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RESEARCH ARTICLE

PROFITABILITY OF ADOPTING PESTE DES PETITS RUMINANTS VACCINE IN DHADING, NEPAL

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ABSTRACT

A study was conducted to understand the Profitability of Peste des Petits (PPR) vaccine adoption in Dhading district, Nepal to determine whether PPR vaccinated goats generate higher profits for female goat keepers and to identifying the associated barriers of PPR vaccine adoption. Altogether 120 households were selected using random sampling technique. Primary data were collected using semi-structured and pre- tested household questionnaire, FGDs and KIIs while secondary data were collected from different published records. Both descriptive and inferential statistics were used to analyze the data. Data were encoded and analyzed excel, SPSS and R-Stat. In subsistence goat farming, the average production cost per goat was NRs.4226 annually, with BCR of 2.05. The vaccinated goats farming have BCR of 4.69 while unvaccinated goats farming has 1.61 BCR, which suggest that the goat farm adopted with PPR vaccination is profitable. Among 13 barriers of vaccine adoption explored the communication in between goat keepers and CAHW and Education status of farmers are more likely to enhance the adoption of PPR vaccine. PPR vaccine adoption is driven by an integrated approach that binds the responsibility of goat farmers, community, local government and national level institutes including government and non-government organizations which help to increase women's economic and social empowerment and contribute to more sustainable agribusiness through equitable subsistence goat farming systems. Moreover, it is important to establish a reliable information system within the cooperative to ensure that farmers receive timely and accurate information about vaccination campaigns and elongate the duration of vaccination campaign.

KEYWORDS

Profitability, Peste des Petits Ruminants (PPR), Goat, Barriers.

1. INTRODUCTION

Nepalese rural economy severely rely on agriculture for household income where livestock rearing play crucial role for earning agriculture cash income and home production consumed within the households (Maltsoglou and Taniguchi, 2004). Specially, Goat (*Capra hircus*) keeping is important culture and contributor of Nepalese rural economy which act as a secure and easily accessible asset for farmers and 73.2% of women who are primary goat caretakers, lacking resources in times of need. (Neupane et al., 2018). In Nepal, twelve millions goats play a significant role in meat production, representing 20.69% of the total output, ranking second only to buffalo at 52.81%. (MOLD, 2019). The national average family in Nepal owns 3.3 goats, and 49.8% of the population engages in goat-keeping (ABPSD, 2011) but the loss of goats has been rampant due to PPR disease outbreak annually. In the Annual Epidemiological Bulletin-2015, 71 outbreaks, 18261 affected small ruminants with 7118 death in 26 districts was recorded (Upadhya, 2015).

The Economic loss due to the PPR accounts to approximately US$115.24 million per annum in the world and the loss of US$46.14 million is mainly due to loss of animal, cost of treatment US$9.76 million, and production loss of US$59.62 million (Acharya et al., 2020; Rajashekhar and Rao, 2012). In Nepalese context the rapid migration of male youth show that goat farming is a good choice because goats are popular small ruminants that can be cared for by women and children even without the help of male household members (Neupane, 2018). Despite the fact that Nepalese women which account for 70-90 percent of goat rearing and caring work are crucial in managing goats, play an important role in enhancing family wellbeing, it is thus essential to determine whether PPR vaccinated goats generate higher profits for female goat keepers (FAO, 2016).

By identifying the barriers that affect women's empowerment in livestock production and vaccine value chains, this research can help stakeholders develop strategies that increase women's participation in these areas, including increased adoption of the PPR vaccine among female goat keepers. Additionally, identifying specific agricultural interventions and strategies that can maximize profit is necessary. Through this article, we would compare profitability of vaccinated goats with non-vaccinated one and recommend some strategies to maximize the profit from goat farming to subsistence goat farmers, especially women, which helps to increase women's economic and social empowerment and contribute to more sustainable agribusiness through equitable subsistence goat farming systems.

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2. Materials and Methods

2.1 Study area, Data Sampling and Analysis

To conduct this research cross sectional descriptive research design was applied in Nilkantha and Dhunibesi municipalities of Dhading district in Nepal where Altogether 6 Focal Group discussions (FGDs); 3 in each municipality with male and female, 120 individual interviews (INDs) with female goat keepers(60 in each municipality) and 8 key informant interviews (KIIs) were conducted. In addition to this, 6 KIIs in Kathmandu were done with Government officials, Agro-veterinary practitioners, the experts from Veterinary Hospital and Livestock Service Expert Centers (VHLSEC) including the public and private vaccine suppliers. The qualitative and quantitative data obtained from KII, FGD and individual interviews were were encoded and examined in Excel, R-Stat and SPSS.

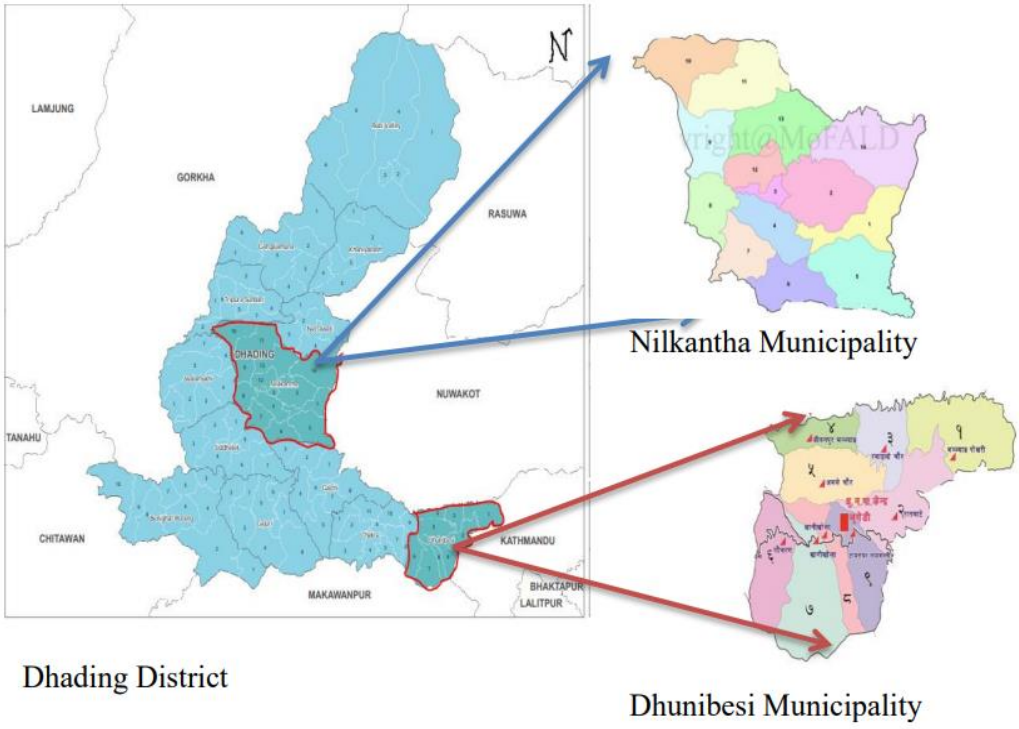

Figure 1: Study site: Dhading (Nilkantha and Dhunibesi Municipality)

2.2 Model Specification Conduct Profitability Analysis

Table 1: Conduct Profitability Analysis in Subsidence goat farming

Parameters	Specification
Gross Variable cost (A)	The total variable cost includes sum of all the costs associated with feed, grain ,medicine, deworming, drenching, PPR vaccination, vaccines other than PPR, electricity charges, skilled and unskilled labor, fodder and forages and transportation . Gross variable cost (A)= $\sum_{j-i}^{m} yi.xi$ Where , yi = Unit price of the variable input in NRs, xi = quantity of the variable input in Kg ,
Gross Fixed cost (B)	The total fixed cost includes the sum of all the associated costs with capital investments, interest on capital/ loan, cost of pen/ shed construction, equipment and machinery, depreciation associated to machinery and shed/ pen, land rent and insurance premium.
Gross Expenditure (C)	Sum of total variable cost and total fixed cost; Here, C=(A+B)
Gross income (D)	Income from subsistence goat farming by selling their goats for chevon, selling their breeding goats, kids, income earned by providing breeding service, income earned by selling manure That is ,Total return = Price of commodity in NRs. × Total quantity produced in Kg Gross Income (D)= $\sum_{1-1}^{n} P1Q1$ where P = Market (unit) price of output in NRs and Q = Quantity of output (kg),
Net income (E)	The difference between Total return and total cost is net profit. Here, E= (D-A+K) where K is Annual fixed cost (depreciation). Or , $E = \sum_{1-1}^{n} P1Q1$-[{$\sum_{j-i}^{m} yi.xi$} +K]
Gross Margin (F)	The difference between total return and total variable cost is gross margin or total margin. Here, F=(D-A)= $\sum_{1-1}^{n} P1Q1$-$\sum_{j-i}^{m} yi.xi$
BCR (G)	The ratio of total income and total expenditure cost is Benefit cost ratio. That is Benefit cost Ration= Total revenue / Total cost incurred. Here, G=(D/C)

This can be expressed in equation as

Gross Income (D *in above table*) = $\sum_{1-1}^{n} P1Q1$ where P = Market (unit) price of output in NRs and Q = Quantity of output (kg),

And,

Gross variable cost (A *in above table*)= $\sum_{j-i}^{m} yi.xi$ Where , yi = Unit price of the variable input in NRs, xi = quantity of the variable input in Kg .

Therefore the model of Profitability would be expressed as: $E = \sum_{1-1}^{n} P1Q1$-[{$\sum_{j-i}^{m} ri.xi$} +K] .

2.3 Barriers of PPR vaccine adoption

The process for pairwise ranking was involved to rank the barriers of adoption of PPR vaccine. The Pairwise ranking matrix template (FAO, UN, Participatory Rural Appraisal Manual, 2009) was taken in to consideration. The PWR exercise was done in 6 FGDs *(Hiti- FGD1, Palpabhanjyang – FGD2, Tinpane –FGD 3, Maidan FGD4, Maheshphant-FGD5, Barthum-FGD 6)* 3 in each municipality respectively with 63 women participants aged in between 21 to 72 years.

3. Result and Discussions

3.1 Socio-demographic characteristics of the farmers.

Table 2: Socio-demographic characteristics of the respondent

1	**Age (Years) of the respondents**			
	Description	**Nilkantha Municipality**	**Dhunibesi Municipality**	**Summary**
	Mean	45	43	44
	Minimum	25	26	25
	Maximum	70	69	70
2	**Gender (Percentage)**			
	Male	25	33.33	29
	Female	75	66.67	71
3	**Size of Family**			
	Average size (Mean±SD)	(5.01±1.6)	(5.15±1.12)	
4	**Education (Percentage)**			
	School Unattained	36.67	16.67	26.67
	Primary Education	35.00	38.33	36.67
	Secondary Education	20.00	36.67	28.33
	Higher Secondary Education	8.33	8.33	8.33
5	**Land holding (in Ha) respondents (Percentages)**			
	Landless farmers (0-.1) Ha	1.67	3.33	
	Marginal farmers (.101-.3) Ha	18.33	28.33	
	Small farmers (.301-.5) Ha	16.67	25	
	Medium farmers (.501-1) Ha	46.67	35	
	Large farmers (1.01-3) Ha	16.67	8.33	
6	**Livestock Holding (Number)**			
	LSU	8.72	13.48	
	Buffalo	1.31	1.21	
	Cattle	1.27	1	
	Goats	9	11	
	Chicks	15.06	75.03	
7	**Occupational Categories (Percentage)**			
	Agriculture	30	50	40
	Service	25	15	20
	Business	6.67	5	5.83
	Remittance	15	18.33	16.67
	Wage based Labor	20	6.67	13.33
	Other	3.33	5	4.17
8	**years of experience of respondents (Percentage)**			
	0-10 years	25	46.67	35.83
	11 -20 years	25	21.67	23.33
	21-30 years	15	5	10
	31-40 years	21.67	13.33	17.5
	41 and above	13.33	13.33	13.33
9	**Source of information about vaccination of PPR (Percentage)**			
	Family	10	6.67	8.33
	Cooperative member friends	36.67	43.33	40
	Community Animal Health Workers (CAHW)	5	18.33	11.67
	Local Government Body	20	23.33	21.67
	Uninformed	21.67	5	13.33
	Other	6.67	3.33	5

Table 2 demonstrate that the mean age of the goat farmers is 44 years where 29 percent are male while 71 percentage of goat keepers are female with average 5 family members. This is similar to the finding of a study conducted which states 73.2% of women primary goat caretakers in Nepal (Neupane et al., 2018). Majority of farmers have education qualification of primary education 36.67 percentage followed by secondary education 28.33 percentage of respondents. There is majority of marginalized goat keepers; 46.67 percentages in Nilkantha and 35 percentages in Dhunibesi Municipality, owing 0.501 to 1 hectare of land allocated for goat rearing and their forage management for their goats (in an average 9 goats in Nilkantha and 11 goats in Dhunibesi) this is also similar to the finding of a research conducted in Gulmi district of Nepal where found that the maximum, minimum and average holding of the goats per each household was found to be 18, 3 and 7 respectively (Panth et al., 2021). But this has increased the risk of low profitability because the less is the farmers' holding the more will be the risk of low profitability (Ume et al., 2018).

Highly experienced goat keepers for more than 40 years have been engaged in subsistence goat keeping where maximum farmers are experienced for 10 years have high chance of getting profitable goat

enterprise than that of less experienced farmers as stated in protected vegetable farming in Nepal (Subedi et al., 2022). The farmers mainly hold agriculture as their main occupation while 5.83 percentages of respondents do their business such as contractors, and commercial vegetable cultivation in the study area. These farmers are members in women cooperatives and saving and credit group who access information

about PPR vaccination campaign and receive other services provided by veterinary hospitals, agriculture knowledge centers and local body. These shows that the house holds that receive technical support to introduce new technology, have access to market, input suppliers, service providers leads to profitable agribusiness enterprise (GC and Hall, 2020). Therefore the socio-demographic character of the farmers also plays key role in profitability in subsistence goat farming after vaccinating their goats.

3.2 Economics of PPR vaccine Adoption in goats

The study analyzed that cost of goat rearing incurred involve the use of materials cost in the local condition, and the average production cost per goat in a year was found to be NRs.4226 in subsistence farming. The cost of production rises up when the shed is newly constructed. But when repair and maintenance of the shed are done every year, it cost NRs 23803 per goat per year the costs goes up to 28029 per goat. Therefore, the subsistence farmers do not repair their shed every year.

Table 3: Cost and Returns from Subsidence goat farming (per goat/ year)

Particular	Nilkantha Municipality	Dhunibesi Municipality	Average
A. Variable cost	3765	4688	4226
B. Fixed cost	26829	20777	23803
C. Total Cost	30594	25465	28029
D. Total return	66277.46	49654.91	57966.19
E. Net profit (D-C)	35683.46	24189.91	29936.69
F. Gross Margin (D-A)	62512.46	44966.91	53739.69
G. BCR (D/C)	2.17	1.95	2.06

Source: Field Survey 2022

It is found that the average selling price of a live goat in study area is NRs. 612; the selling price of 35 kg live goat would be NRs.21, 148. The profit from selling a goat would be about NRs. 8,789. If you invest in goat farming, the return on your investment will be about 2.05% (B: C ratio= 2.05) each year in the beginning, but it will gradually increase over time. In Nilkantha Municipality the BCR of goat farming is 2.17 while Dhunibesi has 1.96. This result aligns with the finding of a study conducted by Panth, B.P. et al.,2021 in Gulmi district of Nepal where the profit from selling a goat was about NRs. 7,454 with the return on your investment will be about 1.7% (B:C ratio= 1.70).

After eliminating the cost of shed the annual cost per goat would be approximately NRs. 6,214, profit obtained by goat would be NRs. 11,786 and B:C ratio at this condition would be 2.89. The production cost of goats in Banke district of Nepal was about the same as above result (Bharati et al., 2021). In India, some researcher figured out different B:C ratio (up to 2) for goat farming in local conditions (Kumar et al., 2014). If we eliminate the cost of shed and building construction (NRs. 23,803 and repair, it with (NRs. 10,000) in next year, the annual cost per goat would be approximately NRs. 13,803, profit obtained by goat would be NRs. 43839 and B:C ratio at this condition would be 4.07.

The table number 4 , reveals that the vaccination is economically very important task. The profit margin obtained by vaccination is almost 3 times more than non-vaccinated goats. The BCR obtained in vaccinated goat is 4.69 while in non-vaccinated goat it is 1.61.The average cost of production in non-vaccinated goat is approximately NRs 2704 while income is approximately NRs 4362. But in vaccinated goat the average cost of production is approximately NRP 1331 while income generated per goat is approximately NRs 6253. This result allign with the study of a group researchers in Senagal where the gross margin remained 675 USD to 1183 USD per goat per year (with out PPR 1726 USD to 2429 USD and with PPR introduced 1051 USD to 1246 USD) (Aboh et al., 2024). This difference income is due to the benefits of vaccination, including reduced mortality rates, increased productivity, and improved livelihoods, outweigh the costs in the long run. This revels that goat farming is economically viable enterprise that is positively catalyzed by PPR vaccination campaign.

Table 4: Profitability among Vaccinated vs Non-Vaccinated Goats

	Non-Vaccinated Goat		Vaccinated Goat	
Parameter	Cost of Production	Income	Cost of Production	Income
Average	27041.58	43620.3	13317.67	62534.8
Maximum	307350	104400	224900	165000
Minimum	0	0	0	0
Margin produced/ goat	1658		4922	
BC	1.61		4.69	

Source: Field Survey 2022

3.3 Barriers of PPR vaccine uptake in study area.

Table 5: Barriers of PPR vaccine uptake in study area.

Barriers of Vaccine uptake	Scores						Total Scores	Rank
	Nilkantha			Dhunibesi				
	FGD 1	FGD 2	FGD 3	FGD 4	FGD 5	FGD 6		
Communication	6	8	9	8	8	8	47	1
Education	7	7	6	6	7	7	40	2
Traditional Medication	3	5	7	7	6	5	33	3
Knowledge	7	6	5	4	5	6	33	3
Vaccination point	6	5	4.5	5	5	4	29.5	5
Size of Heard	5	1	6.5	6	4	6	28.5	6
Vaccinator's fee	4	2	3	3	4	4	20	7
Age	1	4	1	4	1	2	13	8
Gender	2	4	1	1	4	1	13	8
Cast/Ethnic make up	4	3	2	1	1	2	13	8

This study has helped to figure out the barriers of vaccine uptake to the goat keepers of different ethnicity that will ultimately huddles in the vaccination program. Therefore, this information is important to facilitate and redesign these programs and provides opportunity for effective adoption of vaccination program.

3.3.1 Lack of communication about vaccination schedule

Based on FGDs, it was found that the gap aroused in communication and lack of communication procedure ranked in the first with score of 47 as a major barrier in PPR vaccine adoption in female goat keepers. It is found that those who access the information through women cooperatives they get their goats vaccinated with PPR vaccine while women who are not the members of cooperatives, they lack information about vaccination campaign and as a result they do not participate in PPR vaccination campaign.

3.3.2 Lack of basic Education regarding PPR disease and PPR vaccination

Lack of awareness and education about PPR vaccine at the community level hinders adoption of PPR vaccine. It is the second most determinant of PPR vaccine adoption which scored 40. Due to lack of awareness and knowledge about PPR disease PPR vaccine in women, who are the active participants in goat care giving activities it would really lead to failure in PPR eradication campaign. Most veterinarians and officials are located at the center of the districts which invites difficulty in access to the villages due to distance, due to geography. Therefore, formal and informal sharing, training and awareness programs have been difficult to set up. Thus, preparing more community animal health workers would assist in disseminating awareness training program. Additionally, the women CAHW prepared from different ethnic group will surely include their group in training and education program. The knowledge regarding the condition of vaccines, health of animals is found under rated in all FGDs.

3.3.3 Traditional Medication

Use of home remedy and the use of herbal medicines for goat ranked third as barrier for PPR vaccines uptake. The belief that herbal medicines and home remedies were capable of treating and preventing PPR disease has been deeply rooted in the farmers who have been experienced since years hence they feel that there was no need for using vaccines against PPR disease.

3.3.4 Knowledge of farmers

The perception and educational level of the farmers have been another hindrance to PPR vaccine uptake. It also ranked third in terms of barriers. The farmers have little knowledge about PPR disease but do not know the detailed impact of PPR disease, its symptoms and its use . For example, in a FGD of women, they say that PPR vaccine killed their goats last year as result thy have not vaccinated this year. This was happened because one of the leader women farmer didn't know that PPR is not given to pregnant goat.

3.3.5 Caste and Ethnicity

One of the KIIs mentioned that it would be a huge challenge to a *Dalit* woman to get information who resides far away from the community. This is due to traditional residential plan adopted by the community which will take at least a generation to transform the community residential setting. (*individual interview and FGD at Maidan, FGD, Berthum*)

3.3.6 Lack of Vaccinators

In some community it was found that vaccination camp was conducted by school students without maintaining the temperature of the vaccine. So, it gives impression that there is lack of vaccinator too. So, a provision of vaccinators at all the community is must.

3.3.7 Administrative procedures

Information collected indicated there are still insufficient numbers of vaccines available for farmers in *Ratomate* where there is plenty of Kumal tribe. Out of 14 KIIs 6 of the informants said that it has been difficult to coordinate with the local level government. They take vaccine with their responsibility and provide vaccine to their nearest one. Thus, it is must that the government needs to make a priority of where the PPR vaccine will be disseminated; more attention needs to be paid to other areas with potential for the spread of PPR disease and where there is large herd size. The technical officials should be made responsible rather than the political leaders and their representatives.

3.3.8 Lack of infrastructures (road, means of communication, refrigerators)

None of the ward offices in Nilkantha and Dhunibesi municipality were equipped with refrigerators for storing vaccines. This will of course hinder in maintaining cold chain of vaccine. Therefore, the government should establish animal health post and provide the basic amenities such as refrigerators, vaccines, at least a community animal health worker.

3.3.9 Lack of interest in farmers in vaccination campaign

Farmers in *Ratomate and Tinpane* are uninterested in the vaccination campaign conducted by municipality and its respective wards due to inappropriate behaviour of animal health workers, vaccinator and the local leaders. Those who are not connected with these technicians (CAHW/ vaccinators/ officers) and local representatives are demotivated to take their goats to vaccinate their goat.

3.3.10 Vaccination point

The vaccination point are located at the center of the village park or inn in the study area which become barriers to the dependent population and women who has to perform household work from dawn to dusk (*FGD, Maidan)*.

3.3.11 Mistrust of veterinary vaccines and veterinary officers

In FGD of *Tinpane* of Nilkantha municipality the school students of JTA in Animal science acted as the vaccinator , they women did not trust with the capacity of vaccinators (learning students) because the goat get fevered after vaccination of PPR. In the same village the vaccinator of Nepal government stated that the cause of animal sickness was due to inappropriate cold chain management. This created a mistrust of vaccine and vaccinator in the farmers of the study area and lead to barrier of vaccine uptake.

3.3.12 Low remuneration of Community animal health workers and Vaccinators

In FGD at *Maheshphant* and FGD at *Palpabhanjyang* with women , the farmers stated that the remuneration provided to the vaccinator is NRs. 5 per goat. The same is confirmed by a KII in Veterinary Hospital of Nilkantha municipality which is very low to provide to the vaccinators and make them cover all the clusters for PPR vaccination. On the other hand the scattered clusters and short duration of vaccination campaign has created huge burden to the vaccinators to cover all the clusters for vaccination.

3.3.13 Age (Difficulty in restraining animals)

Old aged group, children and women who take their goats at vaccination point has faced this problem this problem because this task is energy intensive work based on physical strength. The percentage of dependent population in the study area is 38.78 who are responsible to take their goats at vaccination point. In one hand there is high dependent population and on the other hand less numbers of vaccinators or community health workers so this causes a huge problem to guide, control and restrain the herd of goats.

4. CONCLUSION

The profitability analysis of the subsistence goat farming demonstrated that the average production cost per goat was NRs.4226 annually, with BCR of 2.05. The vaccinated goats farming have BCR of 4.69 while unvaccinated goats farming has 1.61 BCR, which suggest that the goat farm adopted with PPR vaccination is profitable. Next, the availability of PPR vaccine for free does not confirm adoption of vaccine at local level for various reasons such as socio-economic cause, technical barrier, management failures. Thus, PPR vaccine adoption is driven by an integrated approach that binds the responsibility of goat farmers, community, local government and national level institutes including government and non-government organizations. PPR eradication program would not be successful till 2030 in Nepal unless this integrated approach is taken in to execution.

There is at least a hope that this would need to be accompanied by proper awareness through training to women of all the ethnic group that disseminate the information regarding vaccination campaign, importance of PPR vaccination program, by increasing women participants of different ethnicity. Moreover, it is important to establish a reliable information system within the cooperative to ensure that farmers receive timely and accurate information about vaccination campaigns. For instance, women farmers could inform the cooperative of their absence from the village during vaccination campaigns, and the cooperative could notify them

about the vaccination in advance. Such measures can help to overcome the challenges posed by the information and communication systems and ensure the success of vaccination programs to especially women goat farmers, which help to increase women's economic and social empowerment and contribute to more sustainable agribusiness through equitable subsistence goat farming systems.

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