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Livestock Systems and Forage Resources of Small Ruminant Farms in Some Selected Districts in Sierra Leone

Sylvester Morlu Koroma[1,*], Akiwande Boyle-Renner[2], Tamba Bandabla[3], Fallah Samuel Kassoh[4] and Dauda S. Yillah[5]

[1]Sierra Leone Agricultural Research Institute, Tower hill, Freetown, PMB 1313, Sierra Leone
[2,3,4,5]Sierra Leone Agricultural Research Institute, Tower hill, Freetown, PMB 1313, Sierra Leone
*Corresponding author

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Abstract— *This survey was conducted to ascertain the demographic attributes of household heads, type of livestock kept, rearing systems, feed resources utilized and also to assess farmer's knowledge on feed production and conservation. A total of 298 household heads were randomly selected within five districts and interviewed. Results indicated that majority of the households (73.2%) were headed by men with only (26.8%) headed by women. In terms of educational status 54.7% of the household heads did not go to school, while 24.1% attained formal education and (21.2%) attained Koranic education. Data for religion showed that 94.3% of the respondents were Muslims with 5.7% being Christians. Among the households, (95.6%) kept poultry, (89.5%) kept goats, (51.3%) kept sheep, 5% reared cattle, with only 1% keeping pigs and none rearing rabbits or grasscutters. In terms of average numbers of livestock per household; chickens were (12), ducks (4), and guinea fowl (3). Goats were (5), sheep (4) and cattle (5). Management system for poultry, small ruminants and cattle was mostly semi-intensive in the wet season and extensive in the dry season except for pigs which were managed intensively during the rains, and extensively during the dries. Housing provided for poultry was mostly in the form of cages and baskets, with small ruminants mostly housed in sheds and within fenced areas. Cattle were majorly sheltered in paddocks and pigs confined in fenced areas during the rains and left to roam during the dries. Few farmers reported that they do not provide housing for their animals. Most household heads (83.6%) practiced grazing/scavenging as the main source of feeding animals with only (16.4%) practicing zero-grazing. The grasses most browsed by the animals were Panicum maximum (21.5%), Andropogon gayanus (17.1%) and Pennisetum purpureum (10.1%). The legumes; Centrosema pubescens, Pueraria phaseoloides, and Mucuna pruriens were hardly grazed by the animals with values < or = 1.0%. Majority (91%) of the household heads fed their animals with forages, with only (3.4%) providing concentrate and (7.4%) utilizing supplements. None of the famers (N=298) fed their animals with hay or silage as they lacked knowledge on animal feed production. Crop residues were utilized by (30.2%) of the household heads, with cassava leaves residues (77%) the most fed and soybean haulms (17.8%) the least fed. Shortage of animal feed was most severe in the peak of the dry season (February-march), with 75.9% of households feeding their animals on forages during this lean period through the cut and carry method. From this survey, findings indicated that the inclusivity of women in livestock rearing is low, with management systems still traditional and mostly characterized by low numbers of conventional and a total absence of non-conventional livestock. Furthermore, un-balanced feed rations, feed scarcity and lack of technical know-how in compounding and conservation of animal feed was mostly existent.*

Keywords— ***Livestock systems, Small Ruminants, Farmers, Feeds, and forages***

I. INTRODUCTION

In Sierra Leone, livestock are economically important for household food security, source of income, and as well as being required for various cultural and ceremonial functions (FAO and ECOWAS, 2016). The livestock sub-sector also contributes about 5.7% of agricultural gross domestic product (GDP) (FAO, 2016). Despite the low contribution of the sector to the agricultural GDP, the country has the right agro-climatic conditions such as abundant rainfall, rich soils, natural forage resources, forest cover, and a low population pressure estimated at 79.2/km^2 on the land (FAO and ECOWAS, 2016). Livestock production in the country, especially small ruminant rearing, is an important agricultural activity though most of it is practiced under traditional system of management (FAO and ECOWAS, 2016). Nutrition is a vital component of livestock rearing systems and the feed requirements of farm animals can be met solely through natural forage and fodder or augmented through direct supplementation of nutrients in concentrated and controlled form (Alemayehu *et al*., 2016). In Sierra Leone, grazing is the predominant form of ruminant feeding practiced in most parts of the extensive and smallholder crop-livestock farming areas. Small ruminants graze on communal, fallow and natural pasturelands during the cropping season and on croplands after harvest. Currently there is paucity of information on the availability of feed resources, rearing systems, and farmer's knowledge on animal feed production in Sierra Leone. Therefore, this study aimed to determine the socio-economic and demographic context of the farming communities, animal rearing practice, availability of feed resources, and to assess farmer's knowledge on preservation and processing of these feed resources for sustainable livestock production.

II. METHODOLOGY

A multi stage sampling was used for the selection of individual livestock households. Purposive selection of the five districts (Kambia, Port Loko, Tonkolili and Koinadugu in the North and Moyamba in the South) was done, followed by random selection of chiefdoms from the districts, and then random selection of sections in the chiefdom. The fourth stage was the random selection of localities/villages in the selected sections and finally the random selection of small ruminant rearing households in the village/locality. A total of 298 questionnaires were administered to the sampled small ruminant rearing households in the five districts. Enumerators were trained in administering the questionnaire and entering data directly into the CSEntry using tablets. The baseline data were collected and entered into CSEntry using tablets and the data later imported and stored in the Statistical Package for Social Sciences 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.

III. RESULTS

Table 1: Demographic attributes of the household heads

Variable	Categories	Pooled	
		Frequency	Percentage
Gender	Male	218	73.2
	Female	80	26.8
	Total	298	100
Educational status	Non-formal	163	54.6
	Primary	23	7.7
	JSS	17	5.7
	SSS	19	6.37
	Tertiary	13	4.36
	Koranic	63	21.2
	Total	298	100
Religion	Muslims	281	94.3
	Christians	17	5.7
	Total	298	100

Table 1 shows the demographic attributes of the household heads. Results indicates that (73.2%) of the household heads are males, while 26.8% are females. Data for educational status revealed that 54.6% of the household heads did not go to school, 24.1% attained formal education with 21.2% attaining Koranic education. In terms of religious composition of the targeted household heads, 94.3% were Muslims and 5.7% were Christians.

Table 2: Animals kept by the Households

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

Table 2 shows the results for the animals present in the small ruminant households. Data from this study indicates that, among the respondents, (85.2%) rear chicken, (9.1%) keep duck, and (1.3%) keep guinea fowl. Majority (99%) of the households did not keep pigs with most (89.9%) keeping goats and only (51.3%) rearing sheep. Few households (5.0%) stated that they owned cattle, while none kept rabbits and grasscutters.

Table: 3 Animals Present with the 298 Respondents

Animals Present	N	Min	Max	Mean	S.D
No. of chickens	254	1	50	12	8.141
3.2\3 =No. of ducks	27	1	15	4	3.332
No. of Guinea Fowl	4	2	4	3	.957
No. of Pigs	3	2	12	7	5.033
No. of Goats	268	0	39	5	4.477
No. of Sheep	153	0	25	4	2.900
No. of Cattle	15	1	12	5	3.907

N = Number of respondents, Min = Minimum, Max = Maximum, S.D = Standard Deviation

The total chicken population stood at 254 with an average of 50 chickens per household in comparison to duck (N=27) and guinea fowl (N=4). Data from this study showed that the number of chickens present far exceeds the number of the other poultry species (ducks and guinea fowl). Data shows that the total number of goats and sheep stood at 268 and 153. The number of pigs stood at 3 while the total number of cattle present were 15.

Table 4: Management systems of animals during the rainy and dry season

		Animals (%)						
Management system		Chicken	Duck	Guinea fowl	Pig	Goat	Sheep	Cattle
Raining season	Intensive	1.97	-	-	100.00	14.56	12.84	20.00
	Semi-intensive	72.44	42.86	50.00		52.11	53.38	80.00
	Extensive	25.59	57.14	50.00	-	33.33	33.78	
Drying season	Intensive	1.18	-	-	-	4.60	2.03	20.00
	Semi-intensive	57.09	42.86	-	-	36.02	37.16	60.00
	Extensive	41.73	57.14	100.00	100.00	59.39	60.81	20.00

As shown in table 4, chickens (72.44%), ducks (42.86%) and guinea fowl (50.0%) were mostly managed under the semi-intensive system during the rainy season. With regards to goats and sheep, during the rainy season, (52.11%) and (53.38%) were raised semi-intensively, followed by (33.33%) and (33.78%) reared intensively and (14.56%)

and (12.84%) reared extensively for both goats and sheep respectively. However during the dry season (56.7%) goats and (53.4%) sheep were mostly managed under the extensive system.

Respondents (1.0%) who raised pigs did so intensively during the rainy season, while during the dries, pigs were raised in extensive systems. Majority of cattle owners (80%) managed their animals under the semi-intensive system in the rainy season, with about (20%) rearing cattle intensively.

Table 5: Housing system for livestock reared

	Animals (%)						
Housing system	**Chicken**	**Duck**	**Guinea Fowl**	**Pigs**	**Goats**	**Sheep**	**Cattle**
None	7.1	28.6	-	-	5.7	6.8	6.7
Shed	14.6	14.3	-	-	58.6	65.0	26.7
Paddock	1.2	-	-	-	8.0	6.1	46.7
Fences	10.6	10.7	-	100	24.5	21.6	20.0
Cages	35.8	21.4	100	-	-	-	-
Baskets	30.3	25.0	-	-	2.7	0.5	-
Nests	0.4	-	-	-	0.5	-	-

Table 5 shows the housing system for the different livestock species. Data revealed that (35.8%) of the households sheltered chickens in cages, followed by (14.6%) who confined in sheds. Ducks (28.6%) had no form of housing with only (21.4%) housed in cages and baskets covered with net. Respondents stated cages and fences as the only housing system for guinea fowl and pigs respectively. (58.6%) of the respondents housed their goats in sheds, while (65%) stated confinement in sheds for sheep as the major housing type. Confinement in fences for both goats and sheep was (24.5%) and (21.6%) respectively. Most of the cattle owners (46.7%) confined their animals in paddocks, with only (26.7%) confining in sheds and (20%) in fences.

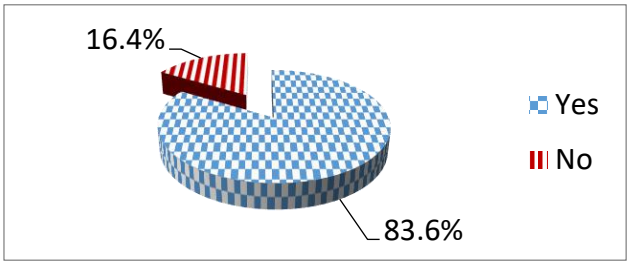

Fig.1: Households that practice Grazing

Majority (83.6%) of the respondents indicated grazing as a feeding practice (fig. 1.) in contrast to (16.4%) who practiced zero grazing.

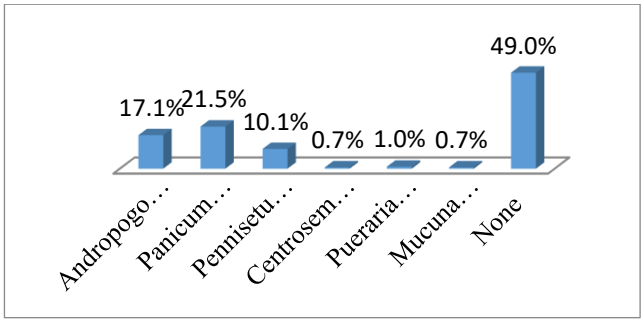

Fig.2: Forages mostly browsed by Small Ruminants

In terms of grazing goats and sheep on herbaceous species of grasses; (21.5%) of the respondents stated that *Panicum maximum* (Guinea grass), as the most preferred, followed by (17.1%) for *Andropogon gayanus* (Gamba grass) and (10.1%) for *Pennisetum purpureum* (Elephant grass). The legumes mostly preferred by the animals were C*entrosema pubescens* (0.7%), *Pueraria phaseoloides* (1.7%), and *Mucuna pruriens* (0.7%). Most of the respondents (49.0%) could not identify or were not aware of the most preferred forages browsed by the animals.

Table 6: Types of feed resources fed to animals

Type of Feed	Percent (n=298)	
	Yes	No
Concentrate feed	3.4	96.6
Forages (grazing)	91.3	8.7
Forages (cut and carry)	68.8	31.2
Hay	0.0	100.0
Feed Supplements (Mineral licks, salt)	7.4	92.6
Produce Silage	0.0	100.0
Other type of feed	19.5	80.5

Table 6 shows the types of feed resources fed to the animals. Few farmers (3.4%) fed concentrate feed, with most (91.3%) grazing their animals directly on forages on pasture lands, with about (68.8%) providing forages for their animals by the cut-and-carry method. None of the respondents (n=298) fed hay or produced silage for their animals while feed supplementation was done by only (7.4%). Few farmers (19.5%) stated that they used other types of feeds.

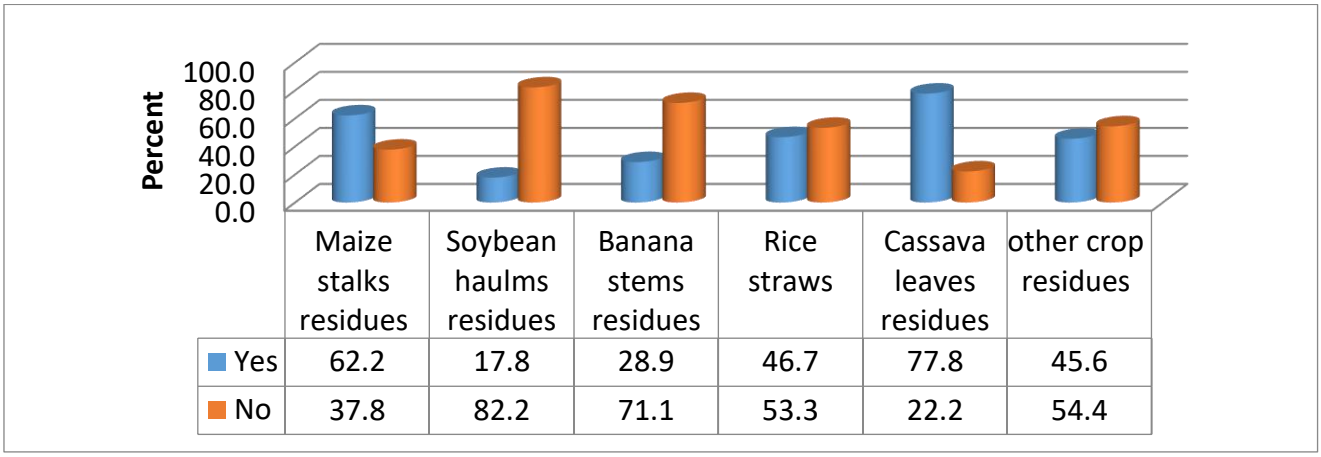

Fig.3: Levels of Utilization of Crop residues by Households

The level of utilization of crop residues is shown in figure 3. The most utilized crop residues were cassava leaves (77.8%), maize stalks (62.2%) and rice straws (46.7%) while the use of soybean haulms and banana stems were (82.2% and 71.1% respectively). For other crop residues (e.g. sorghum and millet), 45.6% of the respondents stated that they offered the residues to their animals while (54.4%) did not feed such residues.

Source of crop residues is presented in (Table 7). Residues sourced from the livestock farmer's own farm accounted for 89.3% (maize stalks), 87.5% (soybean haulms) 88.5% (banana stems,) 71.4% (rice straw) 92.9% (cassava leaves) and 95.1% (other crop residues). Cassava leaves residues (2.9%) was the least sourced as a gift token from farms other than the livestock farmer's while rice straws (28.6%) was the most sourced. Rice straw, soybean haulms and banana stems received as a gift from other farms accounted for about (28.6%, 12.5% and 11.5% respectively) with maize stalks accounting for (7.1%) of crop residues. Purchase of maize stalks, cassava leaves and other type of residues were recorded at (3.6%, 4.3% and 4.9%) respectively.

Table 7: Source of crop residues

Type of crop residues	Source of crop residues (%)		
	Own farm	Gift from other farmers	Purchase
Maize stalks (n=56)	89.3	7.1	3.6
Soybean haulms (n=16)	87.5	12.5	-
Banana stems (n=26)	88.5	11.5	-
Rice straws (n=42)	71.4	28.6	-
Cassava leaves (n=70)	92.9	2.9	4.3
Other crops (n=41)	95.1	-	4.9

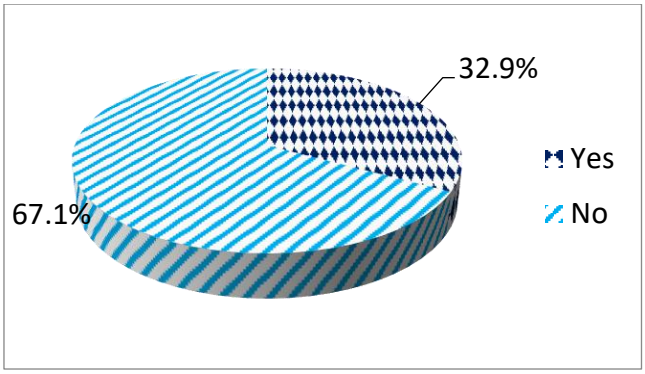

Fig.4: Fodder availability throughout the year

Figure 4 highlights the annual availability of fodder as animal feed. (67.1%) household heads reported that fodder was not available throughout the year while (32.9%) stated relative availability.

IV. DISCUSSION

In this study, the huge disparity in the gender composition of household heads engaged in small ruminant farming is in consonance with (SSL, 2006) report which stated that while women are mostly engaged in crop and poultry farming, men dominate ruminant rearing, hunting and fishing. A major reason for this is due to the fact that in Sierra Leone, women do not have full access or control of property or land, which is a key agricultural resource.

The huge difference in the religious makeup of the household heads in this study, is in line with (ARDA, 2015) which reported that in Sierra Leone, about (71.6%) of the population are Muslims with just (12.9%) being Christians. Formal education is compulsory up to junior secondary school in the country, however majority of the farmers in this study had no formal schooling. In the absence of formal schools, Koranic education was prevalent.

According to (SSL, 2017), the ownership of livestock varies by region and is based on vegetation and cultural habits of the inhabitants of a particular region or district. In this study, the number of households that kept chickens was higher compared to those that keep duck and guinea fowl. This is in consonance with several reports (USAID, 2015; FAO and ECOWAS, 2015) which states that chickens are the most reared poultry species in Sierra Leone. Rearing of pigs was done by few households and this is due to the fact that in this study, majority (94.3%) of the household heads are Muslims and their religion forbids the consumption of pork (*Haram*). Most (89.9%) of the respondents kept goats and about (51.3%) keep sheep. This is consistent with (FAO and ECOWAS, 2016) which reported that in Sierra Leone, goats are more prevalent in livestock farming communities compared to sheep. Few households (5.0%) stated that they owned cattle and this can be attributed to the fact that the target population were mostly small ruminant farmers. None of the households kept rabbits or grasscutters and this was as a result of several factors. Generally for both species, farmers stated that the difficulty in acquiring breeding stock, lack of knowledge in animal husbandry, and feed shortages during the dry season were among the major factors limiting their involvement in small stock production.

Housing for livestock was provided by majority of the respondents with only a few stating that they do not provide housing. The dominant management systems of poultry was mostly semi-intensive and extensive during the rainy and dry season. Ruminants (sheep, goats and cattle) were reared in semi-intensive and extensive systems and was characterized by tethering in natural pastures. This is consistent with (FAO, 2016) which stated that tethering is mostly dominant during the cropping season but the animals are allowed to roam free after the rice harvest in November.

In this study, most of the households grazed their animals on pastures with only a few practicing zero grazing. This is consistent with the result of (FAO and ECOWAS, 2016) which stated that in Sierra Leone, grazing is the most pre-dominant feeding practice in ruminant rearing systems.

According to the farmers, it was observed that the grasses mostly preferred by the ruminants can be attributed to their palatability, abundance and high biomass yield in their localities. Legumes were hardly mentioned as browse plants as farmers stated that their presence was very low. This unavailability may be as a result of the fact that, when legumes are growing with grasses, the grasses are stronger competitors for available nitrogen. This will result to an increased rate of growth, leaf expansion and tillering in the grasses, often leading to suppression of the legume owing to shading (Miles and Manson, 2000). In this study, most (49%) of the farmers could not identify or were not aware of the most preferred forages browsed by the animals. This might be due to the fact that the most of these respondents were not directly involved in the day to day husbandry activities such as moving the animals to grazing sites and therefore could not accurately tell the forages most preferred by the animals.

In this study, the use of concentrate feed was quite low and farmers cited several reasons for this scenario which included; high cost of feed ingredients, availability of feedstuffs and knowledge gap in compounding feeds. Forages (grazing or cut-and-carry) was the major source of feed as it was the most naturally abundant, suitable for their system of small ruminant rearing and which also exacted no financial obligation. Hay and silage was not produced by farmers mainly due to the lack of basic knowledge in

selecting grasses and legumes suitable to be used as standing hay or to produce silage. Supplementation of feed was not common as a result of high cost of supplements, and lack of understanding in adopting the correct levels of supplementation.

According to data from this study, the extent of utilization of the different crop residues mainly depended on traditional feeding practices at village level, where feed resources will vary extensively in both amount and seasonal availability. Furthermore households in rice cropping areas opined that crop residues are used only for shorter periods between the harvest and land preparation for the next cropping season during which rice straws left in the fields are burned.

In this study, cassava leaves residues was mostly sourced from the farmers own farm and this may be due to the fact that the cassava crop, especially the leaves, is highly savored as a major condiment in the diet of rural farmers and therefore this crop was mostly cultivated on farms and backyard gardens.

Natural pastures in the tropics are subject to seasonal variability, with the raining season affecting availability and quality of forage (Fadel Elseed *et al.* 2002). In the wet season, goats have abundant feed in the form of herbaceous species and browse plants. However, animals are not allowed to graze freely in the wet season for fear of straying into cropland and causing crop damage. In the dry season when ruminants are allowed to graze freely, feed availability is low as most forages are lignified and low in nutritive value (Nampanzira *et al*. 2015).

V. CONCLUSION

From this study, it was evident that Livestock production is an important economic activity in the surveyed areas. The inclusiveness of women in animal husbandry was quite low. Islam was the most dominant religion with only a few Christians. Majority of the respondents did not gain formal education and farming was their main source of income.

Livestock kept were poultry, small ruminants, pigs and cattle while none of the farmers reared rabbits or grasscutters. During the wet season, management systems was mostly semi-intensive for all livestock with the exception of pigs. Housing provided for poultry birds was mostly in the form of cages, baskets and sheds. Small ruminants were mostly housed in sheds, cattle were sheltered in paddocks and pigs were mostly confined in fenced areas during the rains and left to roam during the dries.

Majority of the household heads practiced grazing/ scavenging as the main method of feeding animals with only few adopting zero-grazing. Grasses mostly feed upon by the animals were *Panicum maximum*, *Andropogon gayanus* and *Pennisetum purpureum* with the legumes (*Centrosema pubescens*, *Pueraria phaseoloides*, and *Mucuna pruriens*) hardly grazed. Feed resources mostly utilized by these farmers were forages, with few farmers providing concentrate and supplemental feeds. None of the famers fed their animals with hay or silage. Crop residues were utilized by only (30.2%) of the farmers with cassava leaves residues the most fed and soybean haulms the least fed. Shortage of animal feed was most severe in the peak of the dry season (February-march), with majority of households feeding forages during this period by the cut-and carry-method.

RECOMMENDATIONS

Several favorable conditions exists in most rural farming communities for intensifying livestock production. However, these farmers are faced with many challenges which are highlighted in this study. Possible interventions to mitigate these challenges and improve the performance of small scale production are as follows;

1. Advocate for the implementation of gender policies geared towards the inclusion of more women in livestock production. MAFFS have indicated that they have defined policies but lack the resources to implement. Also equal opportunities for women to access credit complimented with subsidies and at reduced rates of interests along with insurance schemes should be provided. Gender issue are significant especially in livestock value chains and they must be addressed in a sustainable way

2. Facilitate access to quality primary and secondary school education in the rural areas especially in communities with high levels of illiteracy

3. Improve access to safe drinking water and sanitation as this may have a positive impact on food and nutritional security

4. Farm field schools for livestock farmers should not only include climate-smart animal husbandry modules but also include animal feed production (especially preservation of hay and silage making) and entrepreneurial/marketing skills

5. GOSL's and its development partners EU, USAID, and World Bank, should promote investments in the livestock value chains especially cane rats and rabbits to diversify livelihoods and reduce vulnerability to shocks. The proliferation of grasscutter farming could also help reduce the risk of a possible re-emergence and transmission of Zoonotic diseases such as the Ebola virus disease (EVD) by providing a readily available and safe source of bush meat.

6. Promote further investment on intensive breeding programs (especially for cattle, goats and sheep) that will

not only increase numbers but also improve performance of the local breeds in terms of meat and milk output through crossing of local breeds with exotic breeds

7. Facilitate the implementation of land ownership policies, and land improvement and conservation strategies. MAF, MLCPE, and EPASL have clearly defined policies that will give women and youths access to land and property and mitigate the effects of climate change through environmental protection. However, they are constrained by lack of funds.

8. Embark on morphological and genotypic characterization of forages existing in the rural livestock farming areas. This will inform decisions on the selection of forages with high economic value for propagation on pasture lands.

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