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Determinants of the Adoption of Boer Crossbred Goat in Pastoral and Agro pastoral Areas of Yabello District, Ethiopia

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Abstract
The study was conducted with the objective of investigating the Determinants of the adoption of improved Boer crossbred goats in Pastoral and Agro pastoral Areas of Yabello District, Ethiopia. A multi-stage sampling procedure was employed to select two rural kebeles and respondents. A total of 120 pastoralists were interviewed to generate primary data. Data were collected from both primary and secondary sources using interview schedule and personal observations. Interview schedule was developed, pretested & used for the collection of the essential quantitative and qualitative data for the study. Moreover, secondary data were collected from relevant sources. The binary logistic regression model was also employed to assess the determinants of adoption of newly introduced Boer crossbred goat in the study area. 10 explanatory variables were used for the binary logit model, out of which 7 variables were found to be significant to influence the adoption of newly introduced Boer crossbred goats in the study area. These variables were: Age, number of livestock owned in TLU, family labour, access to credit, training participation and distance from water sources. Therefore, all concerned bodies: government, non-government and development actors working at different levels in livestock in general and Goat breeding programme in particular should give attention to those variables which positively or negatively and significantly affecting pastoralists' decision to adopt the newly introduced Boer crossbred goats in the study area to enhance the rate of adoption in the study area.
Keywords: Adoption, Boer crossbred goats, Binary logit model

1. Introduction

Ethiopia owns the largest goat population in Africa numbering about 29.11 million goats and the third largest producer of goats in Africa next to Sudan and Nigeria (CSA, 2015). The contribution of the livestock accounts for agricultural GDP in Ethiopia was 45% where goats are the second most important provider herd species next to cattle (IGAD, 2010).

In Ethiopia goats have a diverse function especially for small holder and pastoralists in different part of the country. It was stated that goats provide to farmers and pastoralists with a broad range of products and socio-economic services and have played an important role in the social life of many African people, being used as gifts, dowry, in religious rituals and rites of passage (Peacock, 1995). This author has also indicated that goat can play vital role in ensuring the food security of a household, often being the only asset possessed by poor family (Peacock, 2005). In general, goats are important to socio-economic well-being of people in developing countries in the tropics in terms of nutrition, income and intangible benefits such as saving, insurance against emergencies, cultural and ceremonial purpose (Kosgey, 2004). Similarly, goat contributes significantly to the subsistence, economic and social livelihoods of a large portion of the population in low-input and smallholder production systems particularly goat used as a quick source of cash by billions of keepers in Ethiopia (Ayalew, 2000; Tibbo, 2006)

Efforts was made by the government of Ethiopia to introduce the exotic improved Boer crossbred goats to improve the local breeds and disseminated to different parts of the country both the highland and low land area. Yabello Woreda was one of the sites in which Boer crossbred goats have been disseminated.

Despite these efforts, pastoralists in the study area are keeping local breeds. The study conducted so far was only concentrated on breeding, evaluation and dissemination of the Boer crossbred goats in the study area. Therefore, this study was designed to identify the determinants of the adoption of Boer crossbred goats by the pastoralists to fill the information gap.

2. Review of Literature

2.1. Concepts and definitions of technology adoption

Technologies play an important role in economic development. Adoption and diffusion of technology are two interrelated concepts describing the decision to use or not use and the spread of a given technology among economic units over a period of time. Adoption of any innovation is not a one step process as it takes time for adoption to complete. First time adopters may continue or cease to use the new technology. The duration of adoption of a technology vary among economic units, regions and attributes of the technology itself. Therefore, adequate understanding of the process of technology adoption and its diffusion is necessary for designing effective agricultural research and extension programmes.

Adoption and diffusion are dissimilar but interrelated concepts. Adoption commonly refers to the decision

to use a new technology or practice by economic units on a regular basis. Diffusion often refers to spatial and temporal spread of the new technology among different economic units. Many researchers belonging to different disciplines have defined the two concepts in relation to their own fields. Among others, the definition given by Rogers (1983) is widely used in several adoption and diffusion studies. Rogers (1983) identified a distinction concept between adoption and diffusion. He defined diffusion (aggregate adoption) as the process by which a technology is communicated through certain channels over time among the members of a social system1. This definition identify the following four elements: (1) the technology that represents the new idea, practice, or object being diffused, (2) communication channels which signify the way information about the new technology flows from change agents (extension, technology suppliers) to final users or adopters (e.g., farmers), (3) the time period over which a social system adopts a technology, and (4) the social system. Rogers (1983) then defined adoption as use or non- use of a new technology by a farmer at a given period of time. This definition can be extended to all economic units in the social system.

2.2. Empirical studies on factors affecting adoption of Boer crossbred goats

A number of empirical studies have been undertaken by different people and institutions on the adoption and diffusion of agricultural innovations both outside and inside in Ethiopia. Adoption of agricultural technologies is influenced by a number of interrelated components within the decision environment in which pastoralists operate. For the ease of grouping, the factors identified as having positive or negative relationships with adoption are categorized as household's demographic, economic, psychological and institutional factors.

Demographic factors

Household's demographic factors (sex, age, education and farming experience) are among the most common household characteristics which are mostly associated with pastoralists' adoption behavior.

Sex of the household's head is one of the important factors influencing adoption of newly introduced agricultural technologies. Gender disparity is important in livestock production and must, together with other factors be taken into account. The study by Mupawaenda *et al.* (2009) noted that for mainly traditional and historical reasons, men continue to dominate livestock production and especially the more valuable species. The dominance of men over women shows up in terms of stock ownership, decision-making and control of livestock production systems.

Age is also supposed to be a determining factor of adoption of new technology. Older farmers are expected to have gained knowledge and experience over time and are better able to evaluate technology information than younger farmers. (Kariyasa and Dewi 2011; Mignouna *et al,* 2011). Opposing to this, age was found to have a negative relationship with adoption of technology as the younger farmers are typically less risk-averse and are more willing to try new technologies. For example, Alexander and Van Mellor (2005) found that adoption of genetically improved maize increased with age for younger farmers as they gain experience and increase their stock of human capital but declines with age for those farmers closer to retirement.

Education is one of the key determining factors in adoption studies. Education of the pastoralist has been expected to have a positive or negative influence on decision to adopt new technology. For example a study by Okunlola et al. (2011) on adoption of new technologies by fish farmers and Ajewole (2010) on the adoption of organic fertilizers found that the level of education had a positive and significant influence on the adoption of the technology.

Economic factors

In the rural perspective, livestock holding is an important sign of household's wealth position. Livestock ownership of a household influences the newly introduced improved agricultural technologies differently by different people across different areas. In most cases, livestock holding has a positive influence on household's adoption of agricultural technologies. This is an evident from many of the past adoption studies which have reported positive influence of livestock on adoption. To mention some of them, for example, Dereje (2008) have found that livestock holding has positive and significant influence on adoption of small ruminants among small holder farmers. Contrary to the above findings, Zelelem (2007) reported that livestock holding influenced negatively the adoption and intensity of adoption small ruminant fattening package.

Availability of household labor is another main variable which in most cases has an influence on the household's decision to adopt new technologies. Several studies testified the positive effect on household labor availability for adoption of newly introduced agricultural technologies. For instance, the findings of Legesse *et al.,* (2012) and Mignouna *et al.,* (2011) reported labor availability to have positively and significantly influence adoption of agricultural technologies. Contrary to these results, Abera (2003) reported a negative effect of family labor on the adoption of new technology.

Institutional Factors

Access to credit has been reported to stimulate technology adoption (Mohamed & Temu, 2008). It is believed that access to credit encourages the adoption of risky technologies through relaxation of the liquidity constraint as well as through the boosting of household's-risk bearing ability (Simtowe & Zeller, 2006).

Training is another factor that determines adoption of technology. It enables farmers to learn the existence as well as the effective use of technology and this facilitates its adoption. Pastoralists and agro pastoralists will only adopt the technology they are aware of or have heard about it. Access to information reduces the uncertainty about a technology's performance hence may change individual's assessment from purely subjective to objective over time (Bonabana- Wabbi 2002).

3. Methodology

3.1. Description of the study area

Yabello is one of 13 districts of Borana Zone, Oromia region and lies 570 km South of Addis Ababa. Yabello is the capital town of the Borana zone. The woreda has a total of 23 Peasant Association (PA's) and it has three (3) urban dweller associations (El-way, Haro bake and Surupha). The district is located at the center of the zone and it situated between 3^0,8,46''-10^0,09,04''North latitudinal and 3^0,18,03''-43^0,04,24''East longitudinal. The agro climatic area of the district is tropical 500m-1500m (440km^2) and sub-tropical 1500m-2500m (110KM^2). The altitude of the area ranges from 1000 to 1700 meter above sea level. The mean annual temperature ranges from 19^0c to 24^{o}c and a prominent feature of the ecosystem is the erratic and variable nature of rainfall, with most areas receiving 238 mm and 989 mm annually, with a high coefficient of variability from 18 % to 69 %.
The total population of the Woreda is 102,165 out of which 51,418 were men and 50,747 were women; 17,497 or 17.13% of its population were urban dwellers. The four largest ethnic groups exist in Yabello districts is the Oromo (Borena, Guji, Gabra, the Burji), the Amhara, the Konso and other nation and nationalities (CSA, 2015).

Livestock production is the major component of the farming system in the study area and contributes to the subsistence requirement of the population among other, in terms of milk, milk products and meat, particularly from small ruminants. According to the Woreda Pastoral Development Office (2015), the Woreda's total livestock population is estimated to be 637,314 out of which cattle 265897, Goats 222,779, sheep 97,011, Horses 106, Mules 833, Donkeys 6646 and Camels 44042. Among this, cattle population accounts for 41.7 %, goats 35%, followed by sheep 15.2 % and the remaining was 8.1 %.

3.2. Sampling techniques

The data for this research study was collected from rural households in two kebeles. For this study a multi-stage sampling procedure was used. In the first stage, out of 13 Woreda's of Borana zone, Yabello Woreda was purposively selected based on goat production and the researcher's personal knowledge of the area. In the second stage, out of a total of 23 rural kebeles five kebeles in which Boer crossbred goat have been disseminated was selected purposively. In the third stage, the households in the areas were categorized in to two strata adopter and non-adopter group. Then, 120 sample households, 60 from each category were selected randomly using proportional to the size of the population of each kebeles from which the sample respondents were drawn.

3.3. Data source and method of data collection

A structured survey questionnaire was designed and pre-tested before the collection of the actual primary data. To support the data collected by the enumerators from the pastoralists, focus group discussion and personal observation was made with the pastoralists selected from two kebeles. Four enumerators who had experience in data collection techniques were recruited, training was given to enumerators on the content of questionnaire and of interview techniques before the actual survey begins.

3.4. Methods of Data analysis

Data were analyzed using both descriptive statistics and Binary regression model.

3.4.1. Descriptive analysis techniques

Descriptive statistics such as percentages, means, and standard deviation were employed to analyze data. The independent t-test was used to compare the mean difference between adopters and non-adopters. The chi-square was also employed to analyze categorical data, correlation and cross tabulation was applied to identify the interdependence among various factors influencing the adoption of newly introduced Boer crossbred goat. Besides these, Chi-square was also employed to see the systematic association between the decision on the adoption of newly introduced Boer crossbred goat and with other independent variables for categorical data.

3.4.2. Binary Logistic Regression

The Logit regression Model analysis is a uni/multivariate technique which allows for estimating the probability that an event occurs or not, by predicting a binary dependent outcome from a set of independent variables. Therefore, the binary logistic regression model was employed to assess the determinants of the adoption of Boer crossbred goat in the study areas. According to (Gujarati, 2003), the logistic distribution function for the decision to adopt Dorper sheep is given by:

According to (Gujarati, 2003), the logistic distribution function for the decision to adopt Dorper sheep is given by:

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

Where

Pi -is a probability of adopting Boer crossbred goat for i[th] Pastoralist and Z (i) is a function of **m** explanatory variables (Xi) and is expressed as:

$$Z(i) = Bo + B1X1 + B2X2 + -- + Bmxm \qquad (2)$$

But **$(1 - Pi)$,** the probability of not adopting Dorper sheep, is

$$1 - Pi = \frac{1}{1 + exp[\,(Zi)]} \qquad (3)$$

Therefore, one can write

$$\left(\frac{Pi}{1-Pi}\right) = \frac{1 + exp[\,(Zi)]}{1 + exp[\,-(Zi)]} = e^{Z(i)} \qquad (4)$$

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

$$= e^{Bo}\ + \sum_{n=1}^{m} BiYi \qquad (5)$$

Taking the natural logarithms of the odds ratio of equation (5) will result in what is called the logic model as indicted below

$$\mathrm{Li} = \ln\left(\frac{Pi}{1-Pi}\right) = \mathrm{lm}\left[e^{Bo}\ + \sum_{n=1}^{m} BiXi\right] = \mathrm{Zi} \qquad \mathrm{n} = 1,2,3 \ldots \mathrm{m} \qquad (6)$$

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

$$Zi = Bo + B1X1 + B2X2 + -- + Bmxm\ ---\varepsilon i \qquad (7)$$

3.5. Definition of the variables

The definition, measurement and expected signs of the variables used in the study were summarized in the following table.

Table 1: Definition of Variables used in the econometric Model and their expected signs

Variable name	Definition	Expected sign
Dependent Variable		
ADOPCAT	a value 1 if the HH adopted at least one Boer crossbred goat and 0; otherwise	
Independent Variables		
SEX	Sex of the household head; 1 for male and 0 for female	-
EDUCLVL	1 for literate pastoralist and 0 for illiterate	+
FARMEXP	Goat rearing experience in years	+
AGE	Age of the respondent measured in years	-
TLU	Number of livestock in Tropical Livestock Unit	+
LABORAV	Labor availability	+
ACCESCR	1 if the respondent receive credit and 0 otherwise	+
FREQRLSG	Frequence of listening to radio by the pastoralists	+
TRNGPART	1 if the pastoralists participated in training and 0 otherwise	+
DISFWRSC	Distance of the pastoralists home from water sources	-

4. Result and Discussions

4.1. Descriptive statistics

4.1.1. Characteristics of Sample Household Heads by Age, family labour and farming experience

The age sample respondent for both adopters and non-adopters ranges from 18 to 77 years with the mean age of 38.3 and 51 for adopters and non-adopters respectively. The mean age of adopter is less than non-adopters implying that younger are more likely to adopt Boer crossbred goat than aged households. The result of chi-square revealed that there is statistically significance difference between adopters and non-adopter in terms of

their age. With regard to family labor, the mean family size in man equivalent of adopters and non-adopters was 2.9 and 3.8 respectively. The independent t-test revealed there is statistically significance difference at less than 1% probability level implying that households with smaller family labor are more likely to adopt Boer crossbred goat than households with large family labor. The findings of this study shows that, in the study area goat rearing experience ranges between 4-60 years and adopters had short rearing experience than non-adopters. The independent t-test shows that, there is negatively and statistically difference at 1% probability level between adopters and non-adopters with respect to goat rearing experience.

Table 2: Summary of Descriptive Statistical results for Continuous variables

Variables	Adopters	Non-adopters	Total	t-value
	Mean	Mean	Mean	
Characteristics of HH				
Age	38.3	51	42.6	5.69***
Family Labor	2.9	3.8	3.2	4.05***
Farming experience	18.9	25.3	21.1	3.05***

Source: Own survey, 2017. *** And ** indicates significant at 1% and 5% probability level.

4.1.2 Summary of Descriptive Statistical results for Categorical variables

The respondents were composed of both male and female headed households. The result of the survey indicates that from a total of sample respondents 66.7% were adopters and 33.3% were non-adopters. Out of the total sample adopters the majority of them (86.25%) were male headed households. However, the result of chi-square test indicates that there is no statistically significance difference between adopters and non-adopters with regard to sex. In the study area, the majority (58%) of adopters were found to be literate household head. The chi-square result shows that there was statistically significance difference at less than 1% probability level between adopters and non-adopters with regard to at less than 5% probability level implying that educated pastoralists were more likely to adopt the newly introduced Boer crossbred goat than uneducated pastoralists.

The result of the survey revealed that the majority (75%) of adopter household heads had more participated on training related to Boer crossbred goat compared to non-adopters. There was statistically significance difference at less than 1% probability level between adopters and non-adopters with regard to participation in training. Out of the total sample respondents about 75.8% had access to and use credit. The majority (92.5%) of adopters was credit users and the utilizations differ between adopters and non-adopters pastoralists. The result of chi-square confirmed that, there is statistically significance difference between two groups at 1% probability level with regard to access and credit utilization.

Table 3: Summary of Descriptive Statistical results for Categorical variables

Variables	Category	Adopters		Non-adopters		Total		X2
		N	%	N	%	N	%	
Characteristics of HH								
Sex	Male	69	86.25	31	77.5	100	83.3	1.47
	Female	11	13.75	9	22.5	20	16.7	
Educational level	Illiterate	22	27.5	19	47.5	41	34.2	4.74**
	Literate	58	72.5	21	52.5	79	65.8	
Institutional factor								
Training participation	Yes	60	75	17	42.5	77	64.2	12.25***
	No	20	25	23	57.5	43	35.8	
Access to credit and utilization	Yes	74	92.5	17	42.5	91	75.8	
	No	6	7.5	23	57.5	29	24.2	36.38***

Source: Own survey, 2017. *** And ** indicates significant at 1% and 5% probability level.

4.2. Result of the Binary logit model

The model result (Table 4) indicated that coefficient of the seven variables were found significantly to determine the adoption of the newly introduced Boer crossbred goat in the study area. The results of the model have been presented in the following section.

Age of the Household Head: The result of the model indicated that age was found to be negatively and significantly related to the adoption of newly introduced Boer crossbred goat in the study area at less than 5% significance level. The negative coefficient of the age implies that younger pastoralists are more likely to adopt Boer crossbred goat than the older pastoralist. The result of this study agrees with the earlier findings of Anley et al. (2007) and Tesfaye (2017).

Farming experience: The result of logestic regression revealed that goat rearing experience is negatively and significantly influence the adoption of Boer crossbred goat at less than 10% significance level implying that the

younger are more likely to adopt new technology than older pastoralists. The result of this study contradicts with the findings of Fakoya and Oloruntoba (2009). The reason for this could be explained by the fact the younger are more risk averse and try newly introduced technologies as they have better education background than older.

Number of livestock owned: The result shows that the number of livestock owned in TLUs is positively related to the adoption of Boer crossbred goat implying that pastoralists with large number of TLU are more likely to adopt Boer crossbred goat than with small number of TLU. The odd ratio of this variable indicates that other things kept constant, an increase in one TLUs results in an increase of the probability of adoption of Boer crossbred goat by a factor of 1.1 or by 11%. This study confirms the prior finding of Ahmed (2015) who found similar result.

Labor availability: The result of the model revealed that family labor is negatively and significantly related to adoption of new technology implying the pastoralists with smaller family labor are more likely to adopt the newly introduced Boer crossbred goat than pastoralists with large family labor. The possible explanation for this could be explained by the fact that pastoralists with large family labor tends to send their children to school and they may allocate their money for school fee and buying food to feed their family members and have no enough money to buy the newly introduced Boer crossbred goat. The odd ratio of this variable indicates that other things kept constant, the probability of adoption of the Boer crossbred goat decreases by a factor of 0.418 or 41.8%. The result of this study agrees with the finding of Gershon *et al*., (2015).

Access to credit: The result of the model shows that access to credit is positively and significantly related to adoption of new technologies. The positive coefficient of the variable indicates that pastoralists who had access to credit were more likely to adopt Boer crossbred goat than pastoralists who did not receive credit. The odd ratio of access to credit 15.7 indicates that other things held constant, the probability of adopting newly introduced Boer crossbred goat increased by a factor of 15.7 for a unit credit received. This findings is agrees with the findings of findings of Quddus (2013) who stated credit receiver are more likely to adopt improved dairy technology than non-receiver.

Training participation: The output of the model have shown that training received by the pastoralists was positively and significant at 5% probability level and related to the adoption of newly introduced technologies. This implies that pastoralists who have participated in training are more likely to adopt Boer crossbred goat than who did not participate in training.

Distance of the pastoralist home from water sources: the result of the model shows that the variable is negatively and significantly related with adoption of new technology 1% probability level implying that pastoralist whose residence far from watering point are less likely to adopt the newly introduced Boer crossbred goat than those pastoralists nearer to water sources. The result of this study confirms the finding of Ahmed (2015).

Table 4: The maximum Likelihood Estimates of the Binomial Logit Model for determinants of the adoption of Boer crossbred goat

Variables	Coefficient (B)	S.E.	Sig.	Odd ratio(B)
SEX	0.266	1.039	0.798	1.305
EDUCLVL	0.987	0.616	0.109	2.684
FARMEXP	0.116	0.062	0.06*	1.123
AGE	-0.155	0.064	0.015**	0.857
TLU	0.095	0.036	0.007***	1.1
LABOR	-0.872	0.344	0.011***	0.418
ACCESCR	2.754	1.003	0.006***	15.71
FREQRLSG	0.152	0.252	0.548	1.164
TRNG	1.615	0.834	0.053**	5.028
DISFWRSC	-0.388	0.134	0.004***	0.678
Constant	2.887	2.143	0.178	17.945

Source: Own data, 2017
***, ** and * indicates significant at 0.01, 0.05 and 0.1 significance level
Model Chi-square = 97.767
-2 Log likelihood function = 52.525
Nagelkerke (R^2) = 0.78
Number of observation =120
The model has correctly predicted = 92.3%

5. Conclusion

This study examines results of descriptive and an empirical application of maximum likelihood estimates of Binary logistic regression model to identify determinants of adoption of the newly introduced Boer crossbred goat in the pastoral area of Yabello Woreda**.** The result of descriptive statistics indicted that age, family labor,

farming experience, educational level of household head, training participation and access to and use of credit influences the adoption of Boer crossbred goat in the study area. Furthermore, the result of the binary logistic model indicated that, the coefficients of seven (7) explanatory variables were found to be significant. These variables include: Age, family labor in man equivalent, the number of livestock owned by the household (TLU), Access to credit, training participation, and the distance of watering points from the pastoralists' residence or home. Therefore, all the concerned bodies' government, non-government organization, and other development actors who are working on goat improvement breeding programme should give attention to those significant variables influencing adoption of Boer crossbred goats to speed up the rate adoption in the study area

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Appendix Table 1: 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		

Appendix Table 2: Conversion Factors used to compute Man equivalent (Labour 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