Magnitudes and Determinants of Transaction Costs in a Group-Based Livestock Breeding Approach: The Case of Dairy Goats in Eastern Kenya

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Abstract

Exotic dairy goats have increasingly become important in alleviating poverty and combating hunger and mal-nutrition in Kenya. Such goats were introduced in the eastern Kenyan highlands through a group-based approach about a decade ago by FARM-Africa. It is only through this approach that interested households could access imported Toggenburg bucks and other related services. However, the approach resulted in farmers incurring different magnitudes of transaction costs. This study thus assesses the magnitudes and determinants of transactions costs in a group-based breeding approach. Data was generated using 165 randomly selected farmers from the project area. Main findings were that wealth level of households and participation in credit schemes affected adoption positively and negatively respectively. The study showed that the adoption of the dairy goats was not a costless process, and those who could not afford to meet the transactions costs are likely to be left out.

Key words: Collective action, Dairy goats, Farmers' participation, Group-based breeding, Livestock breeding, Transaction costs, Kenya

Introduction

The introduction of dairy goats in the Kenyan highlands is perceived as a good step towards poverty alleviation among the smallholder farmers. This initiative was started in the 1990s by the German Technical Cooperation (GTZ), Food and Agricultural Research Management in Africa (FARM-Africa), in collaboration with local partners such as the Kenya Agricultural Research Institute (KARI), Ministry of Agriculture (MoA) and Ministry of Livestock and Fisheries Development (MOLFD). The main aim was to improve the livelihoods of the poor farmers in the region through the introduction of pure exotic dairy goat breeds and crosses of German Alpine, Toggenburg, Anglo-Nubian and Saanen. This was done through establishment of dairy goat breeding units and buck stations.

This study focuses on the introduction of exotic dairy goats in the Kenyan highlands by FARM-Africa through a group-based approach about a decade ago. Interested farmers had to organize themselves into legally recognized farmers' groups which would then register with the Meru Goat Breeders Association (MGBA) in order to access the dairy goat technology, bucks and market information. Breeding units and buck stations were established in different areas to provide the services farmers needed for enhanced adoption (FARM-AFRICA, 2006).

The application of the group approach in technology uptake and transfer has emerged as an important strategy of extending or introducing new technologies in developing countries (Knowler and Bradshaw, 2007). Farmers who are members of such groups are not only empowered to make their own evaluations of the technologies but also share knowledge with one another to reduce risks. However this approach results in high transaction costs which are mainly borne by the members of the groups. Empirical estimations of magnitudes of such costs in technology uptake initiatives are still very rare.

The New Institutional Economics and particularly the transaction costs economics framework offers a sound theoretical base for analyzing transaction costs incurred by actors participating in the establishment and maintenance of contractual arrangements, partnerships, and other forms of governance structures in the agriculture sector (Kaaran, 1999). However empirical applications of this theory in agricultural technology uptake have been rare. In most cases transaction costs incurred by farmers taking part in the adoption of new technologies are not estimated, though farmers' participation is recognized as a cost-reducing strategy by other actors such as extension agents and non-governmental organizations (NGOs). In a technology uptake process such as the one being investigated in this study, transaction costs are likely to be induced by transaction attributes, which include: asset specificity and bounded rationality, that are to a large extent dependent on farmers' socio-economic conditions and farm characteristics (Kaaran, 1999). However, the relevance of these factors in determining magnitudes of transaction costs incurred by individual farmers participating in group-based technology uptake initiatives remain largely unknown.

Taking the case of the group-based dairy goat technology uptake approach in Meru South and Meru Central Districts of the eastern Kenyan highlands as an example, the objective of this study is to assess magnitudes of transaction costs from different categories and determine factors influencing them. Analyzing these factors is tantamount to examination of determinants of farmers' costs of participation in the dairy goat breeding initiative since farmers cannot be involved in any initiative without contributing their direct resources such as time and money. Further, the assessment of these factors would enable development agencies to target farmers with relatively higher propensities to adopt the dairy goats in other regions that have similar socio-economic and agro-ecological conditions as the Meru Districts.

Conceptual Framework

Application of the transaction costs framework

Transaction costs economics, though initially developed to study economic organization of the industrial sectors in developed countries, is very relevant in tackling problems being experience in agricultural development such as low participation in emerging markets and reduced uptake of new technologies (Hendrikse and Veerman, 2001; Dorward, 2001). According to this theory, transaction costs arise from creation and implementation of institutional arrangements. They are therefore different from production costs (transformation costs) which are viewed as the costs of land, labour, capital and entrepreneurial skills required to physically transform inputs into outputs (North and Wallis, 1994). Eggertson (1990) asserts that transaction costs arise when information is expensive and induces activities such as information searches, bargaining, making contracts, monitoring, enforcement, and protection of property rights.

Economic literature provides diverse definitions of transaction costs, with most authors preferring those that suit their theoretical conceptualizations and/or are relevant to their empirical cases. Thus what Coase (1937) had initially generally identified as 'costs of organising transactions' has been re-examined and re-conceptualized to reflect transactions costs incurred in specific situations. In this study we adopt the 'categorized' definition of Abdullah et al. (1988) which is easy to apply in empirical studies in agriculture and natural resource management. Here transaction costs are defined as costs of 1) searching and collecting information, 2) bargaining and development of decision-making arrangements or contracts, and 3) monitoring or enforcing compliance with agreements or contracts. The current study looks at both formal and informal institutional arrangements of the dairy goat breeding approach as applied by FARM-Africa and local development in Meru Districts. These organizations established institutional arrangements with local farmers order to boost uptake of dairy goat technology. The first two categories of transaction costs occur before the farmers adopt the technology and/or before the farmer accepts the group-based dairy goat breeding arrangements (that is, before the farmer joins the groups), while the third category occurs afterwards.

These different categories of costs are therefore also referred to as ex ante costs (investment) and ex post costs (operational costs), respectively. This categorization is closely related to the framework of Alston and Gillespie (1988), who classified transaction costs according to the three stages of the production process: pre-production, production and post-production. In the dairy goat group-based breeding strategy, the magnitudes of transaction costs are expected to be influenced by several attributes of transactions (Williamson, 1991). Uncertainty with dairy goat technology 'software', and personnel from development agencies, among others arise due to the bounded rationality of the farmers. The presence of uncertainty is likely to lead to incomplete contracts or unacceptable arrangements which will increase the transaction costs. Under such circumstances, most participants in the breeding initiative who are likely to incur high transaction costs are likely to be the wealthy or those better endowed with financial resources.

Asset-specificity, as hypothesized by Kaaran (1999), is another transaction attribute that is likely to influence the magnitude of transaction costs during the pre-production (ex ante) stage of the exotic dairy goats. This attribute becomes important if one party in a transaction makes an investment which cannot be fully recovered or transferred to other production activities if the transaction is terminated (Williamson, 1991). On one hand exotic dairy goats exhibit a low degree of asset-specificity since they feed on fodder trees and shrubs which are used for other purposes in the farm. But on the other, they show high asset-specificity because they require special husbandry practices, such as; raised floors, to prevent pneumonia and worm attacks. As such, farmers who have gained goat rearing experience through keeping of local goats and learning from development and extension agents, and who have already grown fodder crops in their fields are likely to be key participants of the breeding initiative. Other attributes which might also influence the magnitude of transactions are frequency of transactions such as the number of decision-making meetings and complexity of the institutional arrangements between the farmers and development agencies promoting adoption of exotic dairy goats.

Contextual factors influencing magnitude of transaction costs

According to theories of collective action and social capital, the nature of coordination activities and the social cohesion of the farmers are important in determining the magnitude of transaction costs (Ostrom, 1994). Farmers participating in local groups are likely to be more cohesive, a factor that may reduce the adverse effects of uncertainty of transactions. Hence farmers belonging to such groups are likely to participate more or incur higher transaction costs during the adoption of new technologies. In both ex ante and ex post stages, households should have the capacity to spend time and resources for engaging in the group-based breeding activities. This capacity is proxied by the available financial capital or wealth and the availability of labour in the household. However, having more persons in a household may also imply less wealth when resources are not enough since consumption of household goods increases with the number of dependents. Other factors that have been found to influence participation in rural development projects include socio-economic characteristics such as age, gender, education level, and farm attributes like land holding size and tenure (Cohen & Uphoff, 1977; Staal et al., 2002).

Study Methodology

Study Area

This study was conducted among the smallholder farmers of the Central Kenyan Highlands, and specifically in Meru South and Meru Central Districts. The two districts are similar in almost all aspects: similar ecological zones, are occupied by the same ethnic group (the Merus) and have similar socio-economic activities (Jaetzold and Schmidt, 1983). They cover a wide range of agro-ecological zones ranging from the Upper Highlands (UH1), where tea and dairy cattle (mainly exotic) are the major enterprises, to Lowlands (L5) which are only suitable for dryland crops such as millets and sorghum and hardy indigenous beef livestock breeds. The rainfall pattern is bimodal with the long rain season lasting from mid-March to June while the short one runs from mid-October to December. Annual rainfall ranges from 800 to 1,850 mm depending on elevation and location from Mount Kenya (Jaetzold and Schmidt, 1983).

The human population density in the research area is relatively high, ranging from 450 to 700 persons / km^2. Thus the area is characterized by small land holding size (0.01-1.5 ha) as a result of land fragmentation. This reduces the scale of keeping dairy cattle in the research area. The farm households in the research area are considered to be poor and particularly in the lowlands. The area is characterized by a complex farming system dominated by perennial cash crops such tea and coffee, food crops and livestock.

Milk is important for both cash and domestic use. Much of it is produced through dairy cattle farming. Recently, though, goat milk has become important after the introduction of exotic dairy goats by FARM-Africa in the research area. To-date farmers adopting the dairy goats have raised their annual incomes from less than US$ 100 to 1000 (Peacock, 2008).

Sampling procedure, data collection and analysis

The study utilized primary data collected from a random sample of 165 households. The study population comprised of households within the regions where dairy goat had been promoted by FARM-Africa. In each district two administrative divisions that were leading in the adoption of exotic dairy goats were purposively selected. Since no sampling frame was available, a random walk sampling procedure was adopted. Thus the sample included self-selected adopters and non-adopters of dairy goats.

Before conducting the household survey informal discussions and focus group discussions were held with key informants in order to gather general information on adoption of dairy goats. Persons targeted for these discussions included local leaders and staff from the Ministry of Livestock & Fisheries Department (MoLFD), Farm Africa, and the Meru Dairy Goat Breeders Association. This information was quite useful in the selection of the two administrative divisions targeted for the elaborate collection of transaction costs data and verification of the activities of the adoption process.

A semi-structured questionnaire was used to collect empirical data. It was administered only after a thorough training of enumerators and pre-testing. The questionnaire captured transaction costs data from two phases of dairy goat adoption process: ex-ante (pre-production) and ex-post (production and post-production). For the ex ante phase, data was collected on the total transaction costs arising during the entire phase which lasted for less than a year. The ex-post phase, however, was too long a period for most households to recall data for all the activities, such as participation in meetings in which they were involved since the adoption of dairy goats. In this case only data for the activities of the current year was collected. These costs can therefore only be regarded as the average annual costs of the ex-post phase.

The data collected to facilitate calculation of transaction costs included: (1) time spent participating in meetings, workshops and group activities, and collecting marketing and technical (husbandry practices) information on dairy goats from organizations, friends and relatives, and (2) direct costs of transport, meals and incidental expenses when gathering information or participating in meetings. In collecting both ex ante and ex post costs care was taken to avoid overlaps of activities and double counting, particularly in cases where members of the local goat groups would obtain all types of information from the same source, the groups. This was not only important for activities that provided information but also for the trainings since they could be conducted within and outside the group meetings. Avoidance of double counting was made easy by the fact that majority of the sample households (81%) did not belong to these groups and among the adopters only 27% of the households were registered as group members.

To convert time spent by households in meetings and other activities to real costs, individual wage rates[1] of the participants were multiplied with the reported time spans. These wage rates were however reduced by 30% and 40% in the upper zones (highland lands and upper midlands) and lowlands, respectively, to reflect the availability of off-farm employment in the two research areas (KNBS, 2007). This approach is justified by the fact that in both research areas there is no possibility of households working outside their farms throughout the year. Thus, their contribution of family labour to dairy goat uptake activities could not be valued at the full wage rate (see also Staal et al., 2003). Other types of data collected during the survey included household demographic, socio-economic and farm characteristics such as age, gender, education level, experience in keeping local goats, number and composition of household members, farm size, adoption levels, dairy goat husbandry techniques, dairy goat products and their marketing, farmers' preferences and perception on dairy goats, gender dynamics, off-farm income, and types of labour employed in the farm. Some of the data collected were used to generate a subjective wealth category of the household from variables agreed upon during the focus group discussions.

[1] Different households reported that different wage rates were paid to them if they work in the farms and outside to earn money.

For the data analysis, tabulation of transaction costs for the ex ante and ex post phases of dairy goat adoption is done with Excel and SPSS. To determine factors influencing magnitudes of transaction costs, econometric models were developed and analyzed with LIMDEP. A 'treatment effect model' which involved two stages and use of instrumental variables was used. This model has been explained further in Section 5.

Results

The magnitudes of transaction costs

At the time of this survey, about 70% of the households (116 households out of the sample 165) had adopted the exotic dairy goats. Table 1 presents the average ex-ante transaction costs incurred by the households as a result of being involved in different activities before adopting the exotic goats. The activities included gathering of information on dairy goat management issues before adoption took place, looking for market information, and acquiring information on the availability of a buck for the first time. These activities were useful in reducing the uncertainty with the dairy goat technology. According to the results in Table 1 it can be deduced that the most important information that farmers looked for before adopting dairy goats concerned market outlets goats and their products.

The ex ante transactions costs are derived from households that had successfully adopted the goats as well as those who are yet to adopt but had been involved in the activities. As Table 1 indicates the average total costs incurred by a household before adopting the exotic goats are about Ksh. 81.57 (US$ 1.4). These costs were incurred in a span of less than six months. The costs are considerably low to deter household from participating in the pre-adoption activities considering that more than 20% of them earn more than US $ 1 per day (KNBS, 2007). However, in some cases the costs could be a barrier for the participation of poor farmers as it can be evidenced in Table 1 that some farmers incurred as much as Ksh.1143.75 (US$19) in gathering market information.
During the ex post phase of the adoption process, farmers transaction costs arose from participation in various activities as shown in Table 2. Essentially the ex post stage is required to focus on monitoring and enforcement of agreements and compliance with specifications of the technology, activities that are carried out during the farmers' group meetings, trainings and meetings with external organizations such as FARM-Africa, extension agencies and market agents. However, farmers still need information to improve their profits from the dairy goats in order to be able to sustain the enterprise. This gathering of information is regarded as an ex post activity since it is done to add value to the technology after farmers have adopted it.

The results indicate that each household in the study area incurs about Ksh. 99.7 (US$ 1.7) per year to sustain the dairy goat enterprise (Table 2). These costs are arguably low to hinder sustained adoption of the exotic dairy goats. Although at this stage gathering of information for improvement of goat husbandry practices attract more farmers than any other activity, relatively higher costs are incurred to attend group meetings. While this might be interpreted to mean that joining the goat groups increases the ex post costs of adoption, this activity is important in sustaining the dairy goat technology in the research area since the groups keep most of the exotic bucks. However, because of the associated relatively huge costs (compared to other activities), it was found that farmers were not eager to join the groups in order to adopt dairy goats. This may explain why only 19% of the sample farmers adopted the goats through the group approach.

Descriptive statistics of variables used in the econometric model

Table 3 presents the means and standard deviations of the dependent and explanatory variables that included in the regression analysis. The variables ADOPT, EA_COSTS and EP_COSTS have already been mentioned and discussed. The rest of the variables in Table 3 are discussed in this section. The generation and measurement of FODDER_IN, EXPERIENCE, EXTENSION, CREDIT and AEZ are not discussed since this is clear and straightforward from the description in Table 3. The percentage of male-headed households to female headed ones (see the GENDER variable) is about 88%, while the average age of the households is about 50 years which is well above the national life expectancy age of 47 years (KNBS, 2007). The variable DEPEND_RA considers the ratio of household members who do not contribute to family labour since they are in school to the total household membership. The mean for this ratio is 28.4%. The mean for HHEDU is about 8 years of schooling. This indicates that most of the household heads in the research area have attained primary education and above. The variable GROUPS_NO is used to proxy the level of social capital for each household. However this variable is generated without considering membership in dairy goat groups since is highly correlated with the variable ADOPT. This is because no farmer could join the dairy goat groups without adopting dairy goats.

The wealth categories of the farmers (WELTHCAT) were generated during focus group discussions with key informants and local leaders. This subjective method of categorization depended on many factors such as the education of the household head, presence of well-paying off-farm activities, use of hired labour in the farm, and farm holding size. Using this method, there were about 40% of the household identified as relatively rich.

Factors influencing magnitudes of transaction costs

Based on the theoretical considerations in Section 2, an econometric model is developed to determine factors influencing magnitudes of transaction costs in both ex-ante and ex-post phases. The magnitude of the farmers' participation costs is hypothesised to be linked to adoption of exotic dairy goats and important farmers' characteristics, e.g. socio-economic and demographic characteristics, wealth status, social capital, etc. In addition, a number of factors are included as proxies of some of the attributes of transactions discussed in Section 2. The potential simultaneity bias that would arise in an ordinary least squares (OLS) regression as a result of inclusion of the endogenous ADOPT variable (a dummy coded 1 if the household has any pure, cross-bred or a pregnant local goat inseminated by a dairy breed, and 0 if otherwise) is avoided by adopting a "treatment effect model" (Greene, 2003) which is specified as:

$$y = \alpha_1 + \beta_1 x + \delta_1 z + E_1 \quad (1)$$

$$z^{\bullet} = \alpha_2 + \beta_2 v + E_2 \quad (2)$$

$z = 1$ if $z^{\bullet} => 0$ and $z = 0$, if otherwise.

In this case, y is the magnitude of the farmers ex ante and ex post transaction costs. This dependent variable is a function of the exogenous variables represented by x and the endogenous variable z (α is a constant; β and δ are the estimated regression coefficients and E_1 and E_2 are error terms). The model is estimated through a two-stage least squares (2SLS) regression, using the probit maximum likelihood estimates from equation (2) as the instrumental variable for z. Descriptive statistics of the variables used in the econometric model have been reported in Section 4. Before looking at the model results, we consider, *apriori*, how these variables are likely to influence transaction costs in both ex-ante and ex- post phases.

The GENDER and HHAGE factors are expected to favour more participation in the adoption process since they are likely to enhance decision-making processes in the households. They are therefore expected to have as positive influence on transaction costs of both phases. The influence of DEPEND_RA may however be difficult to predict as explained in Section 2.2. HHEDU is a proxy for human capital development and for wealth in the research area, and together with WELTHCAT are expected to be positively linked to adoption and transaction costs. Educated and wealthy farmers are likely to participate more in both ex ante and ex post phases since they have resources to do so and understand the need for information in any successful transaction.

The variables FODDER_IN and EXPERIENCE are linked to asset –specificity for the dairy goat technology. Both variables are likely to reduce transaction costs since farmers' risks of adopting the technology are reduced. The variables EXTENSION and CREDIT are measures of external support services. It is expected that looking for information from extension agents is likely to increase costs of participation in the dairy goat adoption process. Although farmers participating in credit programs have more financial resources than other farmers, they are likely to be occupied with other activities and may not get time to participate in the dairy goat adoption process. The dummy variable AEZ caters for the differences in the two different broad climate zones the dairy goats have been introduced. It is hypothesized that farmers in the higher zones are likely to participate more in the adoption process since they are wealthier and the weather conditions are more favourable for the exotic goat breeds from temperate areas.

The results of the econometric model are presented in Table 4. Due to space limitations, we discuss significant results only and focus mainly on factors influencing transaction costs. Thus factors influencing the decision to adopt dairy goats are just mentioned. These include male-heading of household (GNDER), age of the household head, education level of the household head and the level of social capital (GROUPS_NO). The first two factors have a positive influence while the last two show a negative one. As hypothesized the level of both ex ante and ex post transaction costs are influenced by the wealth level of the household. This might imply that the relatively poor households are not likely to participate in the dairy goat adoption process due to lack of financial resources such as funds to travel to meetings. The positive influence by this variable also indicates that farmers' participation in the dairy goat adoption process is related to uncertainty of the transactions.

Farmers are likely to spend monetary and non-monetary resources to lessen this uncertainty. Eventually only those who are relatively well off are likely to benefit from the technology since they are better endowed with these resources. The accessibility and participation in credit schemes that involve other farm and off-farm enterprises, other than dairy goats, reduce the likelihood of farmers' participation in the adoption process during the ex ante stage. This significant influence is also negative as expected. It is most likely that once the farmers get credit they become very busy with other farm or on-farm activities to the extent they do not value participation in dairy goat adoption process. As expected, adoption of dairy goats has a robust positive influence on the magnitude of transaction costs in both phases. This result indicates that adopters of the exotic dairy goats significantly bear higher costs that the non-adopters. Thus the adoption process may not be regarded as a costless one since farmers who opt for the technology have to contribute their own resources.

Conclusions

The study concludes that adoption of dairy goats in the east highlands of Kenya, though intended to increase food security and reduce poverty had various transactions costs that made some of the poorer farmers not to participate. The wealthier the household the more likely it was to participate since they could afford to meet the transaction costs. On the other hand, households' participation in credit schemes targeting other activities or enterprises was found to be significantly negatively related to transaction costs and hence adoption. As expected, adopters of dairy goats were likely to bear significantly more costs than the non-adopters.

Several policy implications can be derived from these results. First, to enhance participation in the adoption process, future initiatives could target the relatively wealthier farmers since they have a higher likelihood to incur costs as they participate. This finding also implies that other development interventions in the study area that aimed at increasing the wealth of the farmers in the past are compatible with the adoption of dairy goat technology. Thirdly, farmers that have already secured credit for undertaking activities in other enterprises may not contribute their resources to participate in the adoption of dairy goats and particularly during the initial stages. Thus for targeting purposes, development agencies could pick non-participants in credit schemes for other enterprises to enhance participation in dairy goat adoption. Second, since the adopters bear more costs than non-adopters even in the ex post stage, it is most likely that the former reap certain benefits which are an incentive to adopt the technology. The current study did not however analyze the benefits of adoption as this was beyond its scope. This could be done in the future in order to gauge whether farmers are able to reap enough benefits to offset the transaction costs.

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Table 1: Magnitudes of transaction costs incurred during the ex ante stage

Costs category/activity	n	Minimum	Maximum	Mean	Std. Dev
Gathering technical information on dairy goats for the first time	105	0.00	637.50	58.50	101.85
Looking for initial market information	69	0.00	1143.75	61.47	147.41
Getting first information on the availability of a buck	98	2.10	245.00	52.30	54.06
Total ex ante costs	165	0.00	305.63	81.57	94.16

Table 2: Magnitudes of transaction costs incurred during the ex post stage

Costs category/activity	n	Minimum	Maximum	Mean	Std. Dev
Attending local dairy goat meetings	31	32.9	4390.0	779.18	1004.05
Participating in training meetings	70	0.00	745	30.69	115.61
Participating in meetings called by external organizations	19	3.00	977.50	205.77	243.64
Gathering information to improve management practices	90	2.80	233.75	44.52	50.55
Gathering information to improve dairy goat market	45	0.00	250.6	45.48	52.01
Total ex post costs	165	0.00	551.17	99.69	153.87

Table 3: Descriptive statistics of variables used in the regression analysis

Variable	Definition	Mean	Standard dev	Frequency of (1) in %
ADOPT	Whether the household has any pure, cross-bred exotic dairy goat or a pregnant local goat inseminated by a dairy breed (1= Yes, 0= No)			70
EA_COSTS	Ex- ante transaction costs of dairy goat adoption process in Ksh.	81.57	94.17	
EP_COSTS	Ex- post transaction costs of dairy goat adoption process in Ksh. per year	99.69	153.88	
GENDER	Sex of the household head (1=Male, 0=Female)			88
HHAGE	Age of the household head in years	49.61	14.97	
DEPEND_RA	Percent of household members below 14 years to total household size	28.44	22.19	
HHEDU	Education level of the household head in years	7.62	4.03	
GROUPS_NO	Number of formal and informal groups the household belongs to, excluding the dairy goat group	1.29	1.09	
WELTHCAT	The wealth category of the household 1=Relatively rich 0=Relatively poor			39
FODDER_IN	Whether the household grows indigenous fodder (1=Yes, 0=No)			36
EXPERIENCE	Number of years the household has been keeping local goats	8.06	10.02	
EXTENSION	Whether the household has been in contact with extension agents in the last 1 year (1= Yes, 0= No)			28
CREDIT	Whether the household has been able to access formal credit in the last 1 year (1=Yes, 0=No)			11
AEZ	Agro-ecological zone of the area (1=Upper Midland Zones, 0=Lower Midland Zones)			67

Table 4: Determinants of adoption and magnitude of farmers' transaction costs

Explanatory variables	Adoption (n = 165)	Transaction costs (n=165)	
	(ADOPT)	Ex ante phase (EA_COSTS)	Ex post phase (EP_COSTS)
Constant	-1.126*	-47.980	-93.651
GENDER	0.846***	-40.628	-27.309
HHAGE	0.013*	-0.003	-0.014
DEPEND_RA	0.0042	0.301	0.407
HHEDU	-0.015*	-	-
GROUPS_NO	-0.253**	-	-
WELTHCAT	-	29.504**	59.822***
FODDER_IN	0.059	-2.201	62.225***
EXPERIENCE	-0.001	0.054	0.181*
EXTENSION	-0.116	-2.512	8.435
CREDIT	-	-0.167*	0.127
AEZ	-0.011	6.445	-21.889
ADOPT	-	201.34***	247.917***
Adjusted R^2	0.096	0.13	0.12

*, ** and *** : significant at 10%, 5% and 1% respectively
ADOPT: log likelihood = -92.00, Chi-square = 16.72, Significance level =0.0531
EX-COSTS: log likelihood = -961.83, Chi-square =43.45, Significance level =0.0000
EP_COSTS: log likelihood = -1047.59, Chi-square = 33.99, Significance level =0.0001