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RESEARCH ARTICLE

FACTORS INFLUENCING ADOPTION OF DAIRY TECHNOLOGIES BY URBAN SMALL HOUSEHOLDS: THE CASE OF AMBO TOWN, WEST SHOA ZONE, OROMIA STATE, ETHIOPIA

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ABSTRACT

Although Ethiopia has the largest livestock population, productivity and production have remained low. The dairy technologies encompass the use of crossbred animals, artificial insemination, improved feed technology and improved management. Regardless of the potential to meet the growing demand for milk, there is an immediate need to adopt and follow better technologies of dairy farming. For that, it needs to know the base-line information of current features of technology adoption by the small households and the related constraints to adopt these technologies. This study was carried out in Ambo town in West Shoa zone, Oromia Regional State, Ethiopia. It was selected purposively because of the reason that there was gap between supply and demand of the product in the town. Three kebeles of Ambo town were selected purposively. Among the selected kebeles, household dairy producers were stratified into adopters and non-adopters of dairy technologies. The total sample size for the study was 152 households. Based on their probability proportional to size principle, 74 adopters and 78non-adopters were taken for the study through simple random sampling method. The primary data were collected from sample respondents through a structured questionnaire**.** In addition, key informant interviews and focus group discussion were used. Binary logit model was used to analyze the factors influencing dairy technology among sample farmers. Results of the Binary logit model indicated education level, farming experience of the households, dairy farm income, and frequency of contact with extension workers and knowledge were found to have positive and significant influence and market distance found to have negative and significant influence on adoption of dairy technology in agreement to the initial hypothesis. Clear messages on dairy farming technology and training of both woreda extension workers and households should be emphasized so as to improve their understanding and skills.

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INTRODUCTION

Ethiopia is believed to have the largest livestock population in Africa. This livestock sector has been contributing considerable portion to the economy of the country, and still promising to rally round the economic development of the country. The total cattle population for the country is estimated to be about 53.99 million. Out of this total cattle population, 98.95 percent of the total cattle in the country are local breeds. The remaining are hybrid and exotic breeds that accounted for about 0.94 percent and 0.11 percent, respectively (CSA. 2012/13). Although Ethiopia has the largest livestock population, productivity and production have remained low (Azage *et al.,* 2005).

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Per capita consumption of milk is estimated at 19 liters; this value is lower than African and world per capita averages, which are 27 and 100 kg/year respectively. The poor genetic potential for productive traits, substandard feeding and low level of health care and management practices are the main contributors to the low productivity (Zegeye, 2003). In Ethiopia urban and peri-urban dairying is contributing immensely towards filling in the large demand-supply gap for milk and milk products in urban centers, where consumption of dairy products is remarkably high (Azage *et al.,* 1998).

The low milk production in developing countries occasioned by poor adoption of technologies needed to be addressed for the smallholder farmer to enhance their income. FAO (2010) reported that Asia owned 25.7% of the dairy cattle in the world but produced 14.9% of the world milk, while North America

with 5% of dairy cattle population produced 16.3% of the world milk. Africa on the other hand with a massive 14.2% of the world dairy cattle population accounted for only 4.7% of the world milk production which was far below its requirement. To increase the milk production, improved dairy technology should be adopted in the small household dairy farms. In turn higher level of technology adoption is associated with better milk yield and improved dairying has a direct impact on income generation, poverty alleviation and availability of animal protein.

To increase the country's milk output, a sensible strategy of focusing on high yielding breeds and improved management technology should be adopted for considerable dairy development (SNV, 2008). Adoption of new techniques or technologies is seen to path the way to agricultural development and the analysis of the factors influencing farmers' adoption is therefore crucial to formulate policy recommendations for poverty alleviation. The dairy technologies encompass the use of crossbred animals, artificial insemination, improved feed technology and improved management (Mohamed *et al.,* 2004). But cattle farming in Ambo were constituted mostly from smallholder farming system being managed in traditional ways. The effect of several technical (breeds, artificial insemination, vaccination, etc.) and socio-demographic factors would be beneficial to improve the dairy production. Regardless of remarkable number of households who are engaged on dairy production there is only one milk producers' cooperative. Also on the supply side, there was no improved packaging of the product that poses hindrance in marketing of the product and consequently diminishes economic benefits of the households.

Regardless of the potential to meet the growing demand for milk, there is an immediate need to adopt and follow better technologies of dairy farming. For that, it needs to know the base-line information of current features of technology adoption by the small households and the related constraints to adopt these technologies. Despite of its importance, there is little information on current practices and factors influencing adoption of dairy technologies in the study area. This study, therefore was undertaken to study the factors that influence adoption of dairy technologies by the households.

RESEARCH METHODOLOGY

This study was carried out in Ambo town in West Shoa zone, Oromia Regional State, Ethiopia. It was selected purposively because of the reason that there was gap between supply and demand of the product in the town. Regardless of remarkable number of households who were engaged on dairy production there was only one milk producers' cooperative. Also on the supply side, there was no improved packaging of the product that poses hindrance in marketing of the product and consequently diminishes economic benefits of the households. In turn it affects the efforts of the households to adopt dairy technologies. These facts initiated the researcher to conduct this study in Ambo town. Three kebeles of Ambo town were selected purposively. Among the selected kebeles, household dairy producers were stratified into adopters and non-adopters of dairy technologies. Accordingto Storck *et al*. (1991), the size of the sample depends on the available fund, time and other reasons and not necessarily on the total population. Hence, the total sample size for the study was 152 households. Based on their probability proportional to size principle, 74 adopters and 78non-adopters were taken for the study through simple random sampling method. The primary data were collected from sample respondents through a structured questionnaire. In addition, key informant interviews and focus group discussion were used.

To analyze factors affecting adoption of dairy technologies by urban households, in most of the studies on adoption behavior, the dependent variable can be effectively captured using binary choice models. Binary choice models are appropriate when the decision making choice between two alternatives depends on the characteristics of the problem. Three types of models had been proposed in the econometric literature for estimating binary choice models:the linear probability, logit, and probit models represented by linear probability function, logistic distribution function, and normal distribution function, respectively (Gujarati, 1995). These functions were used to approximate the mathematical relationships between explanatory variables and the adoption decision that was always assigned qualitative response variables. The interest of the study was to analyze the factors influencing the decisions of households to use dairy technologies. The response to questions such as whether a household had used dairy technologies ornot could be yes or no which was a typical case of dichotomous dependent variable. Hence a binary logit model was used to analyze the factors influencing dairy technology among samplefarmers.

Model specification

According to Maddala (1992), Green (2008) and Gujarati () the logistic distribution for the adoption decision of dairy technologies can be specified as:

$$P_i = \frac{1}{1+e^{-z(1)}} \quad \text{.....(1)}$$

Where, P_i is the probability of adoption of dairy technologies for i^{th} farmer and ranges from 0 to 1. *e*- Represents the base of a natural logarithms and Z_i if the function of a vector of n explanatory variables and expressed.

$$Z_i = \beta_o + \sum \beta_i X_i \quad \text{.....(2)}$$

Where $\beta_o$is the intercept and $\beta_i$is a vector of unknown slope coefficients.The relationship between $P_i$and X_i which is non-linear can be written as follows:

$$P_i = \frac{1}{1+e^{\beta o+\beta i+Xi+i.....\beta nXn}} \quad \text{.....(3)}$$

The slopes tell how the log-odds in favor of adopting the technology changes as independent variables change. If P_i is the probability of adopting given technologies, then 1-P_i represents the probability of not adopting and can be written as:

$$1 - P_i = \frac{1}{(1+e^{-zi})} = \frac{e^{-zi}}{1+e^{-zi}} = \frac{1}{1+e^{zi})} \quad \text{..... (4)}$$

Dividing equation (1) by equation (4) and simplifying gives:

$$\frac{P_i}{1-P_i} = \frac{1+e^{zi}}{(1+e^{-zi})} = e^{zi} \quad \text{.....(5)}$$

Equation (5) indicates simply the odd-ratio in favor of probability of adopting the technologies. It is the ratio of the probability that the farmer will adopt the technology to the probability that he will notadopt it. Finally, the logit model is obtained by taking the logarithm of equation (5) as follows.

$$L_i = L_n\left[\frac{P_i}{1-P_i}\right] = Z_i = \beta o + \beta_1 X_1 + \beta_2 X_2 + x \dots\dots + \beta_n X_n \quad \text{.....(6)}$$

Where Li was log of the odds ratio, which is not only linear in X, but also linear in the parameters:

Thus, if the stochastic disturbance term U_i is taken into account, the logistic model becomes:

$$Z_i = \beta o + \beta_1 X_1 + \beta_2 X_2 + x \dots\dots + \beta_n X_n + U_i \quad \text{.....(7)}$$

This econometric model was estimated using the iterative Maximum Likelihood Estimation (MLE) procedure due to the non-linearity of the logistic regression model. The MLE procedure yields unbiased, asymptotically efficient, and normally distributed regression coefficients (parameters).

RESULTS AND DISCUSSION

Binary logistics econometric model was used to study the relative influence of different demographic, socio-economic, institutional, technological and psychological variables on adoption of dairy technology. The model was estimated using the Maximum Likelihood procedure and Statistical Package for Social Sciences (SPSS) for window version 16.

Table 1. Logistic regression for factors influencing dairy technology adoption

Variables	Coefficient	S.E	Wald	Sig.	Odds ratio
Eduhh	.393	.229	2.945	.086*	1.482
Famisiz	.367	.618	.354	.552	1.444
Farexhh	.118	.065	3.228	.072*	1.125
Farinc	2.158	.699	9.518	.002***	8.652
Offfamp	.654	.873	.563	.453	1.924
Excon	.655	1.456	.208	.648	1.944
Foexcon	1.518	.590	6.626	.010**	4.562
Traipa	.032	1.409	.001	.982	1.033
Madis	-4.293	2.168	3.922	.048**	.014
Perdt	.142	.532	.071	.790	1.152
Attdt	1.040	.763	1.857	.173	2.830
Knowl	.425	.166	6.558	.010**	1.530
Radt	1.216	.554	4.815	.128	3.274
Constant	-12.203	2.856	18.256	.000	.000

-2 Log likelihood =71.208
Chi-square value=139.403***
Correctly predicted over all sample=92.8
Correctly predicted adopters=91.9
Correctly predicted non-adopters=93.6
Source: model output. ***Significant at1%, ** significant at 5% and* significant at 10%.

Variables with statistically significant coefficients were then identified in order to measure their relative importance in influencing households' dairy technology adoption decision.

Accordingly, as indicated in Table 1, the $\chi 2$ result showed that the parameters are significantly different from zero at less than $P<0.01$ for the adoption of dairy technologies. The Nagelekerke R square was 0.801 implying that the model explained about 80% of the total variation in the sample households for use of dairy technologies. The model correctly predicted figures for adopters were about 91.9%; while correctly predicted sample size for non-adopters were 93.61%. Among the explanatory variables used in the model, six variables were significant with respect to adoption of dairy technologies at less than 10%probability level. The significant explanatory variables on adoption in study area are discussed below:

Education level of household head

It was statistically significant at less than 10% probability level with expected sign. The model result confirmed that educated farm households were more likely to adopt dairy technology than those who were not educated. This result is consistent with the findings of Mulugeta (2000) and Berhanu (2002). This result implies that education enhances farmer's awareness towards the new technologies. Educated farmers have more access to information and they become aware of new technology and awareness leads to the adoption of technologies. The odds-ratio of 1.482 for education implies that other things being kept constant, the odds-ratio infavor of adopting dairy technology increases by a factor of 1.482 as a farmers' education level increases by one grade.

Farm experience of Household head

The model result indicated that dairy farm experience of household head was positively associated with the adoption of dairy technology at less than 10% significant level. The implication is that household head who have more years of farm experience are more likely to adopt dairy technology than those household heads who have less years of farm experience. Farmers with higher experience appear to have often full information and better knowledge and able to evaluate the advantages of the technology. Other things kept the same, the odds ratio of 1.125 for farm experience indicates that, as farm experience increases by one year, the odds ratio in favor of adopting dairy technology increases by a factor of 1.125.

Farm income

Farm income is the main source of capital to purchase farm inputs and other household inputs. In this study, the household farm income was estimated based on the sales of dairy products. The relationship between adoption of dairy technology and dairy farm income as expected was positive and significant at less than1% probability level. The odds-ratio of 8.652 for farm income implies that other things being kept constant, the odds-ratio in favor of adopting dairy technology increases by a factor of 8.652 as the dairy farm increase by one

Birr. This study confirms with the findings of Degnet *et al.* (2001) and Kidane (2001).

Frequency of contacts with extension workers

As expected frequency of extension workers contact positively and significantly influenced the likelihood of adopting dairy technology. Keeping other variables constant, the odds ratio in favor of adoption, increases by 4.562 as frequency of extension contact increases by one unit (one day)and was significant at P<0.05. Similar results were reported by Abrhaley (2006) and Almaz (2008).

Market distance

As expected, the relationship between market distance and adoption of dairy technology was negative and significant at less than 5% probability level. The implication is that the longer the distance between households' residence and the market, the lower will be the probability of dairy technology adoption. Market accessibility is very important for farmers who have engaged in dairy farm production as it facilitates easy sale of milk and milk products they produce in relatively large quantities and assists them to procure the necessary inputs at fair price. Proximity to mark*et al*so reduces marketing costs. The odds-ratio of 0.014 for market distance implies that other things being kept constant, the odds-ratio in favor of adopting dairy technology decreases by a factor of 0.014 as the market distance increase by one kilometer. This result is consistent with the findings of other studies by Simeon and Naga (1999) and Berhanu (2002).

Knowledge

Knowledge includes the ideas, concepts routines and skills people acquire over time to support their livelihood. Similar to other technologies, dairy technology also needs knowledge on its routine activities. It is statistically significant at less than P<0.05, the odds-ratio in favor of adopting dairy technology increased by a factor of 1.530 for adopters who had better knowledge on dairy technology practices. The finding is in agreement with the finding of Degnet *et al.* (2001) which states that farmers' knowledge on fertilizer use and its application rate positively influenced adoption of high yielding maize varieties.

Conclusion

Results of the Binary log it model indicated the relative influence of different variables on adoption of dairy technology. All hypothesized explanatory variables were included in the model of which six (6) of them had shown significant influence on adoption of dairy technology. Accordingly, education level, farming experience of the households, dairy farm income, and frequency of contact with extension workers and knowledge were found to have positive and significant influence and market distance found to have negative and significant influence on adoption of dairy technology in agreement to the initial hypothesis. Based on the empirical findings of this study, the following recommendations are made:The diffusion of the technology could be facilitated through educated household dairy farmers who are to be used as contact farmers, besides improving households' level of education. The extension service should be further strengthened and urban agriculture extension service should be well facilitated to change the current livestock production practices in the area and to enhance the existing low adoption rate of dairy technologies. Due attention should be given to the livestock sub-sector. The establishment of milk collection centers, organizing farm households in cooperatives, improvement of marketing infrastructure and well organized marketing structure should receive due attention to further enhance adoption of dairy technology. Clear messages on dairy farming technology and training of both woreda extension workers and households should be emphasized so as to improve their understanding and skills.

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