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EFFECT OF MARKET PARTICIPATION ON HOUSEHOLD WELFARE AMONG SMALLHOLDER GOAT FARMERS IN BOTSWANA

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Abstract. Goat farming is a major livelihood activity for most smallholder farmers in Botswana. To ensure sustainable livelihoods for these farmers, a shift from the prevalent traditional and subsistence system to a more market-oriented one is considered necessary. Market participation is widely viewed as an effective means of addressing poverty which is particularly rampant in most rural areas of Botswana and other developing countries. Little evidence is however available on the link between market participation and household welfare, especially among livestock and, in particular, small stock farmers. This paper evaluates the effect of market participation on household welfare among smallholder goat farmers. Estimating an endogenous switching regression model, the results show a positive and significant effect of market participation on household income for both participant and non-participant farmers. This effect was found to be more pronounced among the non-participants had they decided to sell. The results suggest that goat farmers should be encouraged to engage in market participation other than their traditional ways of keeping goats. This implies that existing policies and programs that increase market participation and encourage market-oriented farming should be revised in order to provide efficient and sustainable support. Furthermore, the study recommends that information on goat markets should reach rural areas where most farmers reside and are unable to access technology.

Keywords: market participation, endogenous switching regression, household welfare, smallholder farmers

INTRODUCTION

Agriculture plays a major role in most African economies. In Botswana, about 70% of rural households are directly or indirectly engaged in agriculture and derive their livelihood from it (FAO, 2018). The economy is dominated by smallholder farmers who are engaged in both livestock and crop production. According to the International Trade Administration more than 80% of income in the agricultural sector is derived from livestock, while crop production contributes slightly less than 20%. The potential for crop production is limited mostly due to the impact of Kalahari Desert and persistent droughts since this type of production is mainly based on rain-fed farming (Masole, 2018). The climatic and socio-economic environment in Botswana makes communities vulnerable to food insecurity and livelihood instability, especially in rural areas (Ntseane, 2007).

In comparison to other types of livestock production, goat keeping is the main livelihood activity for the majority of rural farmers (Statistics Botswana, 2019). According to Kumar et al. (2010), goat rearing has distinctive management advantages over other livestock because it requires less initial investment, lower inputs, less labour, and is characterised by early sexual maturity of animals. Kumar et al. (2010) further stated that goats play an important role in the food and nutritional

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security of the rural poor. Moreover, goats can efficiently survive on available shrubs and trees in an unfavourable environment (Byaruhanga et al., 2015). As stated by Kumar (2007), goats are not only an important source of income but they also contribute to increasing employment which is the main concern to many countries including Botswana.

The country has been facing some developmental challenges with a high unemployment rate as one of the socio-economic predicaments which have been proven difficult to deal with (Matandare, 2018). Unemployment is a serious issue in Botswana; it has been estimated at 18.19% and causes abject poverty (Statistics Botswana, 2016). However, despite the challenges that face the country, the benefits of goat farming and its significance to farmers' wellbeing have been evident (Soodan et al., 2020; Kumar et al., 2010). The studies have shown that goat farming has the potential for increasing farmers' income. Moreover, Rabbi et al. (2017) indicated that market participation, which is the main focus of this paper, has the potential to reduce rural poverty and improve welfare at the household level.

The concepts of market participation and commercialization have been used synonymously by different studies (Zhou et al., 2013; Osmani and Hossain, 2015; Wasseja et al., 2016; Rabbi et al., 2017; Megerssa et al., 2020). This is because there is little distinction between them. According to Mumba (2019), agricultural commercialization refers to a transition from traditional farming to a more market-oriented system. On the other hand, market participation is also viewed as an integration of subsistence farmers into input and output markets with the aim of boosting income levels (Otekunrin et al., 2019). However, Osmani and Hossain (2015) emphasized that commercialization usually takes a long transformation process; from subsistence to semi-commercial, and then to fully commercialized agriculture, with the main aim of achieving food self-sufficiency whereas market participation only involves the sale of output in the market outlet (Gebremedhin and Jaleta, 2010). Transformation of subsistence agriculture to market-oriented production is widely considered as the most effective means of addressing abject poverty in the developing world and can cause changes in household income, welfare and also contribute to economic growth (Zhou et al., 2013; Wasseja et al., 2016). This has been a policy objective of many developing countries.

While there is substantial evidence of the effect of market participation on household welfare, the focus is more on crops than livestock (Olwande and Smale, 2014; Rabbi et al., 2017; Opondo and Owuor, 2018). Thus, there is limited evidence of market participation of goat farmers and its effects on household welfare, particularly in Botswana. This paper, therefore, intends to fill this knowledge gap in the literature by assessing the effect of market participation on household welfare. The study is relevant considering its potential to contribute to achieving one of the pillars of sustainable economic development under Botswana's Vision 2036. This is also in line with Sustainable Development Goals (SDGs) to end hunger, achieve food security and improved nutrition and promote sustainable agriculture. The findings of this study would also constitute an important source of information for the development of policies and programs that promote market-oriented goat production in Botswana.

METHODOLOGY

Study area

The study was conducted in the Kweneng East sub-district, which is found in the Kweneng district of Botswana. The sub-district has a goat population of 229,647 (Statistics Botswana, 2017). The place is dominated by *Acacia* and *combretum* tree savannah, with average rainfall between 450 and 500 mm annually, most of which occurs during summer seasons. Most of the farmers in the region are smallholder farmers who keep goats extensively. The goats are mostly the indigenous Tswana breeds characterized by resistance to pests and diseases, as well as drought and heat tolerance (Nsoso et al., 2004).

Sampling technique and data

A multi-stage sampling technique was used to select respondents. Firstly, the Kweneng district was purposively selected due to its highest number of goat farmers. In the second stage, among the two sub-districts in Kweneng, the Kweneng East sub-district was purposively selected because it has a higher number of goats. Thirdly, out of the 31 villages in the sub-district, seven villages were randomly selected. Lastly, in each village, a list of farmers was generated and a systematic random sampling method was used to select the number of respondents proportionate to the population of each village.

The data used for this study is cross-sectional (primary) data collected in August 2019. A semi-structured questionnaire was administered through interviews and gathered information on the farm, socio-economic and institutional characteristics, household income, expenditures and goat farming returns for the 12 months preceding the time of data collection. A sample of 266 was obtained using Yamane (1967) (Equation 1):

$$n = \frac{N}{1 + N(e)^2} \quad (1)$$

where: n – sample size, N – population size and e – is the acceptable error.

To calculate the distribution of the sample size across villages, the number of farmers per village was multiplied by the total sample size and then divided by the total number of farmers in all the seven villages (Table 1):

$$\text{(per village)} = \frac{\text{No. of farmers (per village)} \times 266}{\text{Total number of farmers}} \quad (2)$$

Table 1. Distribution of sample size across villages

Village	Number of farmers	Sample size
Molepolole	480	96
Gakuto	151	30
Mmopane	281	56
Lentsweletau	177	36
Kopong	74	15
Mmanoko	103	21
Gamodubu	58	12
Total	1 024	266

Source: own elaboration.

Analytical framework

While different indicators to measure welfare exist, household income was used as a proxy for the living standards among households, which helps to perform a welfare analysis (OECD, 2011). According to Meyer and Sullivan (2003), income is easier to report and is available for larger samples, which provides a greater power to test hypotheses. In order to calculate the total household income, data was collected on various sources of income such as livestock, crops, horticultural produce, remittances, government pension, savings, off-farm employment and other non-agricultural wages. Data on income from goat sales was also collected from market participants since non-participants had no sales in that period. The significance of income from goat sales was to investigate if there is any effect of market participation on total household income for those who sold and those who did not.

To analyze the effect of market participation on household welfare, an Endogenous Switching Regression (ESR) model was used. ESR model was used because market participation was assumed to be endogenous in the model. Therefore, certain unobserved individualities may influence the decision on whether to participate or not. The model, therefore, accounts for the association between the unobserved attributes in market participation and household welfare (Asfaw et al., 2012; Lapple et al., 2013). The Full Information Maximum Likelihood (FIML) was used to estimate the parameters of interest. According to Lokshin and Sajaija (2004), FIML is considered as an efficient method that simultaneously estimates the outcome and the selection equations.

Model specification

The ESR model draws on that proposed by Anang et al. (2019). Assuming that the choice of market participation is binary, such that farmers choose either to sell or not to sell, the decision-making on market participation and effect of market participation on household income can be modeled in an optimum framework. Market participation can be expressed with respect to a vector of explanatory variables in a latent variable framework as:

$$Z^*_i = W_i\gamma + u_i \quad \text{with} \quad Z_1 = \left\{ \begin{array}{l} 1, \text{ if } Z^*_{i\,i} > 0 \\ 0, \text{ Otherwise} \end{array} \right\} \quad (3)$$

where: Z^*_i – is the latent market participation variable measuring the decision to sell or not; Z_i represents the binary variable with 1 for farmers who participated in the market and 0 for non-participants; W_i – includes all explanatory variables that influence market participation; γ – is a vector of parameters to be estimated and u_i – is the error term.

Suppose Y_i represents the dependent variable of household income, and Z_i is the endogenous dichotomous market participation variable, then the outcome variables can be expressed as:

$$Y_i = X_i\beta + Z_i\delta + \varepsilon_i \quad (4)$$

where: variable Y_i – represents a vector of outcome variables; X_i – is a vector of explanatory variables influencing household income; Z_i – as previously described, represents market participation status; β and δ – are vector parameters to be estimated while ε_i – is a random error term.

In the ESR model, a two-stage estimation procedure is conducted simultaneously. The first stage involves estimating the selection model (Equation 3) to determine the factors influencing market participation. In the second stage, the effect of market participation on the outcome variable (Equation 4) is specified for two regimes of participants (Equation 5) and non-participants (Equation 6) as:

$$\text{Regime 1: } Y_1 = \beta_1 X_1 + \varepsilon_1 \text{ if } Z = 1 \quad (5)$$

$$\text{Regime 2: } Y_0 = \beta_0 X_0 + \varepsilon_0 \text{ if } Z = 0 \quad (6)$$

where: Y_1 and Y_0 – are outcome variables for participants and non-participants, respectively; X – is a vector of explanatory variables; β – is a vector of parameters to be estimated and ε – is the error term. According to Abdulai (2016), the structure of the ESR model allows for an overlap of W in Equation (3) and X in Equations (5) and (6). Therefore, for identification purposes, at least one variable in W should not appear in X, hence the selection equation is estimated using the same variables as in the outcome equation in addition to some instruments. Valid instruments are expected to influence market participation and not household income. In this study, three instruments (payment mode, distance to market and benefitting from government support programs) were used as instruments that influence market participation but do not directly influence household income. The estimated coefficients of the instruments were performed prior to running the model and the instruments were considered to be valid and relevant in identifying the selection model.

Conditional expectation and treatments

In addition to estimating the factors that influence market participation, the ESR model can also be used to determine the effect of market participation on household welfare. This effect was examined by comparing the expected household income of farmers who participated in the market with the expected outcomes of the counterfactual hypothesis that the participants did not participate. Likewise, the study went further to compare the expected household income of non-participants with the expected outcomes of the counterfactual hypothetical cases that non-participants had participated. The expected actual values of the outcome Y on participation and non-participation can be expressed as in Equations (7) and (8), respectively:

$$\text{Participants: } E(Y_1/C = 1) = \beta_1 X_1 + \sigma_{u1}\lambda_1 \quad (7)$$

$$\text{Non-participants: } E(Y_0/C = 0) = \beta_0 X_0 + \sigma_{u0}\lambda_0 \quad (8)$$

where: λ_1 and λ_0 – are the selectivity terms for participants and non-participants, respectively. According to Abdulai, (2016), the variable X in Equations (5) and (6) accounts only for observable factors. However, the ESR model is able to address the selection bias due to unobservable factors within the framework of the omitted variable problem. Vella (1998) has indicated that the selectivity terms from the selection equation (Equation 3) which is represented by λ_1 for participants and λ_0 for non-participants (Equations 7 and 8) corrects for selection bias from the unobservable factors; σ_{u1} and σ_{u0} are the covariance terms for participants and non-participants, respectively.

The expected counterfactual scenarios for participants and non-participants are expressed as in Equations (9) and (10), respectively:

For participants, if they did not participate:

$$E(Y_0/C = 1) = \beta_0 X_1 + \sigma_{u0}\lambda_1 \quad (9)$$

For non-participants farmers, if they participated:

$$E(Y_1/C = 0) = \beta_1 X_0 + \sigma_{u1}\lambda_0 \quad (10)$$

Further, the study estimated the effect of the treatment (market participation) on the treated (ATT) as the difference between equations (7) and (9). Following Muricho (2017), the ATT can be specified as:

$$\text{ATT} = E(Y_1/C = 1) - E(Y_0/C = 1) = X_1(\beta_1 - \beta_0) + \lambda_1(\sigma_{\varepsilon 1u} - \sigma_{\varepsilon 0u}) \quad (11)$$

Similarly, the effect of the treatment (market participation) on the untreated (ATU), for non-participants was calculated as the difference between (8) and (10):

$$\text{ATU} = E(Y_1/C = 0) - E(Y_0/C = 0) = X_0(\beta_1 - \beta_0) + \lambda_0(\sigma_{\varepsilon 1u} - \sigma_{\varepsilon 0u}) \quad (12)$$

RESULTS AND DISCUSSION

Descriptive analysis

Sources of household income aggregates

Total household income was calculated from various sources of income such as livestock, crops, horticultural produce, remittances, government pension, savings, off-farm employment and other non-agricultural wages. Data on income from goat sales, as a significant variable in this study, was also obtained in order to explain its significance for the overall household income relative to other sources of income. The sources of income were aggregated into off-farm and on-farm income. Off-farm income included income from remittances, government pension, savings and job salaries. On-farm income consisted of income from cattle, pigs, chicken, sheep, crops and horticultural sales (Table 2).

Results in Table 2 present the contribution of different sources of income to total household income. Results show that the income from on-farm activities accounted for 46.52% of total household income. This is more than the contribution of off-farm activities which constitute about 38.17%. The low level of off-farm participation by farmers was largely due to a lack of employment opportunities in rural areas. Also, some farmers were full-time farmers without off-farm employment. By itself, goat sales contributed about 16% to total household income and 25.63% to on-farm income, which is relatively significant. The return on goat production agrees with the findings of Metawi (2015) who reported that goat production was more profitable than sheep production. Metawi (2015) reported that within livestock, small ruminants (sheep and goats) contributed about 34.7% to household income. The contribution of the current study is slightly lower than Metawi's because it takes into account goat sales only. According to Metawi (2015), the profitability of goat production results from the fact that goats generate lower production costs.

Table 2. Contribution of different sources of income to total income

Source of income	Mean value (USD)	Contribution to total household income (%)
On-farm income	2,678.97	46.52
Off-farm income	2,198.07	38.17
Goat sales	923.21	16.03
Total household income	5,758.93	100.00
Source of income	Mean value (USD)	Goat sales contribution (%)
On-farm income	3,602.18	25.63

Source: own elaboration.

Socio-economic and farm characteristics

Table 3 shows the variables used in the ESR model. Variables were selected based on previous literature (Filmer and Pritchett, 2001; Assefa, 2008; Lhing et al., 2013; Rabbi et al., 2017; Anang, 2017; Richard, 2017) as well as from economic theory. To test for significant differences among variables between participants and non-participants, the t-test and the Chi-squared test were used for continuous and categorical variables, respectively. Results show a statistically significant difference between participants and non-participants in terms of participation in farmer groups, engagement in off-farm activities, payment mode, as well as selling of goat by-products such as fresh milk, sour milk and leathers. About 70% of the farmers were male, with a slightly higher proportion among the non-participant group. Though there is very low participation in farmer groups, the difference is significantly higher among participants compared to their non-participant counterparts. Contrary to expectations, engagement in off-farm activities was significantly higher among non-participant farmers (92%) while among participants it amounted to 72%. Participants were mainly paid using either cash, cheques or both. In terms of the type of breed, approximately 34% of participants keep improved breeds (either cross-bred or exotic) compared to 23% of non-participants.

Determinants of household income

The estimated results of the ESR model are presented in Table 4. They show that farmers' age positively influenced household income for participants. This is because older farmers are likely to be more experienced and informed on marketing and other livestock husbandry practices such as controlled breeding, which could enhance production efficiency. According to Bellemare (2012), the relationship between market participation and age is positive with increased production by older farmers. Moreover, their household income could also be due to the accumulation of resources and wealth through

Table 3. Definition and descriptive statistics of variables used in the ESR Model

Variables		Participants (206)	Non-Participants (60)	Overall (266)	Significance
Continuous	Description and unit of measurement		Mean		t value
HH income	Household income (USD)	6,503.16	3,203.72	5,758.93	–0.5278
Age	Age of farmer in years	49.17	48.53	49.03	–0.2694
Education	Farmers' years of schooling	8.9	7.92	8.68	–1.363
Extension	Farmers' contacts with extension officers	1.42	0.98	1.32	–1.5608
Training	Number of training sessions a farmer attended in goat farming per year	0.42	0.27	0.38	–1.0568
Active mem.	Number of household members involved in goat farming	3.01	2.9	2.98	–0.4572
Distance	Distance travelled to the marketplace in km	40.91	30.82	38.64	–2.05
Price	Average price of goats in USD	115.53	113.142	114.98	–0.5258
Assets	Asset ownership (Index)	–0.00016	0.00057	–0.000053	0.005
Categorical			Percentage		χ^2 ratio
Gender	% of male farmers	61.17	70	63.16	1.5587
Farmers' groups	% of farmers who participate in a farmers' groups	15.53	5	13.15	4.5124**
Off-farm	% of farmers who engage in off-farm activities	72.33	91.67	76.69	9.7193***
By-products	% of farmers who sell goat by-products	11.65	3.33	9.77	3.6447*
Beneficiary	% of farmers who benefited from government programs	29.61	20	27.44	2.1558
Payment mode	% of farmers who received payment either in cash, by cheque or both	100	0	77.44	260.3121***
Breed	% of farmers who keep improved breed (Cross or Exotic)	34.47	23.33	31.95	2.6485

****, **,* are significance levels at 1%, 5% and 10%, respectively.
Source: field survey, 2019.

investments and savings over time. These results are consistent with Sebatta et al. (2014) who revealed that the positive effect of age can be attributed to the fact that experience in farming is measured by farmer's age.

Education plays a significant role in determining household income. Results indicate that an increase in the number of years of schooling by one year increased participants' income. Generally, educated farmers are expected to have higher incomes as they are exposed to more opportunities and are able to diversify their income-generation activities. On the other hand, in the case of non-participants, the more years of schooling, the lower was their income. Education level negatively affected household income for non-participant farmers probably because they are engaged in full-time goat farming and never used their qualifications to pursue other income-generation activities. Similar results were obtained by Rabbi et al. (2017) who revealed that education level negatively influenced farmers' household income.

Off-farm engagement negatively and significantly influenced household income for both participants and non-participants. More engagement in non-farm work reduced the income of participants and non-participants by 29% and 21%, respectively. The results are surprising

Table 4. ESR results on the factors influencing household income

Household income	Selection model		Participants		Non-participants	
	β	SE	β	SE	β	SE
Farmer's age	–0.0672***	0.0218	0.0130***	0.0048	0.0046	0.0086
Farmer's gender	–0.0719	0.5988	0.0843	0.1426	–0.1892	0.2426
Household members	–0.4936	0.3030	–0.0143	0.0401	–0.0547	0.0618
Years of schooling	0.1550*	0.0828	0.0466***	0.0176	–0.0423*	0.0249
Access to extension services	0.6607**	0.3221	–0.0300	0.1470	0.4831*	0.2566
Number of training sessions	–0.3513	0.5787	0.1532	0.1722	–0.4967	0.3510
SD average goat price (USD)	–1.3525**	0.0902	0.0581	0.0671	0.1936	0.1350
Off-farm participation	–0.1142	0.2842	–0.2877***	0.0618	–0.2145**	0.0833
Type of breed kept	0.5564**	1.1448	0.4273***	0.1436	0.2711	0.3015
Farmer group participation	–0.9430	0.3007	–0.1171	0.1872	0.2276	0.4637
Asset ownership	0.2128	0.5065	0.1947***	0.0686	0.0303	0.1117
Standarised by-products sold	–0.2282	0.4208	0.0831	0.0628	0.1978	0.1853
Constant	7.5481***	0.0255	9.2039**	0.4751	9.7316***	0.6462
Mode of payment	0.0786***	0.0255				
Distance to market (km)	0.0195	0.0146				
Benefitting from government programs	–0.6411	0.5199				
Number of observations	266					
Wald $chi^2(12)$	80.33					
Log-likelihood	–354.59					
Prob> chi^2	0.0000					

***, **,* are significance at the levels of 1%, 5% and 10%, respectively. SE is standard error.
Source: field survey, 2019.

as households which diversify income sources and venture to off-farm sectors are generally expected to have higher incomes (Anang, 2017). However, the explanation to the findings of this study is that farmers who venture into off-farm work do it because of distress and because they are forced to do so, which is why they engage in petty trade and business just to meet basic needs. Findings by Rakotoarisoa and Kaitibie (2019) revealed that participation in off-farm activities has a positive effect on livestock income. This positive effect can be explained by the importance of livestock as an asset for saving and investment in a livestock area (Rakotoarisoa and Kaitibie, 2019).

The effect of type of breed on household income was positive and had a significance level of 1%. Keeping improved breeds increased the income of participants by 43%. This is because improved breeds are expected to yield higher returns due to their value and productivity.

Moreover, farmers who keep improved breeds tend to perform better in their livestock husbandry practices, which results in high birth rates and, therefore, increased production. The results agree with Assefa (2008) who found that large-sized, white colored goats with thick and straight horns have better market value and are fast marketed than other colored goats.

Asset ownership was measured using an asset index. The index includes all the assets owned by a farmer which are farm implements, machinery, vehicles, all types of livestock, total area of land owned, boreholes, houses, house furniture and personal belongings such as mobile phones. The variable positively influenced participant farmers' income at a significance level of 1%. Farmers who owned more assets were likely to increase their household income. Assets such as land, livestock and other productive assets could be leased, sold and be used productively to earn more income. According to OECD (2011), households who have assets can utilize them to generate income and attain a higher standard of living. Further, assets are considered more stable over time and reflect accumulated investments and savings; they are also a good indicator for long-term household economic status and permanent income (Dzanku, 2015).

Access to extension services was significant at the 10% significance level and positively influenced household income for non-participants increasing it by 48%. Farmers who have access to extension services are more likely to acquire knowledge and information on production, input and output prices, markets as well as veterinary services, which could significantly raise the probability of market participation among households (Richard, 2017). Anang et al. (2020) also observed that participation in agricultural extension increases income among farmers, hence the need to improve access to extension services, especially for smallholder farmers.

Effects of the treatment on household income

The study has further compared the expected household income for farmers who participated (a) relative to those who did not participate (b), as well as household income in the counterfactual cases in which those who participated would have not participated (c) and those who did not participate would have participated (d) (Table 4). The results show that participants would earn 7.2% less, had they decided not to sell. Likewise, the household income for non-participants would increase by 12% had they decided to sell. These findings are consistent with other studies which found a positive effect of market participation on income (Muricho et al., 2017; Opondo and Owuor, 2018).

The base heterogeneity effects (BH_1) imply that, had they participated, non-participants would perform better than participants. On the other hand, BH_2 shows that participants would perform better than non-participants even if they did not participate (Olwande and Smale, 2014; Bidzakin et al., 2019). The results indicate that for each decision stage, the counterfactuals are higher than the actual incomes for the two groups. This is because participants tend to benefit above expectation, whether they have sold or not, though they are more advantaged selling than not selling. Similar results were also obtained by Opondo and Owuor (2018) and Muricho et al. (2017). The transitional heterogeneity effect is negative, which shows that the effect is significant for non-participants, relative to their counterparts. Overall results of the study are in line with previous literature that supports positive income effects of market participation at the household level (Tatwangire, 2011; Justus et al., 2015; Richard, 2017).

Table 5. Mean treatment effects on household income

Subsample	Decision stage		
	participants	non-participants	ATE
Participants	a) 9.90	c) 9.23	0.66*
Non-participants	b) 10.12	d) 9.03	1.08*
Heterogeneity effects	BH_1= –0.22	BH_2 = 0.20	TH = –0.42

* significance level at 1%.
Source: field survey, 2019.

CONCLUSION AND RECOMMENDATIONS

This study assessed the effect of market participation on household income among smallholder farmers in Botswana. Results of the average treatment effects model show a positive and significant effect of market participation on household income for both participants and non-participants. This shows that farmers who sell are more advantaged than those who do not sell. The results suggest that goat farmers should be encouraged to engage in market participation other than their traditional ways of keeping goats. This implies that existing policies and programs that increase market participation and encourage market-oriented farming should be revised in order to provide efficient and sustainable support.

Furthermore, the study recommends that information on goat markets should reach rural areas where most farmers reside and are unable to access technology.

With regard to factors influencing household income, the study found that access to extension services plays a significant role. Development and more investment in extension services are vital. Extension programs could clearly define objectives that are helpful to farmers and officers to account for the progress and problems encountered by farmers and any possible solutions. Results also show that type of breed is positively associated with household income. Improved breeds have high productivity and value. Therefore, thorough research and investment to improve goat breeds would be important to enhance production efficiency.

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