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DETERMINANTS OF ADOPTION OF IMPROVED MAIZE TECHNOLOGY IN DAMOT GALE, WOLAITA, ETHIOPIA

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ABSTRACT

The study was conducted in Damot Gale Woreda of Wolaita zone in Ethiopia. The study Woreda was selected purposively based on accessibility and production potential. Out of 51 peasant associations, 4 peasant associations were selected randomly. For selection of study units probability proportional to the size was applied and respondents were selected (adopters and non adopters) through systematic sampling technique. Descriptive statistics and Logit model was applied to estimate the factors affecting adoption of improved maize technology. The study results shows that small holders with more number of livestock, external funding, targeted extension services, unaffordable input price, timely supply of chemical fertilizer and improved seed and farm size are important determinants of adoption of maize technology. Further study reports that adoption is a cumulative effects of several factors.

INTRODUCTION

Agriculture is the basis of Ethiopia economy. It contributes to over 50 percent of the GDP and 90 percent of raw materials requirement of the country's small and medium-sized industries. It is also estimated that agriculture provides employment for about 85% of labour force (MEDaC, 1999).

The wide variability in agro-ecological conditions helps the country to produce different kinds of cereals, fruits and vegetables, and different species of livestock. However, Ethiopian agriculture is characterized by low productivity. Over the last two decades it was not able to produce sufficient food to feed the country's rapidly growing population. The level of technology is almost basic and productivity per hectare is perhaps among the lowest in the world. SG (Sasakawa Global) 2000 indicates that in high agricultural potential areas of Ethiopia (i.e. with high and reliable rainfall), in which crop based system predominates and population densities are highest, productivity is constrained by lack of knowledge, lack of finance and unavailability of appropriate improved technologies.

A close look at the country's declining agricultural outputs and at the same time, ever-increasing population growth begs for a search of alternatives. One of the alternatives to bridge this ever-increasing gap between the two is, increasing programs that focus primarily on the delivery of physical inputs such as fertilizer, high yielding varieties of seed, credit supply to small holders and training on improved agronomic practices. This can be done through government support to agriculture and extension by strengthening research extension linkages (SG, 2002).

In order to achieve food security, a lot of attempts have been made by the government in Ethiopia over the last three decades but failed to increase the expected agricultural production and bring about noticeable change in the life of the smallholder farmers. In this regard, Belay (2002) suggested that one of the reasons for the existing structural food insecurity in the country is the low-level of technology development, which act as the principle barriers to the efficient utilization of the country's natural resource. Even though different extension approaches have been implemented in the country, it did not bring major or expected impacts on the productivity of smallholders and the utilization of modern inputs.

Various types of cereal crops are being produced in different parts of Ethiopia that serve as a staple food for the majority of people. Maize is one of the most important cereal crops in Ethiopia in general and Southern Nation, Nationalities and

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Peoples' Regional State (SNNPR) in particular. It serves as a source of both food and cash income.

The study area has a long history of the implimentation of extension package. A lot of new technologies have been introduced starting from the establishment of WADU (Wolaita Agricultural Development Unit)- the first comprehensive package project started in Ethiopia in 1970 next to CADU (Chilalo Agricultural Development Unit) in Aris region. However, majority of farmers are using their traditional way of farming practices that retarded progress in smallholders' agriculture. A few farmers are using the recommended modern technologies, as a result they are facing food shortage.

Therefore, the main focus of this study was to identify the factors influencing adoption of the new maize technologies in the study area.

The specific objective of this study is:

- To study the factors affecting adoption of maize production technology among farmers in the study area.

RESEARCH METHODOLOGY

The farmers were categorized as adopters when they adopted the recommended improved maize technology (either of three improved varieties being recommended in the area, namely Pioneer (PHB3253), BH540 and CG4141).

The study Woreda was selected purposively based on accessibility, potential to maize production and representativeness of the Zone. The Woreda consists 51 Peasant Associations. Out of these, 4 PAs were selected by using simple random sampling techniques. To give equal chance in selection of study units from each concerned PA, probability proportional to size (PPS) was applied. Finally, through systematic sampling techniques sampling units were selected from each PA for both adopters and non-adopters. Total 150 farmers were selected. Out of this adopter and non-adopter were 64 and 86 respectively.

Table 1. Definition and units of measurement of the variables in the logistic regression

Variables	Description and measurement
Age	Age of household head (year).
FMLSZ	Family size of household (number).
LABR	Labor availability (man equivalent).
EDUCTN	Formal education of household head (grades or number of years in school).
EXPRC	Farm experience of household (years).
HOUSE	Ownership of house, dummy variable, 1; if a farmer owns corrugated metal-roofed house, 0 otherwise.
FRMSZ	Farm size of household (hectare).
OXEN	The number of oxen owned (number).
TRLU	Total livestock owned by the farm household (TLU).
AVALFER	Availability of fertilizer on time, dummy variable, 1; if fertilizer is available on time, 0 otherwise.
CASH	Cash shortage faced by household head, dummy variable, (=1, if yes; =0, otherwise)
CREDIT	Access of farmer to fertilizer and seed on credit (=1, if yes; =0, otherwise)
EXVST	Number of time extension agent visited/advised farmer (number).
DMOSTN	Farmer attended on demonstration of improved maize production technology, dummy variable (=1, if yes; =0, otherwise).
FIELDHS	Farmers host demonstration on their farm, dummy variable (=1, if yes; =0, otherwise).
RADIO	Owning radio at home, dummy variable (=1, if yes; =0, otherwise).
TRAIN	Farmer attended formal agricultural training, dummy variable (1=, if yes; =0, otherwise).
OFFRM	Farmers engaged in off farm activities, dummy variable (=1, if yes; =0, otherwise)
INPRICE	The price condition of agricultural inputs (fertilizer and improved maize seed), dummy variable (=1, expensive; =0, other wise).
DISTNCE	Distance of the respondents' house from input and output market (km).

Both primary and secondary data were used for this study.

Analytical Framework

Different analytical techniques were applied to examine the survey data. These include, t-tests, chi-square tests, and logistic regression model. Frequency and means computed for different variables. The chi- square was used to see if there is systematic association between adoption and some of the farm characteristics.

The logit model applied in this study to assists in estimating the probability of adoption of improved maize technologies that can take one of the two values adopt or do not adopt the technologies.

RESULTS AND DISCUSSION

According to descriptive analysis, some variations were observed between adopters and non-adopter in terms of household characteristics, farm and institutional factors (table 2). The two groups differ to some extent in their farm experience, level of education, farm size, livestock possession, income generated from on-farm and off-farm, access to credit, extension information. The study revealed that adopters have better educational background than non-adopters. In terms of farm experience, average farm experience of adopter was about 20.8 years while non-adopters comprise 18 years of farm experience. Average farm size of adopters' was more than non-adopters. Livestock ownership was another important household's characteristic. Average livestock owned by the total sampled households was 3.5 TLU. Proportionally, adopters owned almost twice greater livestock than non-adopters. Variations were also observed in other socio-economic and institutional factors.

This study also examined the extent of adoption of improved maize technologies and chemical fertilizers among users. Even though, many factors constraints farmers from using improved maize varieties and chemical fertilizer, more proportion of cultivated land was allocated during 2004/05 cropping season.

Most of the farmers did not follow the recommendations of rate of seed, type of fertilizer and rate of application. The rate of improved maize seed applied per hectare was slightly above the recommended rate. The study showed that the rate of fertilizer applied below the recommended rate. In addition, farmers tend to use DAP fertilizer than using both types as per the recommendations.

T- tests and chi-square (?2) tests were used to make sure presence or absence of difference between the two groups of farmers, when appropriate.

Table 2. Summary of means of continuous variable, Damot Gale, Wolaita, Ethiopia, 2004/05

Variable	Adopters		Non adopters		Total sample		t-value
	Mean	St.dv.	Mean	St.dv.	Mean	St.dv.	
1. AGE	40.27	10.11	37.51	9.65	38.69	9.89	1.697*
2. FMLSZ	7.92	3.55	6.53	2.079	7.13	2.89	2.98***
3. LABR	3.66	1.82	3.3	1.5	3.43	1.66	1.42
4. EDUCTN	3.97	3.99	3.06	3.25	3.45	3.60	1.538
5. EXPRC	20.76	9.23	18.00	7.88	19.18	5.57	1.975**
6. FRMSZ	.75	.35	.514	.193	0.61	0.29	5.29***
7. OXEN	1.31	1.17	.36	.507	3.48	2.66	6.764***
8.TRLU	5.00	3.07	2.35	1.52	0.77	0.97	6.926***
9. DISTNC	14.04	4.75	15.12	4.79	14.66	4.79	-1.371
10. INCOM	1317.17	1497	342.24	428.45	758.21	1134.29	5.735***
11. EXVST	3.12	1.60	.895	6.06	1.84	4.27	3.263***

*, **, and *** represents significant at 10%, 5%, and 1% significance levels, respectively.

The mean values of the continuous variables in both categories were compared using t-test. According to the t-values, out of 11 continuous variables, the two categories were found to differ significantly in 8 of them. The computed t-values indicate the mean differences for six variables,

namely family size, farm size, number of tropical livestock units, number of oxen owned, total annual income and extension visit. Similarly, the mean differences for farming experience and age of household head were found to be significant at 5% and 10% probability level respectively (Table 2).

On the other hand, a chi-square test was used to examine the existence of statistically significant differences between the discrete variables of the two categories. Accordingly, discrete variables were considered and the two categories were found to be different in terms of 7 of the 10 discrete variables (Table 3). More specifically, the chi-square test reveals that availability of cash, access to credit, presence on demonstration (exposure to agricultural information) and input price were statistically significant at 1% probability level.

Table 3. Summary of households' scores (yes or no values) on some hypothesized discrete variables, Damot Gale, Ethiopia, 2004/05

Variables	Scores	Adopters		Non adopters		Chi-square value
		Number	%	Number	%	
1. HOUSE	1	26	40.6	5	5.8	27.12***
	0	38	59.4	81	94.2	
2. AVALFER	1	35	54.6	5	5.8	44.81***
	0	29	45.3	81	94.2	
3. MONY	1	49	76.6	67	77.9	0.038
	0	15	23.4	19	22.1	
4. CREDIT	1	25	39.1	6	7	23.04***
	0	39	60.9	80	93	
5. FIELDHS	1	31	48.4	9	10.5	27.055***
	0	33	51.6	77	89.5	
6. DMOSTN	1	21	32.5	6	7	16.59***
	0	43	67.2	80	93	
7.TRAIN	1	28	43.8	5	5.8	30.77***
	0	36	56.3	81	94.2	
8. RADIO	1	15	23.4	2	2.3	16.275***
	0	49	76.6	84	97.7	
9. OFFFRM	1	20	31.3	24	27.9	0.198
	0	44	68.7	62	72	
10. INPRICE	1	61	95.3	84	97.7	0.635
	0	3	4.7	2	2.3	

***, represent significant at 1% significance level.

Logit model results

In this section, selected explanatory variables were used to estimate the logistic regression model to analyze the determinants of households' adoption behavior on maize technology. A logit model was fit to estimate the effects of the hypothesized explanatory variables on the probabilities of adoption.

Finally, a set of 19 explanatory variables (9 continuous and 10 discrete) were included in the logistic analysis. These variables were selected on the basis of theoretical explanations, personal observations and the results of the survey studies. To determine the best subset of explanatory variables that are good predictors of the dependent variable, the logistic regression were estimated using the method of maximum likelihood estimation, which is available in statistical software program (SPSS version 10). All the above-mentioned variables were entered in a single step. The definition and unit of measurement of the variables used in the model are presented in table 4.

Table 4. Logit model estimates for factors affecting improved maize technology, Damot Gale, Wolaita, Ethiopia

Variables	Coefficient	S. E.	W ald-statstic.	Sig.	Odds ratio
FMLSZ	-.042	.200	.343	.835	.959
LABR	-.110	.310	.127	.722	.895
EDUCTN	.005	.111	.002	.966	1.005
EXPRC	.087	.047	3.414	.065*	1.091
HOUSE	.766	1.097	.487	.485	2.151
FRMSZ	5.062	2.042	6.148	.013**	157.901
OXEN	1.990	.837	5.655	.017**	7.319
TRLU	.491	.257	3.642	.056*	1.634
DISTNCE	-.341	.114	8.901	.003***	.711
CASH	4.462	2.024	4.861	.027**	86.643
CREDIT	2.006	.854	5.511	.019**	7.431
EXVST	.044	.087	.251	.617	1.045
DMOSTN	2.982	1.239	5.791	.016**	19.730
FIELDHS	-1.687	1.198	1.985	.159	.185
TRAIN	1.072	1.121	.915	.339	2.921
OFFFRM	-.181	.934	.037	.847	.835
INPRICE	-6.337	2.824	5.036	.025**	.002
RADIO	5.610	2.812	3.981	.046**	273.105
AVALFER	3.812	1.088	12.279	.000***	45.248
CONSTANT	-2.352	3.617	.612	.515	.095
-2 Log likelihood Ratio				66.627	
Chi-square (χ^2)				138.079***	
Correctly predicted overall sample				90.7	
Correctly predicted adopters (%)				85.9	
Correctly predicted non-adopters (%)				88.7	
Sample size				150	

Note: *=significant at p<0.1; **=significant at p<0.05; ***=significant at p<0.001

The logit model results used to study factors influencing the adoption decision of improved maize technology are shown in table 4. Among the 19 variables used in the model, 11 variables were significant with respect to adoption of improved maize varieties with less than 10% of the probability level. These variables include farm size (FRMSZ), oxen ownership (OXEN), tropical livestock (TLUs), cash availability (CASH), access to credit (CREDIT), distance to market (DISTNCE), radio ownership (RADIO), input price (INPRICE), farm experience (EXPRC), availability of fertilizer on time (AVALFER) and attending on demonstration (DMOSTN), whereas the rest 8 explanatory variables were found to have no significant influence on adoption. The effect of the significant explanatory variables on adoption in study area is discussed below:

1. Farm size (FRMSZ): It was found that farm size had positively and significantly influenced the probability of adoption of improved maize varieties at less than 5% significant level. This result implies that farmers with large farm size are more likely to adopt the improved maize technology (varieties) than those farmers who have small land size. The odds ratio of 157.901 for farm size indicates that, other things being constant, the odds ratio in favor of adopting improved maize varieties increases by a factor of 157.901 as the farm size increases by one hectare. The result of this study confirms the earlier findings of (Roy et al. 1999; Nkonya et al. 1997).

2. Tropical livestock unit (TLUs): The model result indicates that number of tropical livestock unit affected positively and significantly the probability of adoption of improved maize varieties

at P<0.1. This result shows that those farmers with large number of tropical livestock units are more likely to adopt improved maize technology than those who own small number of TLUs. Other things held constant, the odds ratio 1.634 for number of TLU shows that, as the number livestock units increases by one TLU, the odds ratio in favor of adopting improved maize technology increases by a factor of 1.634.

3. The number of oxen owned (OXEN): Oxen ownership positively influenced the probability of adoption of improved maize technology at less than 5% significance level. This result suggests that, those farmers who owned more oxen have better chance to use improved maize technology than those who have owned small number of livestock. Other things being held the same, the odds ratio of 7.319 for the number of oxen owned indicates that, the odds ratio in favor of adopting improved maize varieties increases by a factor of 7.319 as the number of oxen increases by one unit.

4. Availability of fertilizer on time (AVALFER): Availability of fertilizer on time had positively and significantly influenced the probability of adoption of improved maize technology at less than 1% level. The model result implies that those farmers who get chemical fertilizer on time are more likely to adopt improved maize variety than those who do not have access to fertilizer on time. The odds ratio of 45.248 in this respect shows that, other explanatory variables kept the same, the odds in favor of adopting improved maize technology increases by a factor of 45.248 as the fertilizer is made available on time. A similar result was reported by Chilot et al. (1996).

5. Market distance (DISTNCE): Market distance to input and output center negatively and significantly associated with the probability of adoption of improved maize technology at less than 1% significance level. The negative association suggests that the likelihood of adopting improved maize variety declines as the distance from market center increases. In another word, the implication of this negative relationship is that if the distance between farmers' living home and the market area is longer, the farmers will be discouraged from adopting improved maize variety. The odds ratio of 0.711 for market distance reveals that, other things being constant, the odds ratio in favor of adopting improved maize technology decreases by a factor of 0.711 as the market distance increases by one kilometer. This result is in consistence with the finding of Legesse (2001).

6. Access to credit (CREDIT): The model result indicates, the variable access to credit had positively and significantly influenced the likelihood of adoption of improved maize technology at less than 5% significance level. From this result it can be stated that those farmers who have access to formal credit from Agricultural Office are more likely to adopt improved maize technology than those who have no access to formal credit. The odds ratio indicated in the model with regard to credit implies that, other thing being held constant, the odds ratio in favor of adopting improved maize variety increases by a factor of 7.431 as farmers get access to credit. Earlier study also reveals that credit is one of factors that affect the probability of adoption of improved varieties and the quantity of fertilizer farmers apply (Legesse, 1992; Tesfaye and Shiferaw, 2001).

7. Availability of cash (CASH): It was found that the availability of cash on hand for down payment significantly and positively influenced the chance of adoption of improved maize variety at less than 5% significance level. This result indicates that farmers who have adequate or sufficient cash on hand tend to adopt improved maize than farmers who do not have adequate cash for the down payment. The odds ratio of 86.643 for cash availability in this study indicates that, other things being equal, the odds ratio in favor of adopting improved maize varieties increases by a factor of 86.643 as availability of cash increases at certain interval. Similar result was reported by Legesse (2001).

8.Attending demonstration (DMOSTN): It was found that exposure to information in relation to attending demonstration had positively and significantly influenced the probability of adoption of improved maize technology at less than 5% significant level. The result of logit model in relation to this variable shows that farmers who have opportunity to attend demonstration of improved

maize technology are more likely to use improved maize than those farmers who have no similar opportunity. Other things held constant, the odds ratio at for variable attending demonstration implies that, as farmers' exposure to agricultural information increases, the odds ratio in favor of adopting improved maize variety increases by a factor of 19.730. This result go along with the study done by Igodan et al. (1988) and Chilot (1994).

9. Ownership of radio at home (RADIO): The radio ownership affected significantly and positively the probability of adoption of improved maize technology at less than 5% significance level. The model result implies that, farmers who owned radio at their home are more probably tend to use the improved maize technologies than those households who have no radio at their home. The analysis indicates that the odds ratio in favor of adopting improved maize varieties increases by a factor of 273.105 as farmers get more access to listen the information through radio. In connection with this result, Tesfaye and Shiferaw (2001) indicated that access to extension message (such as field days, formal agricultural training and listing to radio) systematically associated with adoption of improved maize varieties.

10. Input price (INPPRICE): The variable input price affected the probability of adoption of improved maize technology negatively at less than 5% significance level. This negative relationship indicates that the likelihood of adopting improved maize variety tends to decrease as the prices of inputs increases. Other things kept the same, the odds ratio of 0.002 for input price reveals that, the odds ratio in favor of adopting improved maize technology decreases by a factor of 0.002 as the input price increases at one unit. This result agrees with the study carried out by Itana (1985), which suggested that price of farm inputs affect adoption negatively and significantly.

11.Farm experience (EXPRC): The logit model result indicate that farm experience of household head positively associated with the probability of adoption of improved maize technology at less than 10% significant level. The implication is that farmers who have more years of farm experience are more likely to adopt improved maize technology than those farmers who have less years of farm experience. Other things kept the same, the odds ratio of 1.091 for farm experience indicates that, as farm experience increases by one year, the odds ratio in favor of adopting improved maize technology increases by a factor of 1.091. This result confirms the study done by Abadi and Pannel (1999), who indicated that a more experienced grower might have a lower level of uncertainty about innovation performance. In this case, the value of information due to reductions in uncertainty would be lower. Adesina and Seidi, (1995) also confirmed that experience was positively related with the adoption of new technologies.

CONCLUSION

The study has revealed the key roles of livestock in crop production. Farmers with large number of livestock are more likely to adopt and use improved technologies such as maize. Therefore, efforts to promote crop production in a mixed farming system requires a concerted efforts to the livestock sector, through for instance improved veterinary service, credit for livestock purchase, feed and water development as deemed necessary.

The study also revealed that technological change among smallholders requires an external financial source through credit. Farmers who have access to credit tend to adopt improved maize technology more than those who do not have access to credit. Therefore, barriers on the supply-side of credits (high interest rate, down payment, etc.) should be overcomed if a genuine food self-sufficiency among smallholders is to be achieved.

In spite of four decades of exposure to improved technologies in the study area, response to extension communication through various methods is still effective in the area. Which implies the need for more targeted and continued extension service. Thus, the extension system operating in the area, and elsewhere, need to be strengthened further to increase the flow of information for rural transformation.

Technology application gap is partly influenced by the level of input price. This study has shown that an increase in fertilizer price has

impeded some farmers from using fertilizer at all, while others tend to use lower rates than the recommendation. Therefore, attention is needed on farmers' financial capacity and access to credit mentioned earlier. In addition, equal attention is needed in the timely supply of fertilizers and seeds to encourage farmers to use improved technology and use them as per the recommendation.

It was found that farm size significantly affects improved maize adoption. The result shows that the new maize technology is more likely to be adopted by farmers with large farms. This implies need of research, extension, and planning agencies to be sensitive to the needs of smaller farmers through developing and disseminating technologies and strategies that are relevant to their needs.

Generally, the result of this study indicates that adoption of improved maize technology is a result of an interplay of several factors, which need due attention.

REFERENCES

Abadi, A. K. and D. J., Pannell, 1999. A conceptual framework of adoption of an agricultural innovation. *J. Agricultural Economics*, University of Western Australia, Perth. 2(9): 145-154.

Adesina, A. A. and S. Seidi, 1995. Farmers' perception and adoption of new agricultural technology: Evidence from analysis in Burkina Faso and Guinea, West Africa. *Agricultural Economics*. Vo. 13, N. 1, P 1-9.

Bellay Kassa, 2002. Agricultural Extension in Ethiopia: The case of participatory demonstration and training extension system. V. 18, No.1, 2002.

CSA, 1994. Population and housing census of Ethiopia. Results for Southern, Nations, Nationalities and Peoples' Region. Statistical report on population size and characteristics, Vol. I: part I. June 1996, A.A.

CSA (Central Statistical Authority), 2001. Farm management practices: Private peasant holdings. Statistical Bulletin. Addis Ababa, 2000/2001 *Meher Season.* Vol. 3.

Chilot Yirga, 1994. Factors influencing adoption of new wheat technologies in the Wolemera and Addis Alem Areas of Ethiopia. An M. Sc. Thesis Presented to the School of Graduate Studies of Alemaya University. 121p.

Chilot Yirga, B. I. Shapiro and Mulat Demeke, 1996. Factors influencing adoption of new wheat technologies in Wolmera and Addis Alem Areas of Ethiopia. *Agricultural Economics*, Ethiopia.

Daniel, M., G. Hagos, T. S. and T. Shaffer, 1997. Designing strategies to support a transformation of agriculture in Ethiopia, Grain Marketing Research Project, and Working Paper No. 4. Addis Ababa, MEDaC.

Dasgupta, S., 1989. Diffusion of agricultural innovations in Village India. Department of Sociology and Anthropology. University of Prince Edward Island, Canada. 193p.

Getahun Degu, M. Mwangi, H. Verkuijil and A. Wondimu, 2000. An assessment of the adoption of seed and fertilizer packages and the role of credit in smallholder maize production in Sidama and North Omo Zones, Ethiopia. EARO, CIMMYT, November 2000. P.24.

Igodan Chiris O., Patric E. Ohaji and Johnson A. Ekpere, 1988. Factors associated with the adoption of recommended practice for maize production in the Kainji Lake Basin of Nigeria. Agricultural Administration and extension, 29(2):149-156.

Itana Ayana, 1985. An analysis of factors affecting the adoptions of packages of agricultural technologies in subsistence agriculture. A case study in two Extension Districts of Ethiopia. An M. Sc. Thesis Presented to the School of Graduate Studies of Alemaya University. 160p.

Legesse Dadi, 1992. Analysis of factors influencing adoption and the impact of wheat and maize technologies in Aris Nagele, Ethiopia. An M.Sc. Thesis Presented to the School of Graduate Studies of Alemaya University. 127p.

Legesse Dadi, 2001. Empirical analysis of duration of herbicide adoption in tef-based farming system of West Shewa Zone, Ethiopia. *J. of Agricultural Economics*. 5(1&2):1-22, Feb.2001.

MEDaC (Ministry of Economic Development and Planning), 1999. Survey of the Ethiopian Economy. Review of post reform development, (1992/93-1997/98.MEDAc, Addis Ababa.

Nkonya, E., T. Schroeder, and D. Norman, 1997. Factors affecting adoption of improved maize Seed and fertilizer in Northern Tanzania, 48(1): 1-12.

Roy, B. C., T. S. Bhogal and L. R. Singn, 1999. Tenancy and adoption of new farm technology: A study in West Bengal, India. *Bangladesh Journal Economics.*

xxii 1(1999): 39-49.

SG (Sasakawa Global) 2000/Ethiopia project, 2002. Activities and outputs: An assessment 1993-2001 Sasakawa Global 2000, Addis Ababa, Ethiopia, August 2002.

Tesfaye Zegeye and Shiferew Tesfaye, 2001. Determinants of adoption of maize technologies and inorganic fertilizer in Southern Ethiopia. Research Report No. 39. Ethiopia Agricultural Research Organization (EARO). 54p.

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