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The Epidemiology of Peste des Petits Ruminants in Sierra Leone

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Abstract— *Peste des petits ruminants (PPR) is a major constraint to the productivity of small ruminants in Sierra Leone. The survey aimed to investigate the prevalence of Peste des Petits Ruminants (PPR) and create awareness among livestock farmers on the dangers of the disease to the livestock sector in the study districts. The sampling frame was small ruminants rearing households in Sierra Leone and 298 households were included in the study. A multi-stage sampling was utilized for the selection of individual livestock households. First purposive selection of the five districts, then random selection of chiefdoms, sections, and small ruminant rearing households in the village/locality respectively. Structured questionnaires were developed and administered to the 298 selected households in each locality/village. Data collected were entered into CSEntry using tablets and later imported and stored in the SPSS (version 21). Males are the dominant household heads and most of them went through a non-formal system of education. Goats, chickens, and sheep, are the predominant livestock reared by the households. Many of the respondents can identify the clinical signs and symptoms of PPR, and reported the incident of the disease in their farms. Free range management system in the dries and uncontrolled movement of animals along borderlines are the main sources of PPR outbreaks. The unavailability of vaccines and drugs are principal problem hindering the disease control programmes in the study localities. Though the livestock owners are aware of the morbidity and mortality effects of PPR disease, they have little knowledge of the preventive and treatment measures of the disease on their farms.*

Keywords— ***Epidemiology, Peste des petits ruminants, Livestock, Sierra Leone.***

I. INTRODUCTION

Sheep and goats are the main small ruminant species of livestock in Sierra Leone [1]. In 2007, about 8.5% and 6.6% of households in the country owned goat and sheep [2]. However, the livestock sub-sector's contribution to the gross domestic product (GDP) was still low (5.7%), compared to that of crop (62%) [3]. In 2010, sheep and goat populations were estimated at 682,000 and 803,000 heads respectively [4]. These numbers have decreased considerably during the outbreak of pest des petits ruminant.

Peste des Petits Ruminants (PPR) also known as goat plaque is a highly contagious viral disease that affects many species of domesticated and wild animals [5], [6] PPR is characterized by nasal and ocular discharges, gastroenteritis, necrotic stomatitis, pyrexia, and erosion of the pulmonary tract mucosa [7], [8]. The virus has a high morbidity and mortality, reaching to 100% and over 90% in naïve herds, respectively [9], [10]. This may reduce both the number and productivity of the flock and herd, which in effect negatively affect food security and the livelihoods of rural women and youth who are the main keepers of sheep and goats in the Country.

Serological studies conducted in 2009 at Central Veterinary Laboratory, Teko, Makeni, Sierra Leone, reveal that PPR is endemic in Sierra Leone [11], [12]. Based on molecular analysis of the fusion protein, PPRV has been divided into four different lineages I, II, III, IV, and the PPR viruses from Sierra Leone are clustered in lineage II [13].

A survey was conduct by the Teko Livestock Research Centre on the prevalence and possible control measures of PPR in five selected districts in Sierra Leone. The overall objective of the survey was to create awareness on the prevalence of PPR disease virus to livestock farmers especially women and youths that are actively engage in rearing sheep and goats the study districts; while the specific objective is to develop control measures that will drastically reduce the incidence of PPR disease virus in the selected areas of study.

II. MATERIALS AND METHODS

The study was conducted in selected communities in Kambia, Port Loko, Tonkolili and Koinadugu Districts in the northern region and Moyamba District in the southern region of Sierra Leone.

The sampling frame of the survey was small ruminants (sheep and goat) rearing households in Sierra Leone. A multi stage sampling was utilized for the selection of individual livestock households. The first stage was the purposive selection of the five districts where the study was done and the sample size was then allocated to these districts based on allocation proportional to size methodology. In the second stage, chiefdoms were randomly selected from the selected districts. The third stage was the random selection of sections in the chiefdom. The fourth stage was the random selection of localities/villages in the selected sections. The fifth and final selection was the random selection of small ruminant rearing households in the village/locality.

A structured questionnaire was developed and administered to the selected households in each locality/village. The interviews focused on collection of information on household demography, flock size, species, sex, health, management practices and common diseases in goats and sheep. Other data collected included movement patterns of livestock in the study areas with the affected neighboring countries, surveillance methods used and knowledge on PPR and vaccination. 298 questionnaires were administered to the sampled small ruminant rearing households in the four districts.

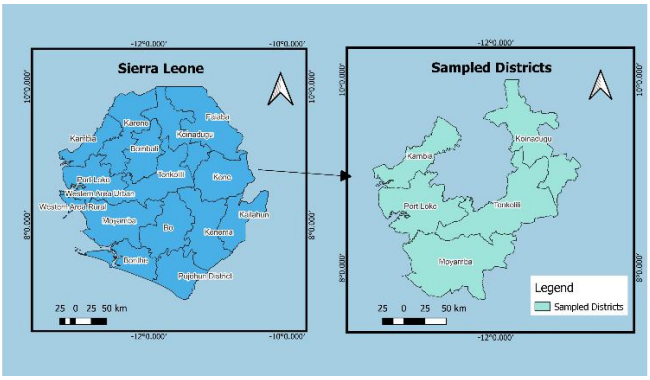

Figure 1. Study Area

Sample Size for the Small Ruminants' Household to Examine

The sample size of small ruminants' household was determined using the formula:

$$n = \frac{z^2 pq}{d^2}$$

Where n = the sample size, z =1.96, p = proportion of agricultural households engaged in animal husbandry, q = a weighting variable computed as 1-p and d = Desired Absolute Precision, ±5%. From the 2015 population and housing census p=0.736 [14].

$$n = \frac{1.96^2 \text{x} 0.736 \text{x} (1 - 0.736)}{0.05^2} = \frac{0.74644}{0.0025} = 298.58 \approx 300$$

The matrix of the number of sample households, localities/villages, chiefdoms and district is shown in Table 1.

The enumerators were trained in administering the questionnaires, and how to enter the data into the CSEntry using Tablets/Smartphones. Enumerators entered data directly into the CSEntry using tablets/smartphones during questionnaire administration, this eliminated errors due to data entry from the filled hard copy questionnaires in to the software.

The baseline data were collected and entered into CSEntry using tablets/smartphones and were later imported and stored in the SPSS (version 21). Descriptive statistics of the explanatory and other variables examined in the study for the small ruminant animal rearing households at the national, regional and district levels were computed using SPSS v.21 software and charts developed using the Microsoft excel 2010.

Table 1. The matrix of the number of sample households, localities/villages, chiefdoms and district

District	Animal Husbandry Household	Sampled Household	Sampled Locality	Sampled Chiefdoms
Kambia	38376	49	5	2
Koinadugu	38968	50	5	2
Port Loko	67071	86	9	3
Tonkolili	48692	63	7	3
Moyamba	40689	50	6	2
Total	**233796**	**298**	**32**	**12**

III. RESULTS AND DISCUSSION

Table 2 shows results for frequency distribution of some demographic attributes of small ruminant farmers in the study area. The results revealed that most of the respondents in all the selected districts are males, representing 73.2% which far exceeds the number of female respondents (26.8). This indicates that males are the dominant household heads with more responsibilities and are therefore left with no option but to take up livestock (especially small ruminants) rearing as a sedentary career to diversify their source of income.

Results for this survey clearly indicate that most (90.9%) of the respondents involved are married. This could be as a result of the age limit captured for this study (18yrs and above). Only 4% of the respondents are single. These are believed to have minimal responsibilities and are mostly school going and are on the search for more lucrative opportunities than rearing animals. 4.4% are Widow/widower who mostly has loss their spouses to sicknesses like the deadly Ebola scourge that devastated the country in 2014 and other conditions.

It could be observed in this study that 94.3% of the respondents are predominately Muslims and are from the northwest and northern regions when compared to Christians representing 5.7% of the sampled population. It indicates that Muslims occupies the chunk of the population in the country. This confirms the 2010 interreligious council estimates of 77% Muslims and 21% Christians for all ethnic groups in Sierra Leone [15]. Despites the vast difference in religious beliefs and practices, the country is perceived as one of the most religious tolerant countries in the world. For the selected study areas, Christians and Muslims accept the consumption of goat meat because of its unique characteristic flavor and low fat; and reared sheep and goats mostly for social, cultural and economic reasons.

Report on educational status of the respondents show that most (54.7%) are non-formal, few attained primary and secondary educational levels (5-7.7%), and 4.4% attained certificates from higher learning institutions. This is because learning institutions (vocational and tertiary institutes) are lacking in these areas with very few primary or secondary school that are miles away. 21.1% of the respondents acquired koranic education. This may be probably owing to the fact that most of the sampled population are coming from Islamic backgrounds, and koranic learning is a mandatory aspect of practicing their beliefs.

Table 2. Frequency distribution of some demographic attributes of small ruminant farmers

Variables		Categories	Gender			Marital Status				Religion			Educational Status						
			Total	Female	Male	Total	Divorced	Widow	Single	Married	Total	Islam	Christianity	Total	Koranic	Tertiary	SSS	JSS	Primary,	Non-formal
North West	North	Freq.	132	26	106	132	1	5	5	121	132	125	7	132	30	8	6	5	4	79
		%	100	19.7	80.3	100	0.8	3.8	3.8	91.7	100	94.7	5.3	100	22.7	6.1	4.5	3.8	3	59.8
	South	Freq.	114	41	73	114	1	6	4	103	114	113	1	114	23	4	9	7	16	55
		%	100	36	64	100	0.9	5.3	3.5	90.4	100	99.1	0.9	100	20.2	3.5	7.9	6.1	14	48.2
	Pooled	Freq.	52	13	39	52	xxx	2	3	47	52	43	9	52	10	1	5	4	3	29
		%	100	25	75	100	xxx	3.8	5.8	90.4	100	82.7	17.3	100	19.2	1.9	9.6	7.7	5.8	55.8
		Freq.	298	80	218	298	2	13	12	271	298	281	17	298	63	13	19	17	23	163
		%	100	26.8	73.2	100	0.7	4.4	4	90.9	100	94.3	5.7	100	21.1	4.4	5.7	6.4	7.7	54.7

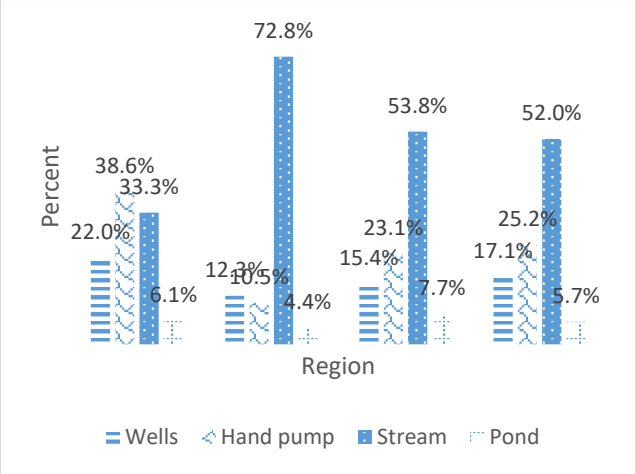

Fig.2. Source of drinking water by region

Source: EU- BAFS survey data 2019

Figure 2 shows the source of drinking water by region for the selected study arrears. 52% of the respondents in all communities used stream as the source of water for their everyday use, while 25% uses well water and 17% uses hand pump with less numbers (5.7%) in these communities used pond water. In almost all rural communities in Sierra Leone small ruminant owners do not provide safe drinking water for their animals. This confirms the results reported by Sierra Leone Demographic and Health Survey (SLDHS) 2013, which clearly stated that higher proportion of rural households uses non-improved sources for drinking water [16]. The animals are free to range in vast communal lands and can thereby make use of the available stream water for drinking. Streams waters are mostly reservoirs for diseases and are highly infested by loads of bacteria, pathogens and other infectious diseases that increase the chances of contracting diseases [17].

Table 3. Animals kept by the respondents

	Percent (N=298)	
Animals Present	**Yes**	**No**
keep chicken	85.2	14.8
keep duck	9.1	90.9
keep Guinea Fowl	1.3	98.7
keep Pig	1.0	99.0
keep goats	89.9	10.1
keep sheep	51.3	48.7
keep cattle	5.0	95.0
Do you keep rabbit	0	100.0
Do you keep Cane rat	0	100.0

Source: EU- BAFS survey data 2019

Table 3 shows livestock kept by the respondents in the study areas. Majority of the small ruminant household heads keep goats, chicken and sheep, (89.9%, 85.2% and 51.3% in that order); very few rear duck and cattle, (9.1% and 5.0% respectively), 1.3% and 1% keep Guinea fowl and pigs respectively and none of the respondents keep cane rat or rabbit.

The number of respondents that keep goats and sheep was high because the study targeted mainly small ruminant rearing households in the study area. In Sierra Leone, it is believed that many households in the rural communities practice small scale poultry or back yard poultry. This was shown in the results by high number of respondents that keep chicken

Table 4. Management system

		Animals (%)							
	Management system	Chicken (n=254)	Duck (n=28)	Guinea fowl (n=2)	Pig (n=1)	Goat (n=261)	Sheep (n=148)	Cattle (n=15)	
Raining season	Intensive	1.97	-	-	100	14.56	12.84	20	
	Semi-intensive	72.44	42.86	50		52.11	53.38	80	
	Extensive	25.59	57.14	50	-	33.33	33.78		
Drying season	Intensive	1.18	-	-	-	4.6	2.03	20	
	Semi-intensive	57.09	42.86	-	-	36.02	37.16	60	
	Extensive	41.73	57.14	100	100	59.39	60.81	20	

Table 4 shows the management systems practiced by ruminant household heads in the two major seasons in Sierra Leone. There are three management systems commonly practiced by livestock farmers in Sierra Leone; these include extensive system, the semi intensive and the intensive management systems. During the rainy season, semi-intensive system of management is said to be predominantly practiced by livestock farmers when compared to the intensive and extensive systems. The raining season is a crop farming season and in the rural area it is compulsory for all livestock farmers to control movement of their grazing animals to prevent them from destroying crop farms. This is believed to be one of the best means of conflict resolutions between crop and livestock farmers. Small ruminants are either tethered on grazing fields or fed on cut and carried grasses by the owners or allowed to browse in paddocks/confined areas.

During the dries however, the extensive management systems for goats and sheep are mostly practiced. After the harvesting periods (a period in anticipation of the dries), the animals are again released to brows freely on the just harvested crop lands. The farmers preferred this system because it is less labour intensive and the animal through their scavenging activities can feed adlib and increased in weight for market values or other purposes.

Table 5. Livestock housing system

	Animals (%)							
Housing system	Chicken (n=254)	Duck (n=28)	Guinea Fowl (n=2)	Pig (n=1)	Goat (n=261)	Sheep (n=148)	Cattle (n=15)
None	7.1	28.6	-	-	5.7	6.8	6.7
Confined in sheds	14.6	14.3	-	-	58.6	64.9	26.7
Confined in paddocks	1.2	-	-	-	8	6.1	46.7
Confined fences	10.6	10.7	-	100	24.5	21.6	20
Cage	35.8	21.4	100	-	-	-	-
Basket covered with net	23.2	21.4	-	-	2.7	0.3	-
Bamboo basket	7.1	3.6	-	-	-	-	-
provides Nest	0.4	-	-	-	0.4	-	-

Table 5 shows animal housing system in the study community. Most respondents rearing goats keep their animals in confined sheds (58.6%) followed by those that confined the animals in fences (24.5%) similarly majority of sheep owners house their sheep in confined sheds (64.9%) and confined fences (21.6%). More cattle owners keep their animals in confined paddocks (46.7%), followed by confined sheds. Since chickens are reared in small scale by many households mainly female members in the family, they either keep them in cages (35.8%) or basket covered with net (23.2%). The cage or basket maybe kept in kitchen stores together with cooking utensils

in order to prevent the animals from theft.

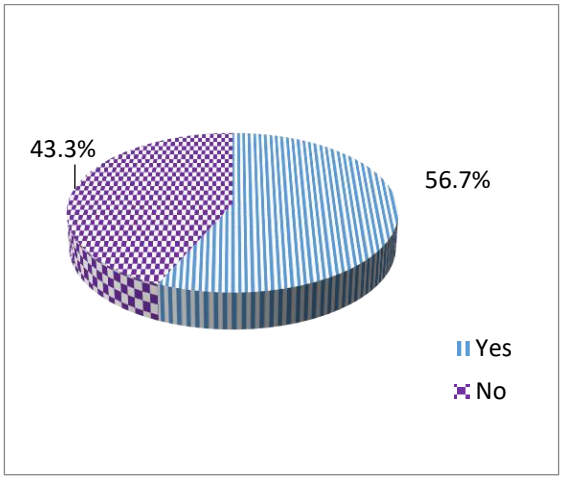

Fig.3. Households that ever heard of the disease Peste des petits ruminants

Figure 3 shows small ruminant household families who are aware of the PPR disease in sampled localities. 56.7% of the interviewed respondents admitted to have heard of the PPR disease possibly from other livestock farmers, Ministry of Agriculture and Forestry, livestock traders Non-governmental Organizations, radio talk shows or even from social media. Despite its endemic stance in the country, 43.3% still complained that they have not heard of the disease probably because most of them are living in rural areas where relevant information on livestock can hardly reach them.

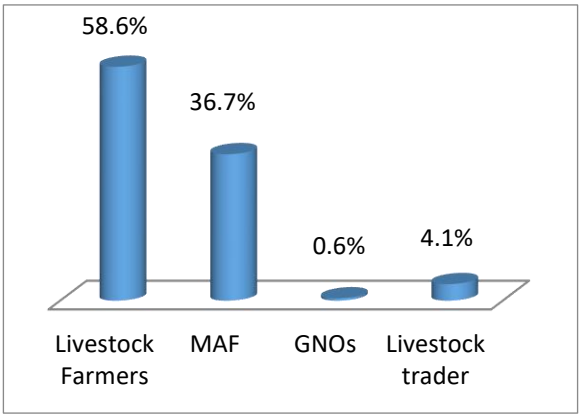

Fig.4. Sources of information for disease Peste des petits ruminants in households

Figure 4 depicts results of sources of information from respondents on the PPR disease virus. Most (58.6%) of the respondents were informed about PPR disease by other livestock farmers that are believed to have concern on the

general welfare of other livestock farmers in their localities. This is commonly done through the town/village heads that can charge the town-crier with the responsibilities of informing the entire community about the outbreak of a disease condition. However, the animal health and extension wings of the Ministry of Agriculture and Forestry (MAF) have played a significantly role (showing 36.7%) in disseminating information about the outbreak and endemic nature of the disease in these sampled communities and beyond. Their involvement in this could be as a result of series of PPR disease outbreak in the year 2018 in the East and Southern parts (Kenema and Moyamba respectively) of the country that left an estimated 127 sheep and goats dead [18], [19]. 4.1% of the respondents learnt about the disease from livestock traders through their trading activities in these communities. The involvement of None Governmental Organization (NGO) in the sensitization is minimal (0.6%). This could be as a result of the very small number of NGOs that are involved in animal health or veterinary activities in the country.

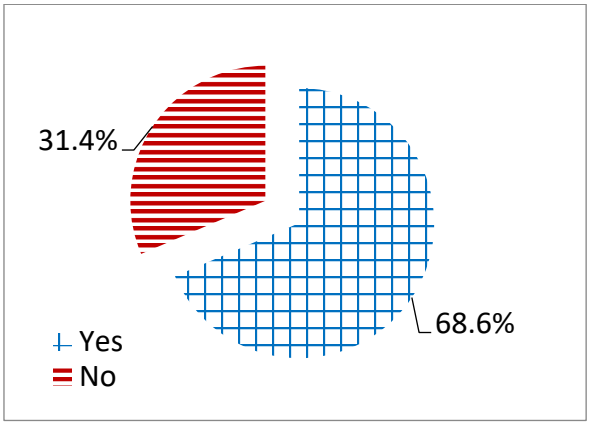

Fig.5. Incidence of PPR in the study area

Figure 5 shows incidence of PPR as reported by the small ruminant households in their flocks. Majority (68.6%) of the respondents reported the incident of PPR in their flocks, only 31.4% of the farmers recorded no cases of PPR in their flocks. The incident of PPR in the study area may be attributed to the various practices, including introducing new animals in the locality without quarantine services, source of drinking water for the animals as many rural farmers leave their animals to roam freely in search of feed and water, and streams provide easy accessibility for drinking water. This water source increases the risk of contracting many animal diseases. Moreover, contaminated water, feed troughs and bedding, could be additional sources of infection for animals [17]. Similarly, free movements of goats and sheep across the porous international borders between Guinea and Sierra Leone along the northern region of the country might have also contributed to the introduction of PPR in the country. In addition, the popular cross border ruminants' market at Gbindi in the Falaba District, northern Sierra Leone bordering Guinea is likely to introduce the disease in the country. introduce the disease in the country.

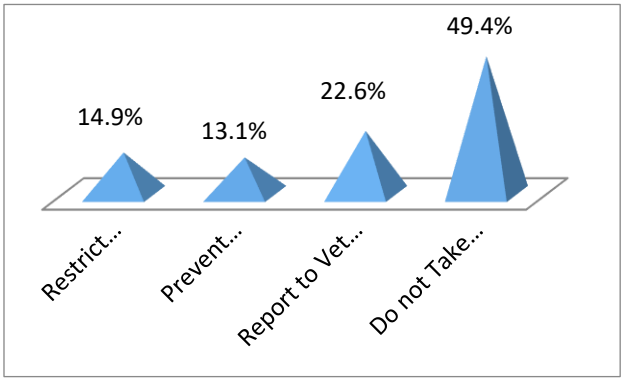

Fig.6. Main protective measures taken during PPR outbreak

Figure 6 expresses results on the main protective measures taken by farmers during PPR outbreak. During PPR outbreak, majority (49.4%) of herds owners do not take protective measures because of the unavailability of vaccines in their localities. 22.6% of the respondents that can access to veterinary services report outbreak of the diseases to veterinary authorities for necessary actions. Other 14.9% and 13.1% of the respondents take proactive measures like adhering to Government instituted laws and reforms that restricted the movement of small ruminant from one place/region of the country to another and preventing contact with other animals respectively. Although the control and preventive measures instituted by the Government to prevent further outbreak of the PPR disease was of immense importance, it is believed to have created an imbalanced socio-economic impact in the lives of livestock farmers.

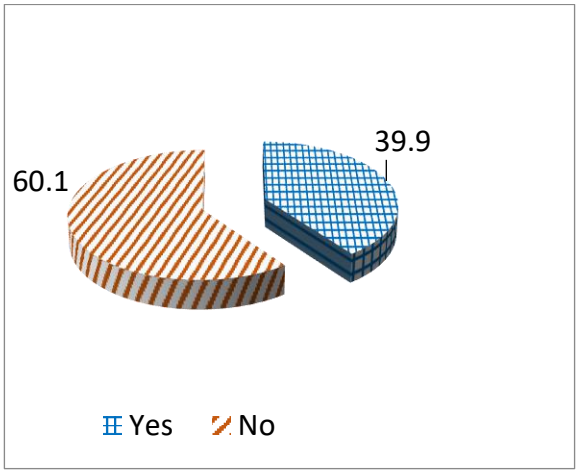

Fig.7. Households that used animal health services in the last 12 months

Figure 7 shows small ruminant households that used animal health services in the last twelve months. The results revealed that majority (60.1%), of the respondents have not used animal health service in the last twelve months. The unavailability of vaccines for the treatment of animals in rural settings, high cost of the relatively available ones and the absence of animal health workers in these localities could be some of the factors responsible for the low use of animal health services by livestock farmers. It was also observed that 39.9% of the respondents admitted to have used animal health service in the last 12 months probably because they can either afford the cost of treating their animals or have access to the services rendered by private veterinarians, or the free services offered by the ministry of Agriculture and Forestry to the very few communities of the sampled areas.

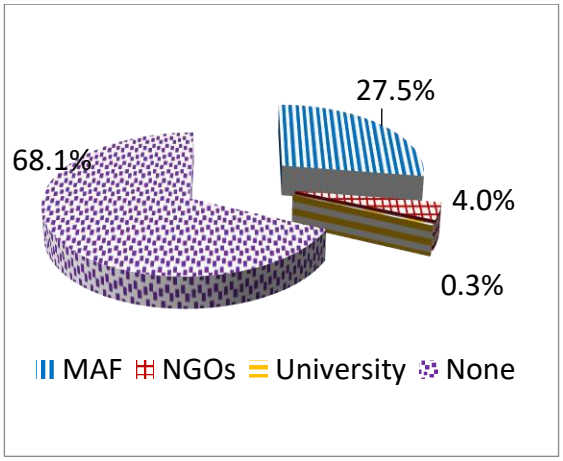

Fig.8. Providers of extension services in the villages/localities

Figure 8 displays results on the institutions that provide extension service to small ruminant farmers in the selected sampled areas. 68.1% of the respondent reported of the unavailability of extension services providers in their localities. This could probably be due to many reasons like the little or no attention given to the livestock sub sector over the years, information on livestock that is not filtering down to farmers in rural settings because of the poor road network, very few or none existing livestock farmer groups that can be contacted by extension officials and limited number of animal extension workers to carry out the task. 27.5% of the respondents measured the Ministry of Agriculture and Forestry as an institution that performed extension services in their localities. These are localities with appreciable road network that extension service providers from MAFs can access. NGOs that are involve in agriculture and universities are playing minimal roles in reaching out these rural communities and spreading out information concerning animal health and diseases.

IV. CONCLUSION

From the study results, it could be concluded that most livestock farmers interviewed are males, Muslims and do not go through formal education and a higher proportion of the population use stream as a source of drinking water.

Majority of the households keep goats, sheep and chicken. Semi-intensive and extensive systems of managements are the main systems of management practiced during rainy and dry seasons, and the small ruminants are mostly kept in confined sheds. Awareness of PPR disease is high among the livestock farmers, and most of them get information on animal diseases from other informed livestock farmers.

The farmers have knowledge on the clinical signs of the PPR disease and therefore majority of them reported the incident of the disease on their farms.

Though the livestock owners are very much aware of the morbidity and mortality effect of PPR disease, they still have little or no knowledge on the preventive and treatment measures of the disease among their herds.

Nevertheless, the survey data indicate that PPR vaccination campaign coverage in the country is low due to a lack of human capacity such as veterinary and extension workers as well as vaccines availability.

V. RECOMMENDATIONS

- Control programmes of PPR should be supported by field data generated by rigorous epidemiological surveillance and risk analysis.
- Veterinary units in the Ministry of Agriculture and Forestry (MAF) across the country should be equipped with more staff, veterinary equipment, and drugs.
- Passive disease surveillance is effective in disease monitoring but should be supplemented with simple laboratory techniques that require low cost equipment—such as light microscopes—to detect parasitic infections in blood and feces. The government should also make available test kits for field diagnosis for PPR and other diseases, as they would be useful to confirm diagnosis and lessen response times.

VI. FUNDING

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VII. THE CONSENT PROCESSES

Prior to the start of each interview an informed consent was obtained and was done in either English or Krio, which seeks the study participant's willingness to participate in the study.

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