean difference between participant and non participant farmers in own land size.

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. 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-participants.

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. 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.

It was assumed that, respondents who owned 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 radio and there was significant statistical mean difference among participant and non-participant farmers. 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 and about 3.33% of FRG participants and 6.675% of non-FRG participants took credit in 2012. 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 while 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.

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 got extension services/contacts with an average of 11.8 times per year. And it was 13.567 and 10.033 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. Access to the research system is believed to widen farmers' attitude of adopting new agricultural technologies. Among the sample households, 68.3% of them had research access for the last three years before FRG establishment through demonstration plots, field days, trainings and experience sharing activities. 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 between participant and non-participant ones.

Table 2: Socio-economic characteristics of respondent farm households

Variables/Factors	Participants	Non-participants	χ^2	Total sample
Dummy variables				
Sex of the household head (Male %)	95	95	0.00	95
Education status (Literate %)	71.7	36.7	14.80***	54.2
Participate in Off-farm activity (%)	20	21.7	0.051	20.8
Radio ownership (%)	75	31.7	22.63***	53.3
Access to credit (%)	83.3	25	41.12***	54.2
Access to training	98.3	13.3	87.89***	55.8
Access to research (%)	80	56.7	22.19***	68.3
Credit obtained in 2012 (%)	3.33	6.67	0.702	5.0
Continuous variables			t-value	
Age of the household head(in years)	45.48	45.47	0.007	45.48
Family size (no)	6.92	6.22	2.080**	6.57
Family size (AE)	5.63	5.08	1.970**	5.35
Total Livestock Unit (TLU)	5.90	4.89	2.259**	5.395
Income from off-farm (Birr/annum)	5214.5	4482.8	0.481	4848.6
Total land owned (ha)	1.35	1.11	2.068**	1.23
Number of extension visits per year	13.567	10.033	3.74***	11.8

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

Gross Margin earning/income from rice production

Based on data collected during interview of farmers about overall rice production (land preparation to harvesting and storage) and current market price of inputs and outputs, it was tried to estimate the cost and return per hectare of rice for FRG participant and non-FRG participant farmers. The mean paddy rice yield per hectare of land was found to be 41.9 quintals. (29.33 quintal per hectare of milled rice). The productivity of paddy rice for FRG participant and non-FRG participant farmers was 48.44 quintal and 35.35 quintal per hectare respectively.

Rice producers generate income from sales of rice grain yield (either in paddy or milled rice form, but mostly milled one) and rice straw (by-product). Therefore, as it is shown in Table 3, the FRG participant and non-FRG participant farmers obtained a gross income of Birr 40,435.52 and 30,808.33 respectively from one hectare of rice land and there is a high statistical mean difference between these two groups (with t-value of 6.706). To produce this gross income, the two groups of farmers on average invested a variable cost of Birr 30,177.61 and 25,929.39 respectively. After the deduction of these variable costs of production on the level of total gross income, the average gross margin of FRG participant and non-FRG participant ones became Birr 10,257.91 and 4,878.94 respectively with high statistical mean difference between groups. This result indicates that, keeping other things constant, due to productivity difference between these two groups, a farmer could generate additional gross margin of Birr 5,378.97 per hectare of rice being participating in FRG approach than being non-FRG participant. This indicates the profitability of farmers' participation in FRG research approach. There was statistical mean difference at less than 1% probability level among FRG participants and non-participants in total gross income, total variable costs and gross margin earning from rice (Table 3).

Table 3: Benefit and cost analysis (gross margin) of respondents from 1ha rice production

Items	Participants (1)	Non-participants (2)	Difference (1-2)	t-value
Gross income (Birr/ha):				
-Rice grain value (Birr/ha)	35942.19	26231.66	9710.53	7.169***
-Rice straw value (Birr/ha)	4493.33	4576.67	-83.34	-0.342
Total gross income	40435.52	30808.33	9627.19	6.706***
Variable costs (Birr/ha)				
- Seed	2326.67	2261.67	65.00	0.342
- Fertilizer	1674.80	1293.91	380.89	2.258
- Chemical (Herbicide +Pesticide)	232.60	171.84	60.76	2.720***
- Human labor	11324.17	10062.33	1261.84	2.349***
- Animal power	2670.967	2394.37	276.60	3.210***
- Land rental cost	12475.66	10468.04	2007.62	2.614***
Total variable costs	30177.61	25929.39	4248.22	3.914***
Gross margin (Birr/ha)	**10257.91**	**4878.94**	**5378.97**	**4.191***

***, ** and * show values statistically significant at 1%, 5% and 10% probability levels respectively.
Source: Own survey result, 2013

Empirical Results of the econometric model

Nine potential explanatory variables that were expected to influence level of farmers' gross margin earnings from rice in the participation of FRG approach were estimated by using the Treatment effect model of Heckman Two Stage procedure (in the second step of treatment effect model). Moreover, dummy participation was included to see the FRG approach participation impact of farmers by estimating its coefficient. The results of Treatment effect model were presented in Table 4. The F-test value 9.25 for the selection model was highly significant and the R^2 was 60.5% that shows the independent variables included in the selection model regression jointly explain the level of participation. Lambda for the level of gross margin earning level was significant at 10 percent probability level, implying that selection bias would have been resulted if the level of gross margin earning had been estimated without taking into account the decision to participate. Family size in adult equivalent (FAML), access to research (RESRCH) and dummy participation in FRG approach (FRGmem) had positive significant relation to gross margin earnings from rice while use of improved rice variety (VART) has negative significant relation.

Family size in adult equivalent influenced significantly and positively the farmers' gross margin earning level at less than 10% probability level. This implied that as the number of family size in adult equivalent increased, the gross margin earning level of farmers will also be increased. This could be justifiable that, farm households who have large family size in adult equivalent have more chance to cultivate (weeding to harvesting and storage) their rice farm than those who have less so that their production and productivity of rice would increase and thereby increasing the earning level of their gross margin. The marginal effect result of the selection model showed that, as family size in adult equivalent is increased by one unit, the gross margin earning level of farmers from rice will be increased by Birr 537.83, holding other variables constant.

Access to the research system has a positive relationship with the gross margin earning level of respondent farm households at less than 10% probability level. The positive relationship could indicate that, those households who participated on trainings, on-farm demonstrations, field days and experience sharing activities are expected to be aware of about the advantage of improved agricultural technologies and are willing to adopt new technologies and produce more, thereby improving their income from rice production. Moreover, farmers who have access to the research system have the chance to get better knowledge and initial basic seeds of improved varieties. Holding other variables constant, a farmer having access to the research system, his gross margin earning level from rice will be increased by Birr 2439.35 per hectare on the average.

Use of improved rice variety influenced the farmers' gross margin earning level negatively and significantly at less than 10% probability level. This means, as farmers use improved rice variety, their gross margin earning level from rice will decrease. This is due to the fact that, improved rice variety (*Nerica-4*) found in the hands of the farmers is not better than their well known local variety (*X-Jigna)* interms of yield especially in the lowland rice ecosystems of rice farms at Fogera. Hence, rice yield may be low for farmers who grew *Nerica-4* than *X-Jigna*. Moreover, most farmers except in the low land rice ecosystem grew the local variety and only those who live in the upland grew the improved one. The improved rice variety, *Nerica-4* gives better yield in the upland rice ecosystem where there is less water. The marginal result of the selection model showed that, as a farmer uses improved rice varieties, his gross margin earning level from rice will be decreased by Birr 2445.90 per hectare on the average, ceteris paribus.

The dummy participation (FRGmem) variable was an explanatory variable in the second-step of the Heckman two-step estimation (treatment effect model) employed for this study. Its coefficient is positive and significant at less than 5% probability level of significant that indicated the profitability of participating in FRG research approach. This shows that, on average, by participating in FRG approach, the FRG participant farmer has got an increment of gross margin earnings of Birr 5772.06 more than the non-participant from one hectare of rice land, ceteris paribus. This was also confirmed in gross margin analysis part of the study. Kidanemariam *et al.* (2012) in benefit of extension participation; Barnabas *et al.* (2012), in benefit of participatory variety selection; and Getaneh, (2006) on bread wheat contract farming participation have got similar results. Therefore, it can be concluded that, the FRG research approach being implemented by Adet research center at Fogera district is profitable.

Table 4: Estimates of selection (treatment effect) model for gross margin

Variables	Coefficients	Robust std. errors	z-values	Marginal effect
EDU	2014.627	1247.667	1.61 (0.106)	2014.627
FAML	537.827	279.823	1.92* (0.055)	537.827
AREA	-1147.718	1295.00	-0.89 (0.375)	-1147.718
RADIO	-229.497	1369.02	-0.17 (0.867)	-229.497
OXEN	-226.035	1169.587	-0.19 (0.847)	-226.035
TLU	255.134	463.118	0.55 (0.582)	255.134
RESRCH	2439.352	1429.988	1.71* (0.088)	2439.352
VART	-2445.914	1395.084	-1.75* (0.080)	-2445.914
MEMR	-546.854	2352.635	-0.23 (0.816)	-546.854
FRGmem	5772.065	2313.998	2.49** (0.013)	5772.065
Lambda	-3781.168	2246.947	1.68*	-3781.168

R-squared = 0.6049
F-value = 9.25 Probability value = 0.0000
Log-L = -17.607614 Log pseudolikelihood = -1246.577
Rho = 3.09 prob value=0.0788
Numbers in parenthesis are p-values.
** and * show the values statistically significant at 5% and 10% respectively.

Source: Model outputs of own survey result, 2013.

Conclusion and Recommendations

The second stage estimation results of the treatment effect model showed that family size in adult equivalent, access to research and dummy participation in FRG approach had positive and significant relation to gross margin earnings from rice while use of improved rice variety has negative and significant relation with gross margin earning.

In conclusion, the comparison between FRG participant/members and non-participants showed that participant households are better than non-participants/members in the gross margin earning/income obtained from rice production that indicates farmers participation (membership) in FRG research approach is found to be profitable both in descriptive and econometric analysis results. Therefore, implementing FRG research approach by improving the associated problems could lead to the increment of rice productivity that would in turn enhance income of farmers. Moreover, it would fasten 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 education, research and information (radio) 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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