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Determinants of adoption of dorper black head Somali crossbred sheep in pastoral areas: the case of Yabello District, Southern Oromia, Ethiopia

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This study aims to investigate determinants of adoption of the Dorper Black Head Somali (DBHS) Crossbred Sheep by the pastoralists in Yabello District, Ethiopia. Data from 123 sample respondents (pastoralists) were collected and analyzed using SPSS version 16.0. A binary logistic regression model was used to estimate the effects of hypothesized independent variables on the dependent variable (adoption of DBHS crossbred sheep) which is dichotomous. The result of descriptive statistics and focus group discussion showed that lack of sources for improved sheep breed (41.5%) and information on the breed (17%) were the major factors hindering pastoralists' decision to adopt. The binary logistic regression model results revealed that number of livestock owned in Tropical Livestock Unit (TLU), access to credit, participation in training, total farm income and educational level of household heads positively and significantly affected adoption of DBHS crossbred sheep; while family labor/size of the household head and distance from water sources significantly and negatively influenced it as well. Therefore, all concerned sheep production bodies need to focus on those variables to maintain or enhance their positive influence and minimize or avoid their negative influences on the decision of pastoralists to adopt the newly introduced DBHS Sheep Crossbreeding to speed up the rate of adoption in the study area.

Key words: Adoption, Dorper Black Head Somali (DBHS) crossbred sheep, binary logistic regression analysis, district.

INTRODUCTION

Ethiopia is a resourceful country, in the Africa continent, bestowed with the largest sheep resource numbering to about 29.33 million in the country, excluding sheep population in the non-sedentary (nomadic) areas of Afar and Somali regions. The Ethiopian livestock population is almost entirely composed of native animals. Recent studies show that 99.78, 0.17, and 0.05% of sheep are indigenous, hybrid and exotic breeds respectively (CSA, 2015).

Despite the largest population of small ruminants in general and sheep in particular with high potential for meat and milk production in Ethiopia, this sector is

currently functioning under constraints because of poor genetic potential of local breeds, shortage of feed and water, lack of veterinary care, shortage of veterinary medicines, drought, absence of awareness, inefficient livestock development services with respect to input supply, credit services, infrastructure and appropriate extension services (Fikru and Gebeyew, 2015). Furthermore, the performance of the Ethiopian sheep industry has been stated to be poor compared to other African countries due to lack of adequate feed and nutrition, widespread disease and health problems, as well as poor management and marketing system (Gizaw et al., 2013). Moreover, Tegegne et al. (2013) identified low accessibility of extension services and inadequacy of practical demonstration as the causes of low adoption among small dairy holders. Insufficient knowledge of farmers and unreliable external support was also mentioned as limitations leading to low adoption rates of crossbreeding (Gizaw et al., 2013).

The main breeding traits for majority of Ethiopian sheep farmers and pastoralists are meat, rather than wool production, and are driven by market demands and agro-ecology. There is also increasing demand for sheep and sheep products both in domestic market and neighboring countries like Sudan and North African countries due to the growing urban population, while farm areas are shrinking considerably due to increase in the rural population (Siegmund-Schultz et al., 2009 and Gizaw et al., 2013). To meet the ever increasing demand for domestic meat consumption and exporting other sheep products to other countries, crossbreeding, which is the mating of animals from different breed, is considered as one of the options and an attractive breed improvement method due to its quick benefit as a result of breed complementarities and heterosis effects (Hayes et al., 2009). Burrow (2012) also suggested combination of multiple breeds to achieve the optimum level of production.

A number of empirical studies have been carried out by different researchers and institutions on the adoption and diffusion of agricultural innovations both outside and inside Ethiopia. Adoption of agricultural technologies is influenced by a number of interrelated components within the decision environment in which pastoralists operate. For the simplicity of classifying, the factors identified as having positive or negative influence on adoption are categorized as household's demographic, economic, and institutional factors. Review of different literature over the years revealed that demographic factors (gender, age, education and farming experience), economic related factors (such as income, livestock holding and family labor), and institutional factors (training, access to extension services, credit, and distance from market and watering point) are the factors commonly affecting adoption of new technologies (Bortamuly and Goswami, 2015). Effort was made by the government of Ethiopia to introduce the pure exotic Dorper sheep breed from South

Africa to improve local sheep breed and disseminated it to different parts of the country, both highlands and lowland areas (Adane and Girma, 2008). In spite of these efforts, most pastoralists in the study area are still keeping local sheep breeds. The study carried out in the area was emphasized only on breeding, evaluation and dissemination of this breed both on station and on-farm. Despite all these efforts, there are no well documented and research studies conducted on factors affecting adoption of DBHS crossbred sheep with local breed generally in Ethiopia, and the study area in particular. Therefore, this study was conducted to identify the major determinants of adoption of Dorper Black Head Somali (DBHS) crossbred sheep in the Yabello district, Borana zone.

METHODOLOGY

Description of the study area

Yabello is one of the 13 Districts of Borana Zone, Oromia region, located at 570 km South of Addis Ababa. The District has a total of 23 rural Peasant associations and three urban dweller associations (El-way, Haro bake and Surupha) (Figure 1). The district is located at the center of the zone and it is situated between 3° 8' 46''-10° 09' 04'' North latitudinal and 3° 18' 03''-43° 04' 24''East longitudinal. The agro climatic area of the district is mainly divided into two, tropical 'Kola' which covers about 82% of the total areas of the districts and subtropical 'Weina dega' which covers 18% of the district. There are two rainy season in the district, namely long rainy season, which is from March to April and short rainy season between September and November. The district has common boundaries with Regional State of Southern Ethiopia in northwest, Teltele district on the west, Arero district at the east, Dugda Dawa district in the north and the Dire district in the south (BZoFEDO, 2016).

The altitude of the district ranges from 1000 to 1700 m.a.s level. The mean annual temperature ranges from 19 to 24°C and a prominent feature of the ecosystem is the erratic and variable nature of rainfall, with most areas receiving 238 and 989 mm annually, with a high coefficient of variability from 18 to 69%. The total population of the District is 102,165 out of which 51,418 were men and 50,747 were women; 17,497 (17.13%) of its population were urban dwellers. The four largest ethnic groups that exist in Yabello District are the Oromo (Borana, Guji, Gabra) followed by the Burji, the Amhara, Konso and other nation and nationalities (CSA, 2015).

Livestock production is the major component of the farming system in the study area and it contributes to the subsistence requirement of the population among others, in terms of milk, milk products and meat, particularly from small ruminants. According to the District Pastoral and Rural Development Office, the District total livestock population is estimated to be 637,314 out of which cattle consist 265897; Goats, 222,779; sheep, 97,011; Horses, 106; Mules, 833; Donkeys, 6646; and Camels, 44042. In all, cattle population accounts for 41.7%; goats, 35%; sheep 15.2 %; and others 8.1% (YDPRDO, 2016).

In general, the District is famine prone, and frequent crop failure is a common problem there that usually leads to food shortage. Moreover, continuously prevailing drought in the district, shortage of water and grazing pasture, Infestation of disease such as trapanosomiasis and internal parasites, traditional or backward animal management system, lack of veterinary extension service are the major constraints hindering the production and productivity
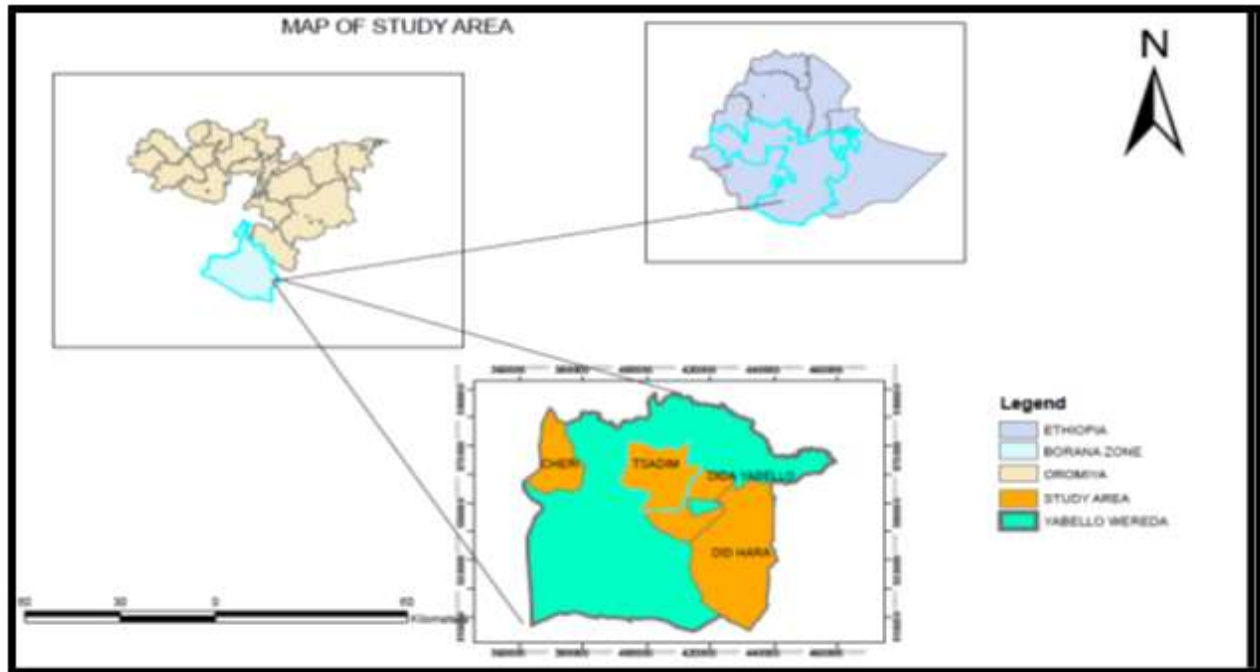
Figure 1. Map of the study area.
Source: BZoFEDO (Borana Zone Finance and Economic Development office), 2016

Table 1. Sample Peasant Associations (PAs) and number of households for two strata from each PAs should be put under sampling procedure and sample size.

Sample PA's	Total HHs	Adopters		Non-adopters		Total sample
		Total	Sample	Total	Sample	
Cheri	1156	54	22	1102	11	33
Did-Yabello	1200	51	21	1149	11	32
Thesdim	800	37	15	763	7	22
Did-Hara	1285	58	24	1227	12	36
Total	4441	200	82	4241	41	123

Source: field survey, 2017. HHs-Household heads.

of crops in general and livestock in particular.

Sampling procedure and sample size

For this study multi-stage sampling procedures was used. In the first stage, out of 13 Districts of Borana zone, Yabello District was purposively selected based on potentiality of Sheep production and accessibility. In the second stage, out of the total of 23 rural peasant associations, 8 peasant associations in which Dorper Black Head Somali (DBHS) crossbred sheep has been introduced were chosen. In the third stage, out of 8 rural Peasant associations, 4 Peasant associations were randomly selected. In the fourth stage, to select the representative respondents from each of the four Peasant association, a complete list of adopter for the last five years from Yabello Pastoral and Dryland Agriculture center (YPDARC) and total number of household heads from Yabello District Pastoral and Rural Development Office (YDPRDO) in the

selected Peasant association were identified and stratified into two strata: adopters and non-adopters. Adopters were sampled from the list independently and non-adopters were sampled from their total household heads excluding the adopters in each Peasant association accordingly, 82 sample respondents from adopters and 41 from non-adopters group were selected randomly through simple random sampling technique, by applying proportional probability to size (PPS). Finally, a total of 123 sample respondents were selected for the interview schedule (Table 1).

Sources and methods of data collection

Quantitative and qualitative data were collected from primary and secondary sources. Primary data were collected from 123 sample households drawn from the selected Rural Peasant association, generated from interview schedule; while the secondary data include household's demographic characteristics (Education, age,

family size, sex), economic factor (number of livestock in Tropical Livestock Unit (TLU), total annual farm income and family labor), Institutional factors like extension contact, distance from market and water sources, training delivered by government and non-government organization, and Socio-psychological factors like attitude and mass media exposure.

Before handling the actual interview questionnaire, general observation of the District, informal discussions with the pastoralists, transect walks in most of the rural Peasant association during two weeks of survey period and pilot study were undertaken. The pilot study was done in two rural Peasant associations which were not used for actual survey, but were nearby and have similar characteristics with the rural Peasant association selected for the survey to ensure that the comparison of information obtained is reliable and informative. The total number of sample household heads used for the pilot study was 15 and they were randomly selected. The purpose of the pilot study was to modify the interview questionnaire, delete unnecessary and ambiguous questions and add more relevant information if any. Crosschecking the survey interview schedule with the secondary sources, personal observation and focus group discussions were also made. After coding, tabulating and cleaning the collected data, data entry was done using SPSS version 16.0 Software.

Secondary data relevant to the research work were obtained from Yabello Pastoral and Dryland Agricultural Research Centre (YPDARC), the Yabello District Office of Pastoral and Rural development Office (YDPRDO), Journals, Books, Internet and websites. To supplement the primary data, focus group discussions were conducted with adopters. A total of 8 focus group discussions, two focus group discussions in each Peasant association having 5-8 household members, were undertaken. The discussion aimed to identify reasons for adopting the newly introduced DBHS crossbred sheep and other related problem. Moreover, review of documents from different sources was carried out.

Method of data analysis

In many adoption studies, responses to questions such as whether the pastoralists/farmers adopt a newly introduced technology could be either 'yes' or 'no', which is typically a dichotomous variable. There are various statistical models that can be used to establish the relationship between explanatory or independent variables and adoption of newly introduced technologies. Conventionally, linear regression analysis is used in most economics and social research because of some of its desirable properties for a specific type of inquiry and data and is widely available in computer packages (Green, 1991). However, some conclusions derived from linear regression analysis may be erroneous if some critical assumptions are not fulfilled and will lead to quite unreasonable estimates. To mention some of the weaknesses of the Linear Probability Model (LPM): It may generate predicted values outside Zero (0) and one (1) interval, which disrupts the basic principle of probability. Moreover, the assumption of normality in disturbance term is no longer reasonable.

The insufficiency of the linear probability model recommends that a nonlinear specification may be appropriate and applicable, provided the data present an S-shaped bounded in the interval of 0 and 1 - (Amemiya, 1981; Maddala, 1983). These authors suggest that the S-shaped curves satisfy the probability model as those represented by the cumulative logistic function (Logit) and cumulative normal distribution function (Probit). Thus, Probit and Logit are the two most commonly used functions for identifying the influence of various factors on the probability of utilization of certain technology (Feder et al., 1985).These models can also give the predicted probability of utilization. However, the logit model was chosen over the probit model because of its simplicity and ease of interpretation, and it is a standard method for understanding the

association between explanatory variables and a binary dependent variable (Green, 2003). Thus, the binary logistic distribution function (logit) model was used in this study to identify and analyze factors affecting the adoption of Dorper-Black Head Somali (DBHS) crossbred sheep in the Yabello District. According to Gujarati (2003), the logistic distribution function for the decision to adopt the newly introduced DBHS crossbred sheep can be specified as:

$$Pi(Yi = 1/xi)) = e^{zi} = \frac{1}{1 + e^{zi}}$$

(1)

where P_i-is the probability of adopting Dorper crossbred sheep for i^{th} Pastoralist and Z (i) is a function of m explanatory variables (Xi) and is expressed as:

$$Z_i = \beta o + \beta_1 X_1 + \beta_2 X_2 + - - + \beta m X m$$

(2)

where βo is the intercept and $\beta_1, \beta_2 ...... \beta_n$ are the logit parameter (slopes) of the equation in the model. The slopes tells how the log - odds in favor of deciding to adopt DBHS Sheep crossbreeding by a unit. The stimulus index, Z_i, refers to the logs of the odds ratio in favor of deciding to adopt DBHS Sheep crossbreeding. The odd is defined as, the ratio of the probability that a pastoralist adopts the DBHS Sheep crossbreeding (P_i) to the probability that he will not adopt $(1 - P_i)$. But $(1 - P_i)$, the probability of not adopting DBHS Sheep crossbreeding is

$$1 - P_i = \frac{1}{1 + exp\,[\,(Zi)]}$$

(3)

Therefore, one can write

$$\left(\frac{Pi}{1-Pi}\right) = \frac{1 + exp\,[\,(Zi)]}{1 + exp\,[\,-(Zi)]} = e^{Z(i)}$$

(4)

So that;

$$\frac{Pi}{1 - Pi} = \frac{1 + exp[\,(Zi)]}{1 + exp[\,-(Zi)]} = e^{Bo} + \sum_{n=1}^{m} BiYi$$

(5)

Taking the natural logarithms of the odds ratio of the Equation 5 will result in what is called the logic model as indicated below

$$Li = \ln\left(\frac{Pi}{1 - Pi}\right) = \ln\left[e^{Bo} + \sum_{i=1}^{m} BiXi\right] = Zi$$

(6)

Where,i=1,2,3…m.

If the disturbance term ui is taken in to account the logit model becomes:

$$Zi = \beta o + \sum BiXi + ui$$

(7)

According to Gujarati (2003) a problem of multicollinearity occurs when the value of VIF is greater than 10 for continuous variables and the value of contingency coefficient is greater than 0.75 for discrete variables. Accordingly, before the analysis and estimation of the model parameters, the existence of problem of multicollinearity or association among continuous explanatory and

Table 2. Definition of Explanatory Variables used in the Binary Logistic Model be added under independent variable section.

Variable code	Description	Type	Expected Sign
FAMLABOR	Family labor availability	Continuous	+
FARMEXP	Farming experience of HHHs in years	Continuous	+
TLU	Number of livestock (herd size) in TLU	Continuous	+
ACCESTCR	Access to credit and utilization	Dichotomous:1= yes, 0= No)	+
TRAINGPAR	Participation in Training	Dichotomous: 1= participated, 0= No	+
PARTINSO	Participation in Social organization	Dichotomous: 1= Yes, 0= No	+
TOTALINC	Total farm income	Continuous	+
SEXHHS	Household head Gender	Dichotomous: (1= Male, 0= Female)	+
EDULVL	Educational level of household	Dichotomous:1=literate, 0= illiterate	+
ACESSEXN	Contact to extension agents)	Dichotomous:1= have contact, 0=No	+
MARKETAC	Market access	Dichotomous: 1= Yes, 0= No	+
DISFWRSC	Distance from the water sources	Continuous	-

discrete variables were checked through the Variance Inflation Factor (VIF) and contingency coefficient test respectively, and no variables had problems of multicollinearity (Tables A6 and A7). Lastly, since none of the 12 variables (5 continous and 7 discrete) have no problem of multicollinearity, they were confidently included in the model for analysis.

Dependent Variable and Independents variables used in the model

Dependent variable

This is a variable that is said to be affected or explained by another variable and representing the decision to adopt. It is modeled as a dummy variable that represents the probability of the household adopting the DBHS crossbred sheep. In this study, Adoption of the DBHS crossbred sheep is treated as a dichotomous dependent variable. The variable takes the value of (1) if the Pastoralists adopt DBHS crossbred sheep; and (0) if otherwise.

Independent variables

The independent or explanatory variables are variables that tend to explain and influence dependent variable. Based on the various studies of adoption, the adoption of DBHS crossbred sheep is influenced by the demographic, economic, and institutional factors which are explained in Tables 2.

RESULTS AND DISCUSSION

Descriptive statistical analysis results

Major reasons for adopting the DBHS Sheep crossbreeding by adopters

When asked the reasons why they adopted the newly introduced DBHS crossbred sheep, 13.4, 40.2, 7.3, and 13.4% adopters said, "Compared to local breed, DBHS crossbred sheep are highly adaptable to our area, high market demand, lean or red meat and fast growth rate

respectively." The rest (25.6%) of adopters reported that the reasons of adoption were all four mentioned earlier (Table A1).

Results of focus group discussion with adopters on reasons of adopting DBHS Crossbred Sheep: During focus group discussion adopters gave reasons for adopting the newly introduced Crossbred. Most of them agreed on the same reasons for adopting and said, "The newly introduced DBHS crossbred sheep is highly adaptable, resistant to disease and drought, fast growing and superior weight gain, red meat and highly demanded by the market as compared to the local breed." They also mentioned that even though they adopt the breed, they are worried as there are no sources of improved breed multiplication centers or organization.

Reasons for rejecting the DBHS crossbred sheep by non-adopters

When asked the reasons why they did not adopt the newly introduced DBHS crossbred sheep 17, 24.4, 12.2, and 4.9% of non-adopters reported the reasons to be lack of information, shortage of money, lack of forage and shortage of labor respectively; while the largest group (41.5%) of non-adopters reported the reason to be the lack of improved breed source (Table A2).

Result of focus group discussion with non-adopters on reasons of rejecting dbhs crossbred sheep: During the focus group discussion when asked why non-adopters reject the newly introduced Dorper Black Head Somali crossbred sheep they reported the main reason of not adopting is the lack of improved crossbred breed sources. According to non-adopters, these reasons are the most serious problems or constraints hindering them from adopting the newly introduced DBHS Sheep crossbreeding in the study area.

Local sheep vs DBHS crossbred sheep in terms of lean to fatty ratio content

During Focus Group Discussion (FGD) adopters explained that local sheep is fatty tailed while DBHS crossbred sheep is thin tailed. They also reported that the local Somali Sheep has low lean to fatty ratio and DBHS crossbred sheep has high lean to fatty ratio and this made Dorper crossbred sheep more attractive and demanded by local and international markets as (Figure A1).

Local sheep vs DBHS crossbred sheep in terms of meat color and lean to fatty ratio content

From the focus group discussion result it was observed that local Somali sheep's meat color is white, and it has higher fatty to lean ratio content compared to DBHS crossbred sheep which has higher lean to fatty ratio (red meat) and low fat content (Figure A2). Furthermore, adopters explained that these characteristics of DBHS crossbred meat made it to be of high demand in the market as compared to local Somali sheep meat.

Determinants of adoption of Dorper Black Head Somali crossbred sheep

Family labor

Family labor is one of the factors affecting the adoption of newly introduced technologies. The Family size was converted to man equivalent or labor force, using conversion factor as prescribed by Storck et al. (1991) (Table A5). Opposed to our prior expectation, the model result indicated that, the family labor of the respondents significantly but negatively affected adoption of the DBHS crossbred sheep (P value < 0.01). The negative coefficient for family labor availability implies that pastoralists with less family labor are more likely to adopt the DBHS crossbred sheep as compared to those with more family labor force. The odd ratio of the labor also confirmed that decrease in proportion of labor availability in family members by one unit (one person), increases the probability of the pastoralists' decision to adopt DBHS crossbred sheep by a factor of 0.307 (Table A3). This may be due to the fact that, households with less family labor tends to rear small number of improved crossbred sheep than keeping large number of local sheep breed, besides shortage of labor force. This is consistent with the findings of Ansah et al. (2015) and Misganaw et al. (2016) who reported family labor to be significantly and negatively related with adoption of dairy technology.

Tropical livestock unit

The number of livestock the pastoralists own plays a key role in adopting the newly recommended breed. The number of TLU was calculated using conversion factors as prescribed by Storck et al. (1991) (as shown in Table A4). The result of the binary model indicated that, the number of livestock in TLU positively and significantly influenced adoption of DBHS crossbred sheep (P value <0.05). This result implies that pastoralists with large number of TLU are more likely to adopt DBHS crossbred sheep as compared to those who own small number of TLUs. The odds ratio of this variable shows that, as the number of livestock units increases by one TLU, the probability of adopting the newly introduced DBHS crossbred sheep increases by a factor of 1.079 (Table A3). The possible explanation for this could be increasing livestock holding enhances the ability of the pastoralists to participate in new technology and provides a better sense of security to bear the risks associated with crossbreeding and other management practices. This finding is consistent with the findings of Ansah et al. (2015) and Legesse et al. (2013) who found the number of livestock and adoption to be positively and statistically significant.

Access to credit

Pastoralists may require credit to purchase the newly introduced technologies and other related inputs which in turn enables them to adopt them. From the output of the model result, it is shown that access to credit significantly and positively influenced adoption of DBHS crossbred sheep (P value = 0.01). The odd ratio of access to credit implies that pastoralists who had access to credit and received credit are 6.417 times more likely to adopt the DBHS crossbred sheep as compared to those with no credit access (Table A3). The possible explanation for this could be, access to credit helps pastoralists to afford the newly introduced and purchase of feed and other necessary inputs especially during the drought season. This finding is in agreement with that of Quddus (2013) who stated that credit receivers are more likely to adopt improved dairy technology than non-receivers.

Training participation

The binary logit model results indicated that participation in training positively and significantly affect adoption of the DBHS crossbred sheep (P value = 0.05). The odd ratio of training participation implies that pastoralists who had participated in training related to the newly introduced DBHS Sheep crossbreeding are 8.26 times more likely to adopt as compared to those who did not participate in training (Table A3). The possible reason for this result could be due to the fact that training increases the level of awareness of the pastoralists and broadens their knowledge with regard to advantage, management practices and other attributes of the newly introduced

DBHS crossbred sheep. This finding is consistent with the findings of Dehinenet et al. (2014) and Tewelde et al. (2015) who reported that training participation of small holder dairy farmers influenced adoption of dairy technology positively and significantly.

Total annual farm income

The result of the model revealed that total annual farm income of the households positively and significantly affected adoption of DBHS crossbred sheep (P value = 0.05). The odds ratio of this variable implies that keeping the influence of other factors constant would increase the likelihood of adoption of DBHS crossbred sheep by a factor of 8.26 as the total annual farm income increases by one unit (Table A3). This is due to the fact that, if the pastoralists have more income, they can afford adoption of new technologies, including improved breed of livestock and can compensate for the risks associated with the crossbreeding, management practices and other necessary inputs. This result is in agreement with the findings of Solomon et al. (2015) and Dehinenet et al. (2014) who found that, the total farm income positively and significantly relates to adoption of Awasi crossbreed sheep and dairy technology, respectively.

Educational level

The result of the binary logit model has shown that educational level of the households' heads significantly and positively influence adoption of DBHS crossbred sheep (P value <0.0). The positive coefficient of education implies that literate pastoralists are more likely to adopt the new introduced DBHS crossbred sheep than illiterate pastoralists (Table A3). This could be explained by the fact that pastoralists with better educational status are more in a position to know the advantage of a new technology and are more enthusiastic to take part of it. This result is consistent with the findings by Quddus (2013) who indicated that adoption of dairy technology was positively associated with the farmers' education level.

Distance from water source

The result of the binary logistic regression shows that the distance from water sources to pastoralists' residence was found to be significant and negatively influenced adoption of DBHS crossbred sheep (P value < 0.05). The odds ratio of this variable showed that keeping other influencing factors constant, as the distance of the residences from water sources increases by one kilometer, the probability of pastoralists' decision to adopt the new breed decreases; in other words, a pastoralist

whose residence is 1 km closer to a water source than another is 1.43 times more likely to adopt the new sheep breed (Table A3). This is because if the pastoralists' home is far from watering point, they may be forced to take their sheep to water sources less frequently than normal, which in turn discourages them to adopt. This study is consistent with the findings of Mamiru and Tedele (2017) who reported that distance between home and farmland influence the adoption of improved forage negatively.

CONCLUSION AND RECOMMENDATION

The performance of the Ethiopian sheep industry has been stated to be poor compared to other African countries, and adoption rate of improved breed among small ruminant holders is very low. Many studies carried out so far in the country in general and in Yabello district in particular were emphasized only on breeding, evaluation and dissemination of the Dorper crossbred sheep to improve local sheep. Therefore, the present study was undertaken to identify determinants of adoption of DBHS crossbred sheep among the pastoralists. The study presents the results of descriptive, focus group discussion and an empirical application of maximum likelihood estimation of a binary logistic regression model to identify determinants of adoption of the new introduced DBHS crossbred sheep in the pastoral area of Yabello District. The result of descriptive and focus group discussion revealed that lack of information and sources of improved crossbred sheep were the major constraints hindering adoption of DBHS crossbred sheep. The result of the binary logistic regression model indicated that the number of livestock owned by the household TLU, training participation, educational level of household heads significantly determined adoption of DBHS crossbred sheep. Watering points distance from the pastoralists' residence and family labor negatively affected adoption of DBHS crossbred sheep. Therefore, this study recommends that all concerned bodies such as government, non-government, development actors, policy makers and other relevant stakeholders working at different levels in sheep breeding should pay attention to those factors which could positively or negatively affect pastoralists' decision to adopt the new DBHS crossbred sheep in the study area. Furthermore, all concerned bodies should jointly work together to enhance the sources of genetically improved sheep breed either through establishing better sheep multiplication centers or importing more exotic breeding stock to speed up the rate of adoption in the study area .

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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REFERENCES

Adane H, Girma A (2008). Economic Significance of Sheep and Goats. In : Alemu Yami and Merkel, R.C. (Eds). Sheep and Goat Production Handbook for Ethiopia. ESGPIP (Ethiopian Sheep and Goat Productivity Improvement Program). 2008, Addis Ababa, Ethiopia pp. 1-4

Amemiya T (1981). Qualitative response models: A survey. Journal of Economic Literature 19(4):1483-1536.

Ansah IGK, Damasius E, Richard A (2015). Socioeconomic Determinants of Livestock Production Technology Adoption in Northern Ghana. Asian Journal of Agricultural Extension, Economics and Sociology 5(3):166-182.

Bortamuly AB, Goswami K (2015).Determinants of the adoption of modern technology in the handloom industry in Assam. Technological Forecasting and Social Change 90:400-409.

Burrow HM (2012). Importance of adaptation and genotype× environment interactions in tropical beef breeding systems. Animal 6(5):729-740.

Borana Zone Finance and Economic Development Office (BZoFEDO) (2016). Annual Report. Yabello, Ethiopia pp.1-38

Central Statistical Agency (CSA) (2015). Agricultural Sample Survey (September-January 2014/15). Report on crop and livestock product utilization. Private peasant holdings, Meher Season. Central Statistical Agency (CSA): Addis Ababa, Ethiopia P 7.

Dehinenet G, Mekonnen H, Kidoido M, Ashenafi M, Bleich EG (2014). Factors influencing adoption of dairy technology on small holder dairy farmers in selected zones of Amhara and Oromia National Regional States, Ethiopia. Discourse Journal of Agriculture and Food Sciences 2(5):126-135.

Feder G, Just RE, Zilberman D (1985). Adoption of agricultural innovation in developing countries: A Survey. Economic Development and Cultural Change 32(2):255-298.

Fikru S, Gebeyew K (2015). Sheep and Goat Production Systems in Degehabur Zone, Eastern Ethiopia: Challenge and Opportunities. Advances in Dairy Research 3(2):1-9.

Green HW (1991).Econometric Analysis. New York University. MacMillan Publishing Company pp. 697-701.

Green W (2003). Econometric Analysis. 5th Edition, New Jersey: Prentice Hall.

Gizaw S, Getachew T, Edea Z, Mirkena T, Duguma G, Tibbo M, Rischkowsky B, Mwai O, Des-sie T, Wurzinger M, Solkner J, Haile A (2013). Characterization of indigenous breeding strategies of the sheep farming communities of Ethiopia. A basis for designing community-based breeding pro-grams. International Center for Agricultural Research in the Dry Areas (ICARDA). 40 p.

Gujarati D (2003). Basic Econometrics. 3rd Edition, Mc Graw-Hill Inc, New York.

Hayes BJ, Bowman PJ, Chamberlain AJ, Goddard ME (2009). Invited review: Genomic selection in dairy cattle: Progress and challenges. Journal of Dairy Science 92(2):433-443.

Maddala GS (1983). Limited-Dependent and Qualitative Variables in Econometrics. Cambridge University Press.

Mamiru T, Tedele M (2017). Determinants of Adoption of Improved Highland Forage Type: Evidence from Dendi District, West Shoa Zone, Ethiopia. Journal of Experimental Agriculture International 15(1):1-8.

Misganaw A, Samuel D, Efrem A, Beza E Addisu B (2016). Adoption and Impacts of Dairy Production Technologies in Southwest Ethiopia : The Cases of Jimma and Ilu- Ababora Zones. Journal of Biology, Agriculture and Healthcare. 6(7):1-12.

Quddus MA (2013). Adoption of dairy farming technologies by small farm holders: practices and constraints. Department of Agricultural Statistics, Bangladesh Agricultural University, Bangladesh. Bangladesh Journal of Animal Science 41(2):124-135.

Siegmund-Schultze M, Legesse G, Abebe G, Zárate AV (2009). Bottleneck analysis of sheep production systems in southern Ethiopia: Comparison of reproductive and growth parameters. Options Méditerranéennes 91:67-69.

Solomon T, Mesfin B, Berhan T, Belay D (2015). Adoption of Awasi-cross Sheep Breed and its Impact on Household Income in Ethiopia. American Scientific Research Journal for Engineering, Technology, and Sciences 12(1):29-39.

Storck H, Emana B, Adenew B, Borowiecki A, Wolde-Hawariat S (1991). Farming Systems and Farm Management Practices of Smallholders in the Harerghe Highlands-a Baseline Survey Farming Systems and Resource Economics in the Tropics. Kiel, Germany: Wissenschaftsver lag Vauk, Kiel, Germany 11:41-48.

Tegegne A, Gebremedhin B, Hoekstra D, Belay B, Mekasha Y (2013). Smallholder dairy production and marketing systems in Ethiopia: IPMS experiences and opportunities for market-oriented development. Working paper No. 31.ILRLI; Addis Ababa, Ethiopia.

Tewelde H, Tesfatsion S, Kibrom G (2015). Determinants for the Attraction of Urban Dairy Farm Investment in Mekelle City, Ethiopia. Research Journal of Finance and Accounting 6(9):44-63.

Yabello District Pastoral and Development Office (YDPRDO) (2016). Socioeconomic profile and Report for 2015. Yabello, Ethiopia.

ANNEXURE

Table A1. Reasons for adopting DBHS crossbred sheep by adopters.

Reason for adopting	Adopter	
	N	%
Adaptable to the area	11	13.4
High market demand	33	40.2
Lean or red meat	6	7.3
Fast growth rate	11	13.4
All	21	25.6
Total	82	100

Source: Own survey, 2017, N= Number.

Table A2. Reasons for rejecting DBHS crossbred sheep by non-adopters.

Reason of rejecting	Non-Adopter	
	N	%
Lack of information about it	7	17
Shortage of money to buy it	10	24.4
Lack of forage	5	12.2
Shortage of Labor	2	4.9
Lack of improved breed source	17	41.5
Total	41	100

Source: Own survey, 2017, N= Number.

Table A3. Maximum Likelihood estimates for factors affecting adoption of DBHS crossbred sheep.

Independent variables	Coefficient	Standard Error	Wald	P- Value	Odd Ratio
Family Labor	-1.18	0.449	6.907	0.009***	0.307
Farming experience	-0.05	0.038	1.682	0.195	0.951
TLU	0.076	0.038	3.929	0.047**	1.079
Access to Credit	1.859	1.01	3.391	0.066*	6.417
Training Participation	2.111	0.992	4.524	0.033**	8.255
Participation in Social org.	-1.096	1.473	0.553	0.457	0.334
Total Farm Income	1.07E-04	4.37E-05	6.022	0.014**	1.000
Sex of HHHs	-0.194	1.323	0.021	0.884	0.824
Educational Level	1.203	0.7	2.951	0.086*	3.331
Access to extension	0.574	0.953	0.362	0.547	1.775
Market access	0.481	1.197	0.162	0.687	1.618
Distance from water source	-0.361	0.156	5.327	0.021**	0.697
CONSTANT	-0.979	1.9	0.266	0.606	0.376

Source: Model output; *, **, *** significant at 10, 5 and 1%, respectively.
Dependent variable is adoption of DBHS Sheep crossbreeding
-2 Log likelihood Ratio = 50.144, Chi-squared = 101.804
R^2 (Nagelkerke's) = 0.79
Predicted success =Adopters = 93.7%, non-adopters = 82.5% and overall success = 90% Number of sample observations =123.

Table A4. Conversion factors used to estimate total livestock unit.

Animal category	TLU	Animal category	TLU
Calf	0.25	Donkey (young) Camel	0.35
Weaned Calf	0.34	Camel	1.25
Heifer	0.75	Sheep and Goat (adult)	0.13
Cow and Ox	1.00	Sheep and Goat (young)	0.06
Horse	1.1	Chicken	0.013
Donkey (adult)	0.70		

Source: Storck et al. (1991).

Table A5. Conversion factors used to compute man equivalent (Labor force).

Age group (years)	Male	Female
Less than 10	0	0
10-13	0.2	0.2
14-16	0.5	0.4
17-50	1	0.8
Greater than 50	0.7	0.5

Source: Stork et al. (1991).

Table A6. Variance Inflation Factors for the continuous explanatory variables.

Variable	Collinearity statistics	
	Tolerance (R^2i)	Variance inflation factor (VIF)
Family labor	0.662	1.510
Farming experience	0.698	1.432
Number of livestock	0.836	1.196
Total Farm income	0.696	1.438
Distance from water source	0.836	1.196

Source: Own survey, 2017.

Table A7. Contingency coefficients for discrete explanatory variables.

Variables	SEXHH	EDUCLVL	PARTNSO	ACESSEXTN	ACESSCR	TRAINGPAR	MARKETAC
SEXHH	1	0.171	0.056	0.115	0.222	0.047	0.103
EDUCLVL		1	0.200	0.213	0.185	0.240	0.054
PARTNSO			1	0.577	0.397	0.387	0.219
ACESSEXTN				1	0.442	0.350	0.204
ACESSCR					1	0.155	0.325
TRAINGPAR						1	0.137
MARKETAC							1

Source: Own survey, 2017.

Figure A1. Local sheep vs DBHS crossbred sheep in terms of Lean to fatty ratio content.

Figure 2A. Local Sheep vs DBHS crossbred sheep in terms of color and Leanness of meat.