

IMPACT OF COOPERATIVE MEMBERSHIP ON ADOPTION OF IMPROVED GOAT PRODUCTION PRACTICES IN CHITWAN DISTRICT OF NEPAL

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ABSTRACT

Lack of proper production practice is identified as constraint in production performance of goats. In this context, this study attempts to assess the impact of cooperative membership on adoption of improved production practices among smallholder goat farmers. The analysis is based on data obtained from in-person interview among 327 cooperative members and 334 non-members. The study employs Poisson regression model with endogenous treatment to address the endogeneity. The findings show that cooperatives strongly facilitate adopting improved production practices among goat farmers. Average treatment effect is 2.607, and the average treatment effect on treated is 2.11 and 1.447 in nearest neighbor matching and inverse probability weighted regression adjustment, respectively. The number of improved practices shows non-linear relation with livestock unit. The number of improved production practices increases with training and decreases with distance from tar road. The finding suggest scope to increase the adoption of improved production practices through cooperative membership.

Key words : Cooperative, endogeneity, goat, improved production practices, smallholder farmers

INTRODUCTION

In most developing nations, smallholder farming plays an essential role in animal production. Smallholder agriculture relies heavily on livestock, and goats are raised by the majority of farmers in developing nations. Smallholder farmers in tropical Asian countries raise livestock in traditional and ancestral ways, with few inputs and limited technical improvement, resulting in low output. Smallholder goat farmers in Nepal show a lack of commitment to better management practices, resulting in low goat productivity (Redding *et al.*, 2012). As a result, smallholder farmers are unable to perform to their full potential because production efficiency is heavily dependant on the farmers' goat-raising practices. Improving smallholder farmer performance is seen as a critical strategy for rural development and poverty reduction in agro-based developing countries (Mendola, 2007). As a result, it's critical to encourage and support smallholder farmers to adopt better goat-raising practices.

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In Nepal, the number of cooperatives is steadily expanding year after year. The number of cooperatives had grown to 34,837 by the end of the fiscal year 2019/20, with 65, 15,460 members. Heifer International, Nepal presented strong evidence that a farmers' cooperative may be the ideal option to function as an aggregating agency and improve goat farmers' efficiency under the Smallholders' Livestock Value Chain Project launched by the organisation in 2012. (Heifer International, 2012). A total of 113 cooperatives have been working to assist goat farmers in 30 districts across Nepal with this goal. However, no systematic research has been conducted to determine the effectiveness of cooperatives in supporting farmers. As a result, the purpose of this study is to look into the impact of cooperative membership on farmer motivation.

CONCEPTUAL FRAMEWORK

Figure 1 depicts a straightforward path. Agricultural cooperatives promote technology among smallholder farmers through training and awareness (Ma, Abdulai, and Goetz, 2018; Wollni and Zeller, 2007). Farmers get assistance from government and non-government linkage and affiliation (Johnson and Shaw, 2014). Thus, cooperatives, directly and indirectly, facilitate improved practices that help to acquire better productivity and higher income (Hoken and Su, 2018; Kumar *et al.*, 2018; Michalek *et al.*, 2018). Higher income motivate farmers for improved practice. This pathway has been realized by various studies which reveal the positive role of agricultural cooperatives to enhance technology adoption and improvement in farm output and revenue (Hoken and Su, 2018).

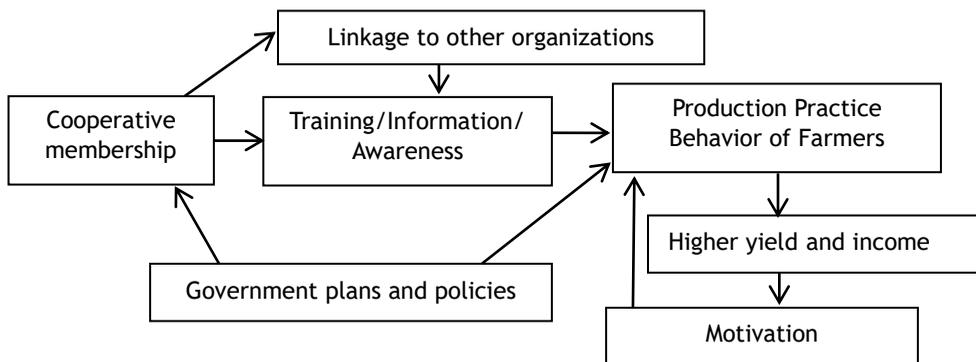


Figure 1. Conceptual framework

STUDY AREA, SAMPLING AND DATA

Smallholder goat farmers are included in the sampling frame. A multi-stage stratified random sampling procedure is used to choose the samples. Two districts, Chitwan and Nawalparasi, have been designated as the primary goat-producing areas (Kolachhapati and Devkota, 2012). Two villages from Chitwan district (Siddhi and Shaktikhor with altitudes of 750 masl and 550 masl, respectively) were chosen to represent Nepal's hilly regions, while two villages from Nawalparasi (Deurali and Nayabelhani with altitudes of 170 masl and 240 masl, respectively) were chosen to represent the plain region (Figure 2). The sampling frame is collected from HEIFER International, Nepal, an international non-governmental organisation that supports regional cooperatives, in the form of a list. The non-members were chosen at random from a list of village households. The cross-sectional household-level data are obtained through in-person interview.

The dependent variable is the score for improved production practices adopted by farmers. Table 1 describes the list of improved production practices to count the score of improved practices as a dependent variable in the analysis.

Table 1. Description of production practices

Practices	Description
Selection of breeding stock	Selection of strong and healthy male and female for breeding (culling of weak stock).
Proper age of castration	Age of 8 to 12 weeks is considered ideal when burdizzo castrator is used
Fodder sufficiency	Sufficient amount of green fodder either from own source or forest
Provision of iodine added salt	Provide goat with regular salt supplemented with iodine
Mineral block	Mineral blocks prepared by farmers and hanged near drinking water/shed
Sufficient spacing	Goats have sufficient as per their age and condition
Ventilation	Proper ventilation provided in the shed
Raised housing	Shed of goats should be raised at about 1 meter from ground level
Vaccination	Regular vaccination for contagious disease
Wormicide	Provide regular wormicide to every goat

EMPIRICAL MODEL

The study uses a Poisson regression model aided with an endogenous binary-treatment variable. Endogeneity is a common realistic situation that causes empirical challenges; therefore, failure to control them may lead to biased and inconsistent estimators (Heckman, 1979). Possibility of endogeneity of membership in an agricultural cooperative cannot be denied because membership decision is self-selected. The study aims to explore the intensity of improved practices adopted by smallholder goat farmers and address endogeneity.

The dependent variable is a count variable with a non-negative integer value from 0 to 10, where 0 indicates no improved practices adopted and 10 indicates the maximum number of approaches adopted. The analysis intends for estimation of binary choice (member or non-member) model with endogenous behavior. Therefore Poisson regression model aided with an endogenous binary-treatment variable is used to assess the factors affecting the number of improved practices adopted by the members and non-members of a cooperative. The membership in cooperative being a binary dummy variable.

The equation for outcome and treatment is expressed as:

$$E(y_i / x_i, m_i, e_i) = \exp(\beta x_i + \delta t_i + e_i) \tag{1}$$

$$m_i = 1, \text{ if } t_i Y + u_i > 0 \text{ and } m_i = 0, \text{ otherwise}$$

i.e. $t_i Y + u_i$ is the likelihood of household membership in the cooperative.

Where, Y_i is an outcome, X_i are the independent variables of the model, t_i are covariates for treatment model, e_i and u_i are error terms with bivariate normal distribution with the mean value 0. The covariance matrix is:

$$\begin{bmatrix} \sigma^2 & \sigma\rho \\ \sigma\rho & 1 \end{bmatrix}$$

The covariates X_i and t_i are exogenous, i.e., unrelated to the error terms.

The dependent variable in the model is the number of improved production practises used by goat farmers. Explanatory variables include socioeconomic and farm factors, as well as cooperative membership (m), which indicates whether a household is a member ($m=1$) or non-member ($m=0$). As a result, the dummy endogenous-variable model allows for the joint determination of outcomes and treatment status, allowing for joint treatment and effect estimation. However, because membership is self-selective, there is a chance that cooperative membership is endogenous. A household's decision to join a cooperative, for example, can be influenced by the motivating component like visit to an NGO/ INGO's.

RESULTS AND DISCUSSIONS

DESCRIPTION OF DEPENDENT VARIABLE

Table 2 shows the frequency distribution of different improved practices among members and non-members. Findings show that less than one-fourth of the farmers are maintaining strong females for breeding. The findings are similar to a previous study that reports that only 27% of farmers adopt proper breeding practices in a village of Syangja district of Nepal (Nepali *et al.*, 2007). Other findings also report that farmers do not cull their goats to maintain strong breeding stock (Mhlanga *et al.*, 2018; Dossa *et*

al., 2015). The majority (82%) of cooperative members and only 7.5% of non-members castrated their goats at the appropriate age.

The majority of members (96.6%), as well as a non-member (89.6%), have sufficient fodder for their goat. The Source of fodder in the study site included annual or perennial grasses or fodder trees in the farmers' field or from the forest nearby. Feeding concentrate is also important for better performance of goats and goats should be feed according to their stage. In the study site, concentrates are homemade in all households. Redding *et al.* (2012) also reported a similar condition where none of the goat farmers is using commercial feed for goat. The average quantity of concentrate fed by the member is 229.36 grams while for non-member is 142.39 grams. Supplement feed also plays a remarkable role in the growth and development of animals. Iodine supplemented salt was regularly provided by 96.6% of members and 89.6% of non-members. Only less than one-third of members and less than one-fourth of non-members were preparing the mineral block for their goats.

The study shows that only about 12% of non-members have raised shed for their goats while all the members have raised shed. The majority (89%) of members and less than one-third (31%) of non-members are vaccinating their goats against PPR. Similarly most of the members (98.8%) used regular wormicides, while less than one-fourth (20.9%) of non-members were protecting their goats using regular wormicides.

Table 2. Frequency of adoption and non-adoption of practices

Practices	Member (%)		Nonmember (%)		Total (%)		x ² test (p-value)
	Yes	No	Yes	No	Yes	No	
Selection of breeding stock	76 (23.2)	251 (76.8)	74 (22.1)	260 (77.9)	150 (22.7)	511 (77.3)	0.781
Castrate at an appropriate age	268 (82.0)	59 (18.0)	25 (7.5)	309 (92.5)	293 (44.3)	368 (55.7)	0.000
Sufficient fodder	311 (95.1)	16 (4.9)	260 (77.9)	74 (22.1)	571 (86.4)	90 (13.6)	0.000
Regular iodine added to salt	316 (96.6)	11 (3.4)	300 (89.6)	35 (10.4)	616 (93.1)	46 (6.9)	0.000
Mineral block	98 (30.0)	229 (70.0)	74 (22.1)	260 (77.9)	172 (26.0)	489 (74.0)	0.021
Sufficient space	321 (98.2)	6 (1.8)	279 (83.6)	55 (16.4)	600 (90.8)	61 (9.2)	0.000
Sufficient ventilation in shed	311 (95.1)	16 (4.9)	270 (80.9)	64 (19.1)	581 (87.9)	80 (12.1)	0.000
Raised shed	327 (100)	0 (0.0)	39 (11.6)	295 (88.4)	366 (55.3)	295 (44.7)	0.000
Regular	291 (89.0)	36 (11.0)	104	230 (69.0)	395 (59.7)	266	0.000

Vaccination			(31.0)		(40.3)	
Wormicide	323 (98.8)	4 (1.2)	70 (20.9)	70 (79.1)	393 (59.4)	268 (40.6)
						0.000

DESCRIPTION OF EXPLANATORY VARIABLE

The explanatory variables include socioeconomic characteristics, farm characteristics, and institutional supports received by the farmers. The data of household characteristics include characteristics of the household head because the household head is mostly responsible for decision making of the economic activities in the family. The age, gender, and schooling years of the household head is therefore considered in the study. The family characteristics included in the study are the number of members involved in agriculture, the help of male members in household works, migration of family members for employment purposes, and ethnic group of the family. The characteristics of the family are an essential consideration for goat farming because family members mostly carry out smallholder agriculture as a family profession. The migration status is proxy for additional income through remittance. Migration reduces the workforce and thus affect agriculture activities, and at the same it is a source of off farm income which may reduce the agricultural activities (ILO, 2019). The farm characteristics are denoted by the variables like landholding status, distance from road head/tar road and number of goats in the farm. The institutional service is represented through training in goat management and other supports. The institutional support are source of information and motivation which may determine the goat rearing practices.

Table 3 describes the explanatory variables used in the empirical analysis. The number of members involved in agriculture is higher in member households than non-members, and the help of male members is higher in member households. The proportion of non-elite groups is higher among members while non-members consist mainly of the elite group. Member households have a higher probability of receiving training on goat management. Other variables are not significantly different among members and non-members.

Table 3. Definition and summary statistics of the selected variable

	Description	Members	Non-members	Difference	Mean
District	0= Nawalparasi, 1= Chitwan	0.658	0.642	0.016	0.650
Age of household head	Continuous	51.492	50.510	0.982	50.995
Gender of household head	0= Female, 1= Male	0.887	0.845	0.042	0.866
Schooling years of household head	Continuous	4.602	3.994	0.608	4.295
Members in agriculture	Continuous	3.511	2.875	-0.636***	3.189
Male members help in household works	0= No, 1= Yes	0.817	0.696	-0.121***	0.755

Migration	0= No, 1= Yes	0.220	0.364	-0.144	0.293
Elite group	0= No, 1= Yes	0.110	0.319	0.209***	0.216
Landholding (hectare)	Continuous	0.399	0.353	0.047	0.376
Landholding ² (hectare ²)	Continuous	0.164	0.127	0.036	0.145
Distance from tar road	Continuous	3.737	3.893	-0.156	3.816
Livestock unit (LSU)	Continuous	4.259	1.686	2.574***	0.341
Livestock unit ² (LSU ²)	Continuous	20.215	3.879	16.336***	2.957
Training on goat management	0= No, 1= Yes	0.535	0.152	0.383***	0.341
Visit to NGO/INGO	0= No, 1= Yes	0.223	0.060	0.164	0.140

Note: *** indicates significant at 1% level.

Table 4 represents the two-stage selection model where cooperative membership is estimated in the first step and improved practices for goats in the second step. It evaluates the factors influencing a farmer's decision to become a cooperative member (column 2nd) and factors that affect the adoption of improved practices (column 3rd). The analysis estimates both outcome equations jointly.

DETERMINANTS OF COOPERATIVE MEMBERSHIP

The study assumes that farmers join cooperatives if they feel it beneficial. Cooperative membership exerts cost in terms of money, time, dedication and bound for various activity, therefore, farmers join cooperative only if they have a higher opportunity cost. Column 2 of Table 4 shows that age and gender of the household head do not make a difference in membership decisions. The results are consistent with Ankrah *et al.* (2021). However some studies shows that female headed household (Ma *et al.*, 2018, Verhofstadt and Maeertens, 2015) and older farmers are more likely to be cooperative member (Chagwiza, Muraduab and Ruben, 2016; Wossen *et al.*, 2017). The schooling years of the household head has positive and significant impact on the cooperative membership. Previous findings also show positive impact of education on membership decisions (Ankrah *et al.*, 2021; Verhofstadt and Maertens, 2015). Households with a higher number of members in agriculture are more likely to be involved in cooperative indicating that dependency of households on agriculture motivates membership as reported by Ma and Abdulai (2016). Members from the elite group are less likely to be cooperative members as compared to non-elite. This might be because of off-farm income sources bieng more educated people. Here elite and non-elite groups are classified based on the caste system, which prevails in most South Asian countries. Landholding size and distance of household from tar road have a non-significant impact on membership. The land holding of household is a proxy for wealth. Studies show that probability of cooperative memrbship increases with land holding (Verhofstadt and Maertens, 2015; Wossen *et al.*, 2017) and other shows negative relation between land holding and cooperative membership (Chagwiza, Muraduab and Ruben, 2016). The livestock unit (LSU) positively impacts membership. Farmers visiting the office of NGOs/INGO are more likely to be involved in cooperative

as these organizations advocates for cooperative membership.

DETERMINANTS OF SCORE

Column 3 of Table 4 deduces the factors affecting the adoption of improved practices (score). The non-significant effect of landholding size in adopting improved production practices indicates that smallholder farmers can efficiently manage goats in the mixed farming system. The non-significant impact of the district on the score of adoption of improved practices indicates that farmers in both plains and hills can properly manage goats. Farmers' characteristics: age, gender, and schooling years of the household head do not affect adoption of improved production practices. This is primarily because goats being easy to handle due to smaller size and gentle nature can be well managed by all ages of males and females. Also, even the less educated household heads are adopting improved production practices which might be because goat farming has been carried out by farmers as family business since long. The findings are in line with the findings in Ghana where the score of technique adoption was equal among men and women (Doss and Morris, 2000). Further, the cooperation of male members in household works resulted in more improved practices. The non-significant effect of landholding size indicates that agricultural activities do not affect goat production practices among smallholder farmers. The significant negative impact of distance of household from tar road on adoption of improved practices may be because of higher transaction cost for distant households.

Migration of youth male for employment does not affect adoption of improved production practices for goats. This shows that goat farming can be effectively carried out by the women as reported by Neupane *et al.* (2018). The non-linear relation between number of goats in terms of livestock unit and adoption of improved production practices indicated that the number of improved production practices decreases after a threshold of a number of goats in the farm. The result shows that number of improved production practices adopted by the farmer increases till the livestock unit of goats is seven which is equal to about 25 matured goats. The analysis uses a livestock unit for the number of goats as a representation of various goats, and the livestock unit gives a systematic measure for goats of varying ages. Live weight of animal of 400-500 kg is measured as 1 LU. Thus on an average a smallholder farmers can provide proper management practices to about 25 matured goats. The positive impact of training indicates that goat farmers is supported by findings of Mhlanga *et al.* (2018).

This paper focuses to access the impact of cooperative membership on adoption of improved production practices. The result of this study is in line with the result from turkey which shows a positive impact of cooperative membership on goat production efficiency (Cinemre *et al.*, 2006). This result is also verified through the density distribution of score of improved production practices (Figure 3). Consistent result is

observed in average treatment effect for both matched and unmatched sample from different matching methods: nearest neighbor matching and inverse probability weighted regression adjustment.

Table 4. Poisson regression with endogenous treatment

Score	Coefficient (Robust Std. Err.)	Coefficient (Robust Std. Err.)
	First stage probit estimates	Second stage estimates
District		-0.031 (0.035)
Age	-0.002 (0.006)	-0.001 (0.001)
Gender	0.320 (0.209)	0.0356 (0.032)
Schooling years	0.042 ** (0.021)	0.001 (0.000)
Members in agriculture	0.169* (0.105)	0.054** (0.021)
Male members help in domestic works	0.443** (0.191)	0.068* (0.039)
Migration for employment		0.010 (0.006)
Elite group	-0.640** (0.216)	
Area (hectare)	0.343 (1.419)	3.229 (2.020)
Area ² (hectare ²)		-3.021 (2.547)
Distance from tar road	0.023 (0.026)	-0.055* (0.015)
Livestock unit (LSU)	0.879*** (0.073)	0.084** (0.038)
Livestock unit ² (LSU ²)		-0.008** (0.004)
Training in goat	0.126* (0.165)	0.165 *** (0.036)
Help of NGO/INGO	0.712*** (0.206)	
Cooperative (outcome mean)		0.362 *** (0.062)
Constant	-3.98 ** (0.709)	0.420 (0.400)
/athrho	-1.769 ** (1.067)	
/lnsigma	-4.393 ** (1.659)	
Rho	-.9435576 (0.117)	
Sigma	0.012 (0.021)	

Note: ***, ** and * indicates significant at 1%, 5%, and 10% level, respectively. Statistical computations are based on the authors' questionnaire

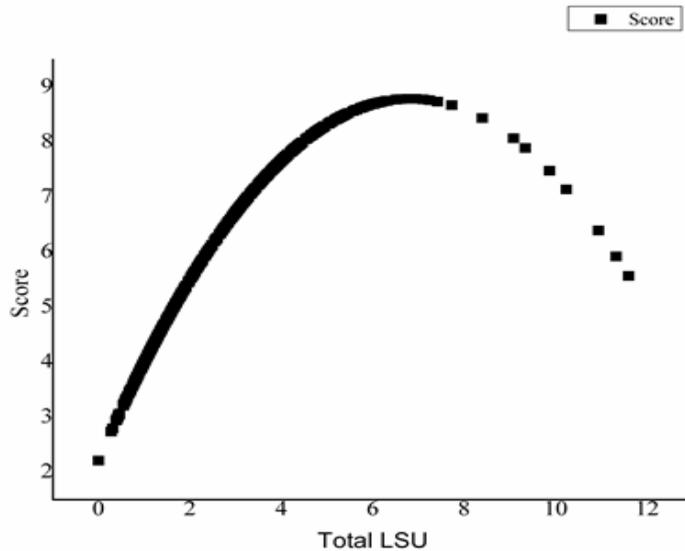


Figure 2. Score in relation to total LSU

Cooperative (outcome mean) coefficient specifies the logarithm value of the ratio of the treated potential outcome means to control potential outcome mean. A positive value of Cooperative (outcome mean) signifies a higher potential mean of treatment. The significant value of the Wald test for independent equations suggests the endogeneity of cooperative membership, and neglecting this aspect would give biased result. A similar effect of regressors in both regimes explains that the treatment variable does not interact with the outcome variable and therefore cancel from the ratio of potential-outcome means.

Figure 3 shows the right shift of distribution with a higher peak for members compared to nonmembers indicating that cooperative membership positively impacts the adoption of improved production among goat farmers.

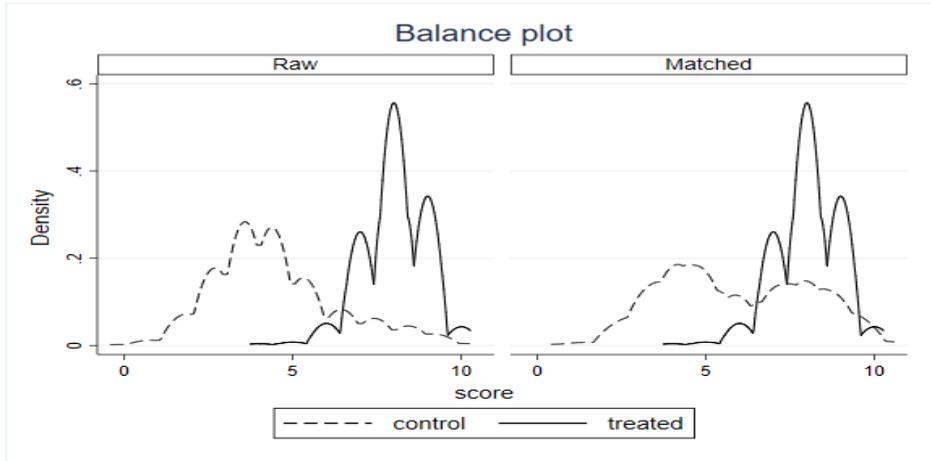


Figure 3. Density distributions of score among members and non-members

The result is consistent for both unmatched and matched samples. The matching is performed through the five nearest neighbor mating method of the propensity score. The result of cooperative membership’s impact assessment is presented in Table 5. The average treatment effect on treated shows the difference between improved practices in cooperative members after being involved in cooperative and before being a member. The result shows that cooperative memberships have a significant and positive impact on adopting improved practices for rearing goats.

Table 5. Impact of cooperative membership on adoption of improved production practices

	outcome indicator	Members	Nonmembers	Treatment effect	%Change
Average treatment effect	Score	8.111 (.0856)	5.504 (.134)	2.607*** (0.155)	47.37

Note: *** indicates significant at 1%. Statistical computations are based on the authors’ questionnaire.

CONCLUSIONS

Because goats are commonly thought to be raised by smallholder farmers with limited access to information and resources on better techniques, goat productivity falls short of its potential due to a lack of adequate management practises. Goat farmers’ production efficiency is limited by poor breeding, feeding, housing, and treatment. These constraints need to be overcome through either support and a coordinated approach. The study shows that the number of improved practices increased with an increase in a number of goats equivalent to 25 matured goats and decreases after that indicating that smallholder farmers can perform best up to the given production threshold because of a mixed farming system, as smallholder farmers are involved in livestock and crop farming. Instead of " production of mass, " a policy of “production by mass” instead of “production of mass” would be advantageous for better production of

goat rearing among smallholder producers of developing countries who execute a mixed farming system. Farmers need specific training regarding goat farming and initial support from government and/or non-government organizations. Further, since the impact of help from a male in the household was observed on the adoption of improved practices, awareness about gender mainstreaming, and the importance of equally bearing responsibility by both genders to better the household. From this study, it can affirmatively be asserted that cooperative membership can be helpful to change the farmer's behavior in improving management practices and thus help to improve the yield potentiality of goats. Participation in agricultural cooperatives motivates farmers by creating awareness, improving skill through training and providing required input accessibility, and creating we-feeling among members to help each other in society.

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REFERENCES

- Ankrah Twumasi, M. Jiang, Y. Addai, B. Ding, Z. Chandio, A. A. Fosu, P. and Agbenyo, W., 2021. The Impact of Cooperative Membership on Fish Farm Households' Income: The Case of Ghana. *Sustainability*, 13(3): 1059.
- Chagwiza, C. Muradian, R. and Ruben, R., 2016. Cooperative membership and dairy performance among smallholders in Ethiopia. *Food Policy* 59: 165-173.
- Cinemre, H.A. Ceyhan, V. Bozođlu, M. Demiryürek, K. and Kılıç, O., 2006. The cost efficiency of trout farms in the Black Sea Region, Turkey. *Aquaculture* 251(2-4):324-32.
- Doss, C.R. and Morris, M.L., 2000. How does gender affect the adoption of agricultural innovations? The case of improved maize technology in Ghana. *Agricultural economics* 25(1):27-39.
- Dossa, L.H. Sangaré, M. Buerkert, A. and Schlecht, E., 2015. Production objectives and breeding practices of urban goat and sheep keepers in West Africa: regional analysis and implications for the development of supportive breeding programs. *SpringerPlus* 4(1):1-2.
- Heckman, J.J., 1979. Sample selection bias as a specification error. *Econometrica: Journal of the econometric society* 153-61.
- Heifer International Nepal, 2012. A study in Goat Value Chain. Heifer International Nepal, Hattiban, Lalitpur: 1-20.
- Hoken, H. and Su, Q., 2018. Measuring the effect of agricultural cooperatives on household income: Case study of a rice-producing cooperative in China. *Agribusiness* 34(4):831-46.
- ILO, 2019. Eight ways to grow Nepal's agriculture sector, A rapid assessment and ranking of agricultural sub-sectors. International Labor office, CH-1211, Geneva22, Switzerland 51-57.

- Johnson, H. and Shaw, L., 2014. Rethinking rural co-operatives In development: Introduction to the policy arena. *Journal of International Development* 26(5):668-82.
- Kolachhapati, M. and Devkota, N. R., 2012. Entrepreneurial Goat Production in the Eastern Mid-Hills and Terai Region of Nepal. In Technical Publication. Kathmandu: National Agricultural Research and Development Fund: 33-42.
- Kumar, A. Saroj, S. Joshi, P.K. and Takeshima, H., 2018. Does cooperative membership improve household welfare? Evidence from a panel data analysis of smallholder dairy farmers in Bihar, India. *Food Policy*. 75:24-36.
- Ma, W. and Abdulai, A., 2016. Does cooperative membership improve household welfare? Evidence from apple farmers in China. *Food Policy* 58:94-102.
- Ma, W. Abdulai, A. and Goetz, R., 2018. Agricultural cooperatives and investment in organic soil amendments and chemical fertilizer in China. *American Journal of Agricultural Economics* 100(2):502-20.
- Mendola, M., 2007. Agricultural Technology Adoption and Poverty Reduction: A Propensity-Score Matching Analysis for Rural Bangladesh. *Food Policy*. 32(3): 372-393.
- Mhlanga, T.T. Mutibvu, T. and Mbiriri, D.T., 2018. Goat flock productivity under smallholder farmer management in Zimbabwe. *Small Ruminant Research* 164:105-9.
- Michalek, J. Ciaian, P. and Pokrivcak, J., 2018. The impact of producer organizations on farm performance: The case study of large farms from Slovakia ☆. *Food Policy* 75:80-92.
- Nepali, M. B. Tiwari, M.R. Sapkota, S. Poudel, H.P. Acharya, B.R. and Gautam, S., 2007 Marketing constraints to goats in the Western Hill of Nepal. *Nepal Agriculture Research Journal* 8:95-102.
- Neupane, N. Neupane, H. and Dhital, B., 2018. A socioeconomic view of status and prospects of goat farming in rural areas of Nepal. *Journal of the Institute of Agriculture and Animal Science* 35(1):1-8.
- Redding, L. Chetri, D. K. Lamichhane, D. K. Chay, Y. Aldinger L. and Ferguson J., 2012. Animal production systems of small farms in the Kaski district of Nepal. *Tropical animal health and production* 44(7):1605-13.
- Verhofstadt, E. and Maertens, M., 2015. Can agricultural cooperatives reduce poverty? Heterogeneous impact of cooperative membership on farmers' welfare in Rwanda. *Applied Economic Perspectives and Policy*, 37(1), 86-106.
- Wollni, M. and Zeller, M., 2007. Do farmers benefit from participating in specialty markets and cooperatives? The case of coffee marketing in Costa Rica¹. *Agricultural economics* 7(2-3):243-8.
- Wossen, T. Abdoulaye, T. Alene, A. Haile, M. G. Feleke, S. Olanrewaju, A. and Manyong, V., 2017. Impacts of extension access and cooperative membership on technology adoption and household welfare. *Journal of rural studies*, 54, 223-233.