

Full Length Research Paper

Econometric analysis of factors determining households' access to cross breed dairy cows in Tigray, Ethiopia

Embaye Kidanu Kindeya

Tigray Agricultural Research Institute, Socioeconomic Researcher P.O.BOX: 492 Mekelle, Ethiopia.
E-mail: embayehiwot@gmail.com, Cell phone: +251914755997 Office telephone: +251 344 408 575,

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Abstract

This study aimed to identify factors associated with households' access to improved dairy cows. An econometric model PROBIT is used to estimate the determinant factors, moreover, endogeneity problem was detected on some of the explanatory variables, However, it was found a "proxy" for the stochastic explanatory variables such that, they are uncorrelated with the stochastic disturbance term. Such a proxy is also known as an instrumental variable. This was provided by the two-stage least squares (2SLS). Accordingly, from the determinants of access to crossbreed cows; number of extension agent visit, participation in extension demonstration, access to veterinary service affects the probability of access to improved dairy cows positively, whereas, households distance to the district town affects the probability negatively. The available sources of improved breed cow are district office of agriculture and rural development, relief society of tigray (NGO) and from market.

Keywords: Econometric analysis, access to dairy cows, instrumental variable

INTRODUCTION

Dairy production, among the sectors of livestock production system, is a crucial issue in Ethiopia where livestock and its products are important source of food and income. However, dairying has not been fully exploited and promoted in the country. Despite its huge numbers, the livestock subsector in Ethiopia is low in production in general, and compared to its potential, the direct contribution it makes to the national economy is limited. A number of fundamental constraints underlie these outcomes, of these constraints limited access to dairy inputs like improved dairy cows is the major one. (Berhanu *et al.*, 2006). Inputs that are needed for dairy production and marketing like type of breeds are largely in a traditional basis in the study areas. This indicates as there is a problem of access to these improved inputs and/or the supplying institutions could not able to address all the smallholder producers. Several researchers have

reported that introduction of crossbreed cows enable to achieve rapid breakthrough in milk, butter production, longer lactation period and shorter inter calving period. Moreover, crossbreed cows convert feed in to milk more efficiently than indigenous breeds. In addition, the unit cost of milk production is significantly lower for crossbreeds as compared to the local breed cows. Therefore, the productivity of crossbreed cows is often substantially higher than that of local breeds (Sharma and Singh, 1995). Provide this, access of improved breed cows and less availability of AI services found to be important production problems in the region, as the endogenous cattle breeds are characterized by low productivity. Therefore, this section of the study is targeted in identifying socio-economic and other factors determining households' access to improved dairy cows so as to boost dairy production and consumption in the country.

Objectives

- To identify factors determining households' access to improved dairy cows
- To assess the sources of improved dairy cows

METHODOLOGY

Methods of Data Collection

The data used for this study was collected both from primary and secondary sources. Secondary data was collected from different institutions, organizations and offices as well as through reviewing documents and publications. Primary data was collected from the producing farmer survey through structured questionnaires.

Sample Size and Procedure

The decision involved are partly a function of the information currently known, time and resource available, accessibility to and openness of the survey participants. In order to achieve these goals, a two stage sampling procedure was adopted. The first stage involved the random selection of rural peasant association in the study districts. Based on the distribution of population, a total of 14 rural peasant associations from Atsbi-wonberta district and 7 rural peasant associations from Alamata district were selected. These criteria were adopted because they determine largely the behavior of dairy production characteristics of the districts. The second stage of sampling involved the selection of respondents. Once the list of dairy producing household in each selected rural peasant associations was obtained, household heads were selected proportionally using the random selection method. By adopting the proportional random selection method, 200 dairy producer households from two districts were selected randomly.

Method of Data Analysis

An econometric model PROBIT is used to identify factors determining access to crossbreed cows in relation to households' socio-demographic, economic, intellectual and spatial characteristics. In addition to the model, descriptive statistics was also used to explain households' characteristics. The probability of getting access to crossbreed cows can be formulated as binary choice model. This model can be analyzed using the PROBIT equation below. The empirical specification of the probit model to be estimated by maximum likelihood estimation is defined as:

$$Y_i = \beta_0 + \sum_{i=1}^m \beta_i X_i + \epsilon_i$$

Where: $i = 1, 2, \dots, m$

Y_i is a dummy variable indicating the probability of getting access cross breed cows that is related to the equation as $Y_i = 1$ if a farmer have access to improved breeds, $Y_i = 0$, otherwise.

β_i , are the coefficients to be estimated,

x_i' are explanatory variables in the Probit regression model,

ϵ_i is random error term

The PROBIT functional form compels the error term to be homoscedastic because the form of probability depends only on the difference between error terms associated with one particular choice and other (Amemyia, 1985). The marginal effects were estimated on the variable means. This calculation involves taking the partial derivatives that measures the change in the probability of getting access per unit change in the independent variables.

RESULTS

General Characteristics of Farm Households

From the total interviewed dairy producer farm households 81.5% are male-headed and the rest 18.5 % were female-headed households. About 51% of the respondents range under age category of 45-64.99 years and 45%, 4% are under the category of 20-44.99 and 65 and above respectively. The average family size, which is a composition of different age groups, was 6.5, and average economically active labor force of the households is 3.8 person-days as measured in man equivalent. With respect to educational status of the household head, the 40.5% of dairy producers of the study areas were literate to read and writes. The overall proportion of illiterate farmers was 38.5% of the total respondents, about 20% and 1% are elementary completed and high school educated households respectively. Of the sample households about 58% of them respond, as they have no access to improved (cross) breed cows. On the other hand, the rest 42% of the households inform as they have access to improved breed of cows regardless of their adequacy and timelines. For 70.5% of the sample farmers, local breed cows are the sole source of milk. As the survey result indicates, local breed cows are characterized by low productivity, which was (1- 2.5 liters of milk per day/cow), as compared with that of cross breed cows in which they yield (5-10 liters of milk per day/cow) in the study areas. The households using only cross breed cows, mostly residents of semi-urban areas, are (5.5%) out of the total sample and (24%) of the households were used both crossbreed and local breeds to produce milk. Even if

Table 1: Source of crossbreed cows

Source of cross breed cows	households' woreda		Total %N
	Atsbi Wonberta district %N	Alamata district %N	
Market	2	4	3
district office of agriculture	70	74	72
relief society of Tigray	28	22	25

Table 2: Probit model estimates of households' access to crossbreed cows

Variables	Coefficients	Marginal effects	T-ratio
CONSTANT	-.69213 (1.5511)	-.26800 (.6009)	-.446
Age of household head(years)	.02931 (.02852)	.011352 (.0110671)	1.028
Sex of household head	-.49946 (.37719)	-.193401 (.14626)	-1.324
Family size	-.266280 (.30922)	-.10310 (.11977)	-.861
Experience in dairying (years)	.03691 (.025035)	.027908 (.019707)	1.47
Off farm income	.00011 (.0001342)	.0000434 (.0000520)	.835
Distance to development center (Km)	-.01526 (.046592)	-.0059073 (.018041)	-.327
Distance to weathered road (Km)	-.010139 (.032835)	-.00393 (.01271)	-.309
Distance to district town (Km)	-.02947** (.01241)	-.01141** (.00482)	-2.374
Land size (ha)	.07088 (.35530)	.02744 (.13761)	.200
Labor supply (man days)	.40544 (.36865)	.15699 (.14284)	1.100
Formal education	-.06325 (.28739)	-.024494 (.11127)	-.220
Number of local breed cows	-.06302 (.08729)	-.024404 (.03386)	-.722
Participation in demonstration	1.41624*** (.28237)	.54840*** (.11013)	5.016
Credit access	.39192 (.31586)	.15176 (.12224)	1.241
Feed access	.41785 (.44199)	.19413 (.17075)	.931
Extension contact frequency (number)	.69954* (.37761)	.27087* (.14626)	1.853
Access to veterinary service	.29989** (.1035)	.11612** (.04038)	2.91

Percentage of correctly predicted = 91,
N = 200

Chi-squared = 90.609***,

Log likelihood function = -90.75341

Restricted log likelihood = -136.0584,

^a = predicted values for endogenous variables using two stage least squares

* = 10% significance level

** = 5% significance level

*** = 1% significance level

(standard errors in brackets)

farmers are keen and interested to get crossbred cows for milk production, they could not able to get these breeds. Table 1 indicates, out of the total introduced crossbred cows, 72% were supplied by the district office of agriculture (WoARD), in addition 25% and 3% were introduced by relief society of Tigray (REST) and from market respectively.

Econometric Analysis

To analyze the factors affecting households' access to crossbred cows, PROBIT model is used. The variables hypothesized for this problem are households' socio-demographic, economic and spatial characteristics. The dependent variable is access to crossbred cows which is assigned BREEDACES = one, for households have access, BREEDACES = zero, otherwise. A software known as LIMDEP was used to estimate the parameter coefficients of the probit model. There is no problem of multicollinearity among the regressors as it was tested using variance inflating factor (VIF) for continuous variables and contingency coefficient for categorical variables.

However, explanatory variables such as access to credit, access to feed, access to veterinary service and participation in extension demonstration are likely to be endogenous variables. Consequently, taking these variables their actual value can introduce endogeneity problem, (the endogenous variables could be stochastic and correlated with error term in this equation) and resulting inconsistency in the parameter estimates of the model (even sample size increases definitely the parameter estimates could not converge to their true population parameters). However, it was found a "proxy" for the stochastic explanatory variables such that, they are uncorrelated with the stochastic disturbance term. Such a proxy is also known as an instrumental variable. This is provided by the two-stage least squares (2SLS), developed independently by Henri Theil and Robert Basmann (Green, 2003). As the name indicates, the method involves two successive applications. The first stage is made by regressing the suspected endogenous variables over the pre-determined or pure exogenous variables to get their predicted values (1st stage). The predicted values of the endogenous variables in the first stage are used to estimate the breed supply equation (2nd stage).

Table 2 presents the results of the probit estimations of factors influencing households' access to crossbred cows. The model correctly predicted 91% of the observations, with significance chi-squared of 90.609. Four of the hypothesized variables had coefficients that were significantly different from zero. Three of the variables were positively associated with the probability of households having access to improved breed cows. Access to veterinary service, participation in extension

demonstration and frequency of extension contact increased the chance of household access to crossbred cows. Whereas, distance of households' residence from their district town affects the probability of access to the breeds negatively.

The results imply that getting veterinary service by experts has a significant marginal effect on increasing the probability of having access to the crossbreeds. This may be because of crossbred cows are vulnerable to livestock disease and needs proper management and timely treatment. Therefore, farmers whom did not have access to veterinary service have lower chance to get crossbred cows than their counter parts. In addition, households participating in extension demonstration regarding dairying and more extension contact have better knowledge of management of new breeds and motive to expand their dairy enterprise, due to this reason, these households may get high priority to use crossbred cows. On the contrary, as farmers become far from their district town they may not have enough contact and information relating to improved breed cows and it may also difficult for them to get inputs for these breeds, consequently, as farmers residence becomes far and far, the probability of having access to crossbred cows decreases.

CONCLUSION

Out of the total interviewed households about 58% of them responded that they have no access to improved (cross) breed cows. Moreover from the introduced crossbred cows 72% were supplied by the district office of agriculture (BoARD), in addition 25% and 3% were introduced by relief society of Tigray (REST) and from market respectively. The determinant factors of households' access to crossbred cows are frequency of extension agent contact; Access to veterinary service and participation in extension demonstration which positive effect on the household access to crossbred cows. Whereas, distance of households' residence from their district town affects the probability of access to the breeds negatively. While investments in additional crossbred dairy cows and other dairy technologies has the greatest potential for smallholder dairy production, the full dairy production potential from the adoption of improved dairy cows is not been realized due to aforementioned factors.

RECOMMENDATIONS

The PROBIT model results of access to crossbred cows suggest availability of veterinary service, participation in extension demonstration, frequency of extension contact and proximity to district town determines farmers'

probability to have access to such breeds. Accordingly, the following recommendations are produced

- adequate and on time veterinary service, providing training with regard to crossbreed management and treatment can minimize loss of livestock and initiate serving institutions their supply of these breeds.
- The implication for distance to district town again suggests the opening of road networks, Marketing institutions and market access in order to provide farmers with options to get crossbreed cows.
- Over all, more attention is needed for investments in development of physical infrastructure, communication and road networks. It is also important develop farmers awareness and decision making capacity through training as well as experience sharing.
- Institutional arrangements like cooperatives can also be very successful in dealing with both information asymmetries and easily attain competitive edge.

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