Effect of PPR disease on socio-economic characteristics of farmers in Moyamba District, Sierra Leone

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Goats provide the critical link between traditional and modern culture with the relevant spiritual, religious, cultural and economic values, especially in black Africa. Although different animals are associated with different phenomena in the spiritual and human world, goats today carry a broader meaning in the economic lives of the people. This study investigated the effects of peste des petits ruminants (PPR) disease on goat herds and on the socio-economic characteristics of the rural poor in Sierra Leone. A survey (involving 120 randomly-selected respondents in 10 animal-rearing village communities) was conducted across 4 chiefdoms in Moyamba District, Sierra Leone. The study showed that PPR disease was an existential threat to goat herds in the investigated rural communities, with the potential of wiping out entire herds in a community. With this characteristic signature, PPR disease in goats affected every aspect of the socio-economic lives of the rural poor in the study area. Herd size varied with reasons for rearing the animals, which also varied with the degree to which the people relied on the herds for livelihood. Sufficient land and pasture were available for raising huge herds of goats and other ruminants in the study area. The culture too was supportive of goat market in the region, providing a strong basis for the development of livestock industry in the country. However, there was a clear need for relevant stakeholders to join hands to protect the industry. Among others, there was the need to develop supportive policies to prevent, treat and eliminate especially the highly-deadly PPR disease in the region. This will have beneficial ripple effects on rural communities in the study area and beyond.

Keywords: PPR disease, ruminant, water source, morbidity and mortality, goat herd, Sierra Leone

Abstract

Introduction

As human civilization has always held a special place for animals, human-animal connection runs deep the entire history of mankind. The practice of animal husbandry started at about the same time as that of agriculture. Animal husbandry is a branch of agriculture that deals with the domestication, caring and breeding of animals (Zeder 1982; Mark 2010). Although goats and sheep were domesticated in the Middle East some 10 000 BC (Farrari et al. 2016), the importance of small ruminants in the tropics is well recognized (Williamson & Payne 1978). Sheep and goats mainly constitute the small ruminants with a range of cultural connotations, social statuses, religions ceremonies and economic wealth.

Tropical Africa has one-sixth of the world's flock of sheep and one-third of that of goat (Lockhart 2016). Total meat from sheep and goat in Africa was estimated at 1.3 million metric tons, about 16% of the world total (FAO 2005). In Africa, sheep and goat contribute respectively 10.9% and 8.4% of total meat and 8.6% and 18.2% of total milk production (FAO 1982). Ruminants (large or small) graze on a wide range of grass, shrub and other plants that other species of domestic animals tend to refuse. Although small ruminants are easier to keep and are quite more prolific than large ones (Kristina et al. 2017), their contributions to the economy, food security and livelihood of communities are often overlooked.

Animal husbandry in Serra Leone is uneven, but people raise more small ruminants than large ones. Like in many other countries, sheep and goat are among the main small ruminant species in Sierra Leone (FAO 2005; SSL 2015). In 2010, the population of sheep and goat was estimated respectively at 682 000 and 803 000 heads (IMF 2012; OEI/FAO 2016). In 2007, some 8.5% and 6.6% of the households in Serra Leone reared goat and sheep, respectively (SSL 2016). The predominant breeds of goat reared in Sierra leone include trypanoso-tolerant West African Dwarf (WAD) and Djallonké breeds (Trail et al. 1980). There are also the larger Sahelian goats and cross-breeds of the WAD and Sahelian goats (Mason 1996).

Goats belong to a species of domesticated animals with the fastest herd growth in the world (Boyazoglu et al. 2005). In addition to the social, cultural and religious functions, goat is nicknamed "mobile bank" or the "poor-man's bank" because of its ready marketability for cash (Imana 2008; Kristina et al. 2017). In Sierra Leone today, a mature goat (2–3 year-old) could cost anything in the range of Le 150 000–250 000 (USD 20–30), depending on the sex, and body size. Especially for the rural poor who live on less than USD 1.0 per day, cash sales from goats can be very handy for household financial matters such as school fees, medical bills, farm labor, food, etc. This makes rearing animals a crucial part of the socio-cultural and economic life of rural communities.

Because they require little care (especially under free-range system) and not only highly adaptable but also survivable under various geo-climatic conditions, goats are the most widely raised ruminants in Sierra Leone. Out of the 812 906 goats raised in the country, 5.0% (40 646) are in Moyamba District; which is the second highest goat herd (23.0%) in the Southern Province of Sierra Leone (SSL 2016). By virtue of this, the socio-cultural and economic livelihood of the people in Moyamba District is very much interwoven with goat rearing (OEI/FAO 2016).

Despite the countless benefits goats provide to farmers and herd communities, the threat of diseases has always intensified. The main disease affecting goat herds in Sierra Leone is Peste des Petits Ruminant (PPR). PPR, also known as 'sheep and goat plague', is a viral disease of goats and sheep that is characterized by fever, mouth sore, diarrhea, pneumonia and eventual death (Fernandez & White 2016). It is caused by *Morbillivirus* which is in the family of *Paramyxoviruses* and it is related to rinderpest, measles and canine distemper (Kgotlele et al. 2014). PPR has a high mortality rate (90–100%) in goats and sheep, which has had a significant socio-economic effect on farmers in Moyamba District. The seasonal (wet or dry season) nature of the outbreak of PPR disease increases the risk of death of goats, which in turn infringes painful economic hardship on farmers (Kihu et al. 2015).

Small ruminants like goats and sheep are particularly susceptible to PPR disease (Kgotlele et al. 2014). The characteristic symptoms of PPR viral disease include high fever, mouth sore, diarrhea, pneumonia and sudden death. In terms of transmission, the disease is contagious, air-borne, water-borne and food-borne; with the initial mild disease condition quickly turning virulent and lethal (Lefevre & Diallo 1990; Couacy-Hymann et al. 2007; Shadmanesh 2014).

About 70% of the world's rural poor depend on livestock for livelihood (FAO 2005). The loss of herds to lethal diseases affects farmers in various ways. This study investigated the socio-economic effects of PPR viral disease on goat farmers in Moyamba District, Sierra Leone. The results of the study could contribute to the development of functional policy strategies to prevent, control and eliminate disease conditions in domesticated animals in not only the study area, but the country at large. This will have huge beneficial implications not only for poor rural farmers, but for national development in the largely agro-driven economy.

Materials and Methods

Study Area

The study was conducted in four chiefdoms (Kori, Kowa, Kamajei and Kongbora) in Moyamba District, which is one of the four districts in the Southern Province of Sierra Leone (Fig. 1). The district covers an area of 6902 km^2 (2,556 mi^2) with population of 259 617 (CSO-SL 2006),

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17.66% of which herd ruminants including goats. The district ranks second in terms of goat herd in the Southern Province, although this is gradually shifting in favor of cattle.

The annual rainfall is 2500 mm, with some 7–8 months of rainy and muddy conditions (the wet season) and 4–5 months of cold, dry and dust weather (the dry season). There are several rivers, streams and inland valley swamps in the district, with secondary forest and grassland as the predominant vegetation. Recently, however, forest vegetation has rapidly disappeared due to slash-burn shifting cultivation, charcoal production for domestic market and lumbering for export market. By the dictates of the culture, a patch of forest is always reserved nearby every village in the district and across the country for the purpose of secret societies and other cultural rites. The dominant occupation in the district is agriculture, skewed largely towards crop production (especially rice, which is the staple food crop of over 90% of the national population). The other cultivated crops include groundnut, maize, cassava, coffee, ginger, etc.

Also a good chunk of the agricultural income is derived from rearing small ruminants (goats and sheep) in the region. Apart from bringing in hard money, ruminants (especially goats and sheep) have special connotations in the socio-cultural lives, running deep through the entire history of the civilization.

Moyamba District is a predominantly a "Kpa-Mende" land (a large tribal sect in Sierra Leone that is notable for the Wonde secret society), where goats are in every aspect deeply connected with culture. With this, disease outbreaks are expected to significantly affect the livelihoods of the people; for which reason the district was selected for research in this study.
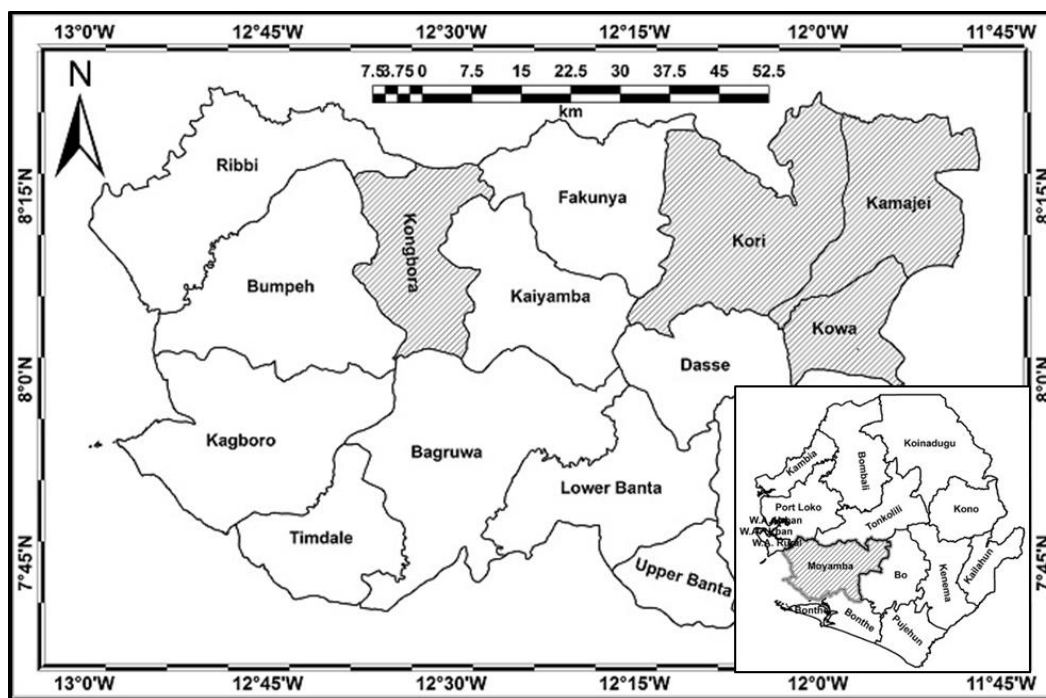

Fig. 1: A map of Sierra Leone depicting Moyamba District (are with strips in inset at bottom right corner) and an expanded map of the district depicting the 4 chiefdoms (regions with strips) covered in the study.

Sample Size

In this study, 120 respondents (goat-rearing household heads) were randomly selected in the top 12 goat-rearing village communities (10 respondents per village) across four chiefdoms (three villages per chiefdom — Kori, Kowa, Kamajei and Kongbora Chiefdoms) in Moyamba District for participation in a survey on the impact of PPR disease in goats on farmers. In Kori Chiefdom were Mokonde, Mosongo and Moyambawo; in Kowa Chiefdom were Njagbahun, Njama and Kayeihun; in Kamajei Chiefdom were Gondama, Senehun and Mogbuma; and then in Kongbora Chiefdom were Pelewahun, Mokorewo and Yaoyema Villages selected.

While the district, chiefdom and village selections were purposively due to their involvement in goat-rearing, the selection of the respondents in a village was random (Karidjo et al. 2018), but also confined to goat-rearing household heads. Thus, a purposive, semi-structured and random sampling method was used to develop a stratified questionnaire such that the information derived adequately reflected the aim and objectives of the study.

Data Collection

A combination of methods was used to collect the data, including desk research (internet, printed publications, etc.) and questionnaire-driven field survey (stratified

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questionnaire, informal interview / discussion, personal observation, etc.).

For the desk research through the internet, search engines were used to locate data relevant to goat rearing. Published books, journals, articles, monographs, etc. were also another key component of the desk research for information relevant to goat rearing.

For the field research, semi-structured questionnaires were developed to solicit information on the socio-economic impacts of PPR disease on farming communities in the study area. Along the questionnaire, random informal interviews were conducted both among and outside the respondent participants in the survey. In some cases, personal observations were used to validate the claims of the respondents. Some indirect comments and interactive discussions were also encouraged.

Data Analysis

The field data collected from the 120 respondents in the 12 villages across the four chiefdoms in the study area were encoded in MS Excel, on which platform simple tallies, frequency distributions, percentages, averages, correlations and variances (including ANOVA) were done. MS Excel is a powerful statistical platform commonly skipped in favor of SPSS, but with a capability commensurate to more commercial statistical packages.
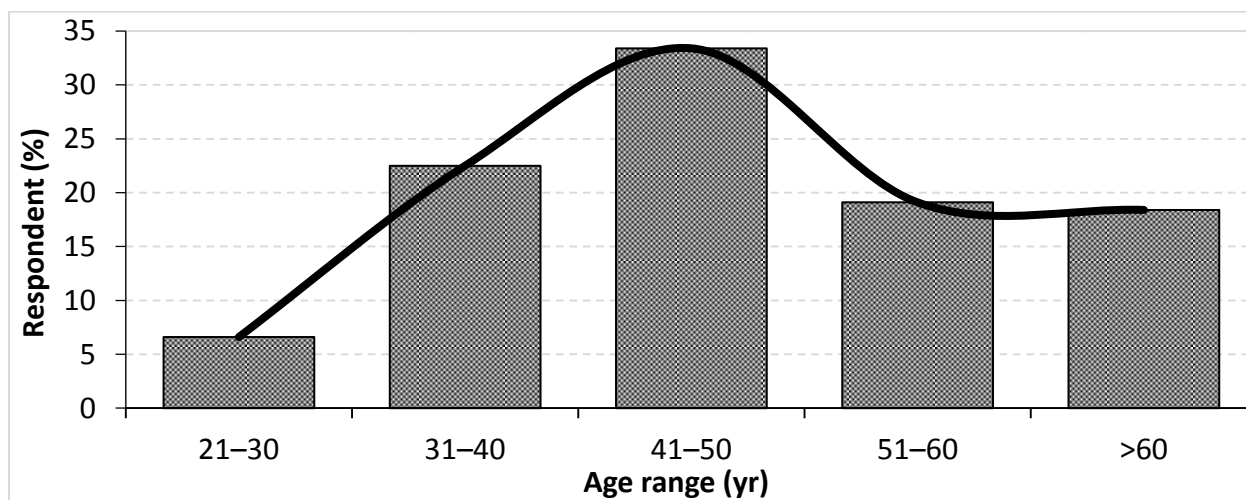
Also tables and graphs (as distribution curves, charts, etc.) were used to discuss the data in relation to the aim and objectives of the study. Qualitative data gathered from personal observations and interactive discussions were used to supplement interpretation of the quantitative data.

Results and Analysis

Respondent Personal Attributes

Fig. 2 shows that a total of 33% of the respondents are in the age bracket of 41–50 years and this is the age group with the largest goat herd in the study area. The other age range (including 31–40, 51–60 and above 60 years) have near-equal distributions. Only a small percent (7%) of the respondents are in the 21–30 age bracket. This is a relatively young age, with less responsibilities and therefore on the constant look for more lucrative prestigious career opportunities than rearing animals.

At middle age (41–50 years), family commitments begin to weigh in with the need to settle down, making goat rearing (a sedentary career) a more viable alternative. People in this age bracket are normally breadwinners, needing to diversify their sources of income, and therefore take up goat rearing as a major source of income in rural communities.

Fig. 2: A plot depicting age distribution of goat owners in Moyamba District, Sierra Leone.

Fig. 3 shows that the sex distribution of goat herders a bit favors the male (67%) over female (33%) and Muslim (56%) over Christian (44%) population of the community. In the Moyamba District study area, it is obligatory for men to belong to the "Wonde" secret society where goat is a must-have requirement. This is the reason why men own and rear more goats than women in the study area. Most women with goat herds are widows of husbands who belonged to the "Wonde" secret society. With widows too, goats provide the income necessary to run the household.

This makes goats such a valuable asset in the study area, which is very much the case for most of continental Africa.

The other half of Fig. 3 which depicts the distribution of goat owners to a large extent depicts the link between goat and religion, especially the Islamic religion. Both Christians and Muslims in the study area appreciate goat meat because of its characteristic flavor and low fat content. Moreover, goat is prolific and highly useful as a social, cultural and economic tool, which rural people so well know and rely on for their livelihood.
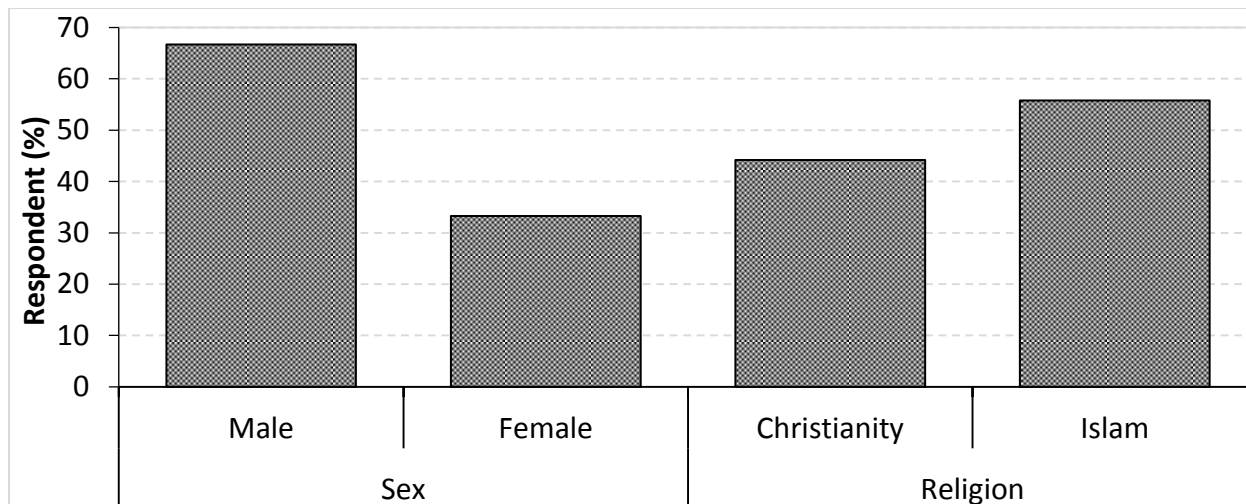
Fig. 3: A bar-chart depicting the distribution of goat owners by sex and religion in selected goat-rearing communities in Moyamba District, Sierra Leone.

Vegetation Distribution

Fig. 4 details the types and distributions (by area) of vegetation in the investigated goat-rearing communities in Moyamba District, of which 66% of the vegetation is shrub. This type of vegetation is very ideal for the West African Dwarf (WAD) goat in terms of size, height and colour. The most dominant colors of WAD goat are black and white; a good camouflage against predators, but also help owners easily locate the animals. The small size makes the goats move with ease under shrub vegetation.

Forest vegetation is today limited to the backyards of villages (mostly reserved for secret society services), alone water courses, in disputed bushes or along administrative boundaries (Larbi 2012). Short fallow periods and periodic burning in the slash-burn shifting cultivation system have increased the area under grassland to 22%. This is good too for sheep rearing as ruminants graze appetizingly on grass more than all vegetation types.
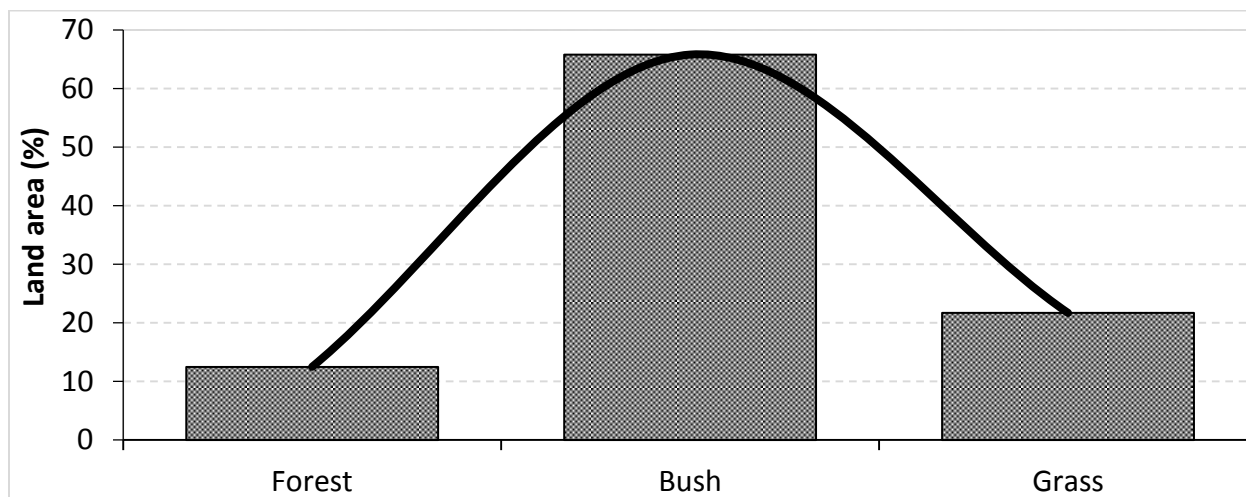

Fig. 4: Plot of the land area under each vegetation type in the investigated goat-rearing communities in Moyamba District, Sierra Leone.

Goat & Water Sources

Fig. 5 shows that over half (52%) of the respondents acquire their animals from the community of residence, 40% from neighboring communities, another 8% from other regions and less than 1% from other countries. This

gives a vivid idea on the risk of diseases from recycling infected animals in the communities. Irrespectively, animal traffic (within or outside the localities) is associated with the spread of diseases (OIE 2011).

The second half of Fig. 5 shows that 70% of the people in the goat-rearing communities use stream as the source

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of water for daily needs. Another 23% of the people use well water and a much less number of people use either tap water (4%) or pond water (3%).

In most rural communities in Sierra Leone (including Moyamba District), most goat owners do not give animals water to drink. The largely free-roaming animals use any available water for drinking. As goats are largely raised under free range system in rural communities, streams provide easy accessibility to water for drinking, but also increase the risks to contract diseases or being eaten up by predator animals.
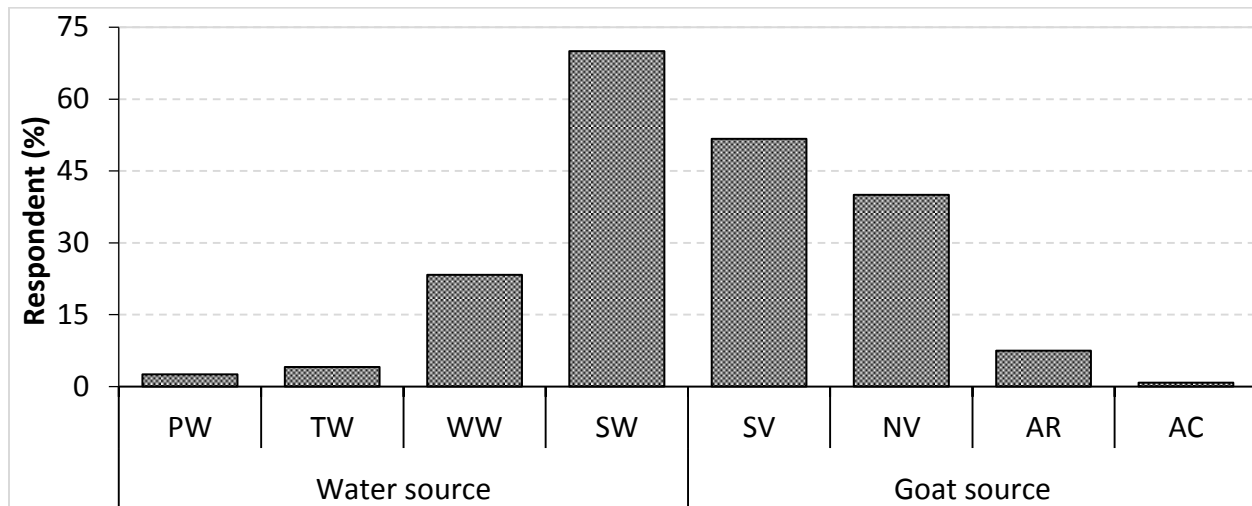
Fig. 5: A plot depicting the distribution of the sources of water and goats in goat-rearing communities in Moyamba District, Sierra Leone. PW = pond water, TW = tap water, WW = well water, SW = stream water, SV = same village, NV = neighboring village, AR = another region and AC = another country.

Herd Size, Management & Sales

The first part of Fig. 6 depicts annual goat sale by herd owners in goat-rearing communities in Moyamba District, with most of the goat owners (66%) selling less than 5 goats per year. Another 26% sell 5–10 goats per year and 8% sell 11–15 goats per year. The dynamics of goat sale suggest that most of the people rear goat for reasons other than generating income. This may include the mandatory requirement of secret societies, naming ceremonies, wedding ceremonies, gifts, burial rites, etc. Nevertheless, the 8% of the people who sell 11–15 goats per year could rear goats mainly for economic reasons.

Also from Fig. 6 (middle section), some 50% of the goats are under free-range all-out system of management. In this system, animals are totally free to roam about and fend for themselves. The animals go out and browser and even sleep in the open air with no overhead shelters. This could be one of the reasons for the periodic outbreaks of diseases in the study area. Another 30% of the animals are under tethering management system, where the animals are tied on ropes. This is mainly done during crop-growing season to avoid conflicts with crop farmers

(Iheukwumere et al. 2007). Tethering can, however, increase the risk of transmission if the virus already exists in a community (Rahman et al. 2015). Only 11% are under free-range all-in and 9% under semi-intensive systems. In free-range half-in system of management, animals are allowed to graze freely and shelters are provided at strategic locations for daytime rest and nighttime accommodation.

The last section of Fig. 6 shows that the majority of the people (65%) have less than 5 goats in the herd. This clearly shows that goats are reared not particularly for income generation, but more salient reasons as social, cultural, educational and religious obligations. Another 29% of the respondents have more than 5, but less than 10 goats and only 8% have over 20 goats in the herd. This clearly suggests that although the vast majority of the people raise goats for reason other than economic, there are also some who do so mainly for economic benefit. Herd sizes of above 20 goats can generate significant income to take care of many other needs in the family. In fact, it is for this reason that goats are nick-named "mobile bank".
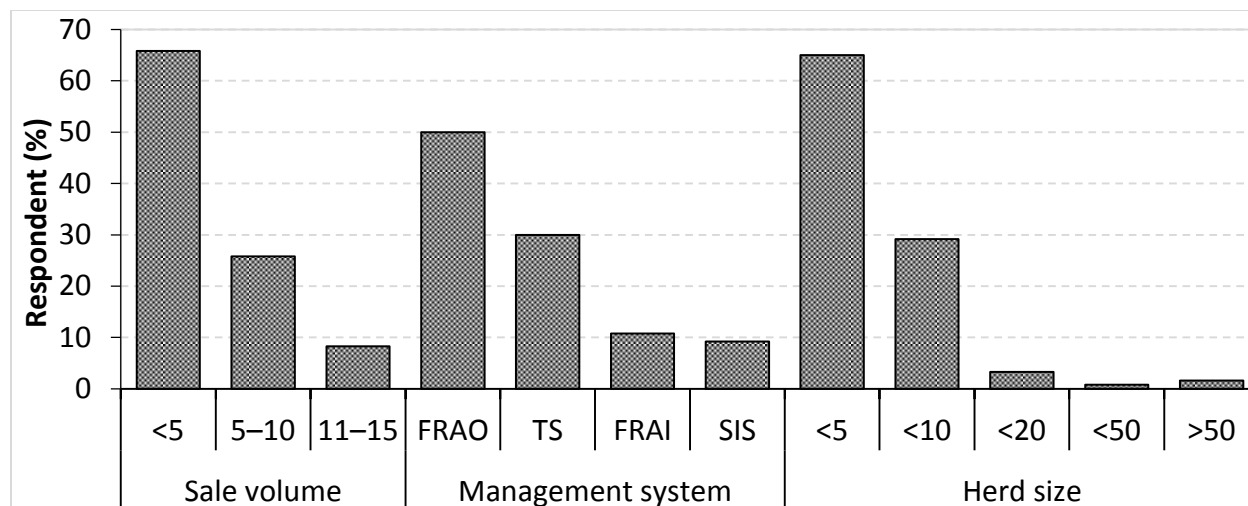
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Fig. 6: A plot depicting the distribution of goats by sale volume, management system and herd size in goat-rearing communities in Moyamba District, Sierra Leone. FRAO = free-range all-out, TS = tethering system, FRAI free-range all-in, and SIS = semi-intensive system.

Reasons for Raising Goats

In Fig. 7 are plotted the distribution of the respondents based on the reasons for raising goats. The plot shows that 82% of the people raise goats to generate income, which could be used to settle various responsibilities, including paying school fees and medical bills, buying furniture and other household goods, etc. Among the other reasons for raising goat include: secret societies (81%) and this includes the "Wonde", "Poro" and "Bondo" societies; family consumption (74%); farming (73%); religious rites (57%); business (46%); marriage ceremonies (40%) and naming ceremonies (40%).

The above distribution shows that the reasons for raising goats are many, underscoring the importance of goat in rural communities in Sierra Leone. According to Kristina et al. (2017), goat is "poor man's friend", meaning that goat can be used for virtually everything. Traditional ceremonies, secret societies, bride prices, guest gestures, funeral rites, spiritual rites, economic tool, as measure of social status or strength, etc. Thus goats, more than many other ruminants, have a special place in the cultural civilization of Sierra Leone.

Goats are easier to acquire and manage than other large ruminants like cattle, and also more aromatic than other similar ruminants like sheep. Thus goats are the 'mobile bank' of the rural poor as they are readily sold to raise income to offset pressing needs. Goats are sold to support farming activities and for buying farm inputs such as planting materials, seeds, fertilizers, agro-chemicals, farm tools and for hiring farm labour. Traditional herbalists, Muslims and Christians use goats for ceremonies initiation, naming, baptism, etc. Goats are so much so accepted that they can be used to serve almost every ceremony or rite. Goats can provide the ready money to start petty-businesses upfront. Sometimes the people run in problems that lead to financial losses in business and goats are sold to raise immediate cash to save the business from collapse. Not many people do not eat goat and hence goat is a particularly preferred as a source of meat in Sierra Leone.
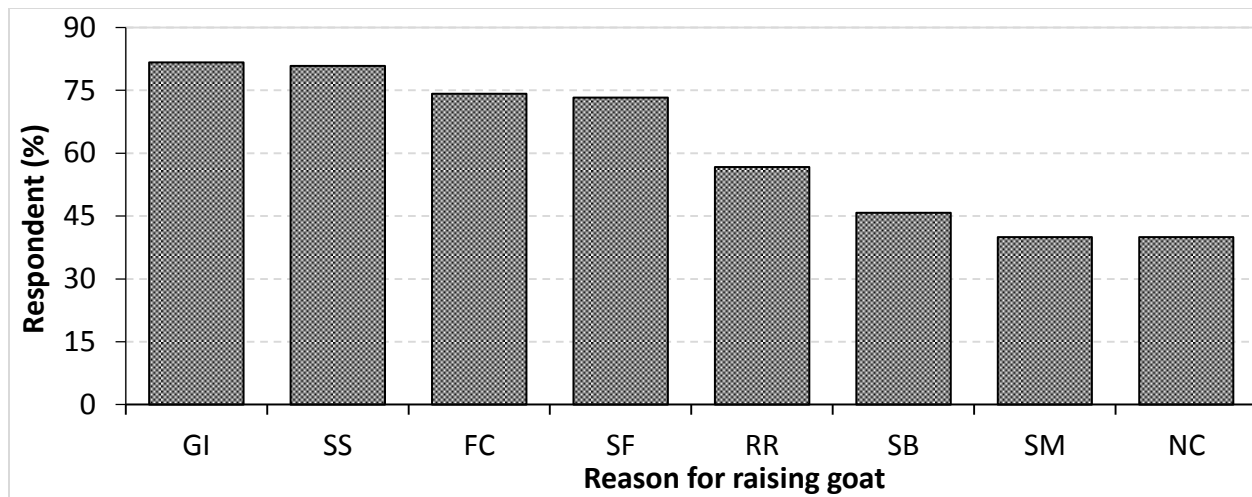
Fig. 7: A plot of the distribution of respondents rearing goats for diverse reasons in goat-rearing communities in Moyamba District, Sierra Leone.

Animal Disease & Farmer's Livelihood

Fig. 8 summarizes the effects of PPR disease on goat herd size and on socio-economic characteristics of farmers in goat-rearing communities in the Moyamba District study area. Based on the responses, goat herd size was affected across the board by PPR disease. In fact, some 50–90% of the herds are lost to the disease during outbreaks (CFSPH 2008). Because of its high morbidity and mortality, each and every farmer describes PPR disease as virulent and deadly (Subir & Islam 2011). Interactive discussions further reveal that sometimes entire flocks are wiped out by PPR disease during outbreaks.

Because PPR disease is highly morbid and mortal in goats, it affects the income of 89% of the farmers in the study area. Across the socio-economic characteristics of the farmers affected by PPR disease infection of goat herds in the study area are farming activity (76%), medical bill (70%), economic status (68%), social status (68%), family debt (64%), food security (63%), business performance (63%), family health (60%) and business opportunity (59%). Because PPR disease condition in goats affect each and every measured socio-economic characteristic of over 50% of the farmers, it is critical that disease conditions in goats are prevented, treated or eliminated in the study area.
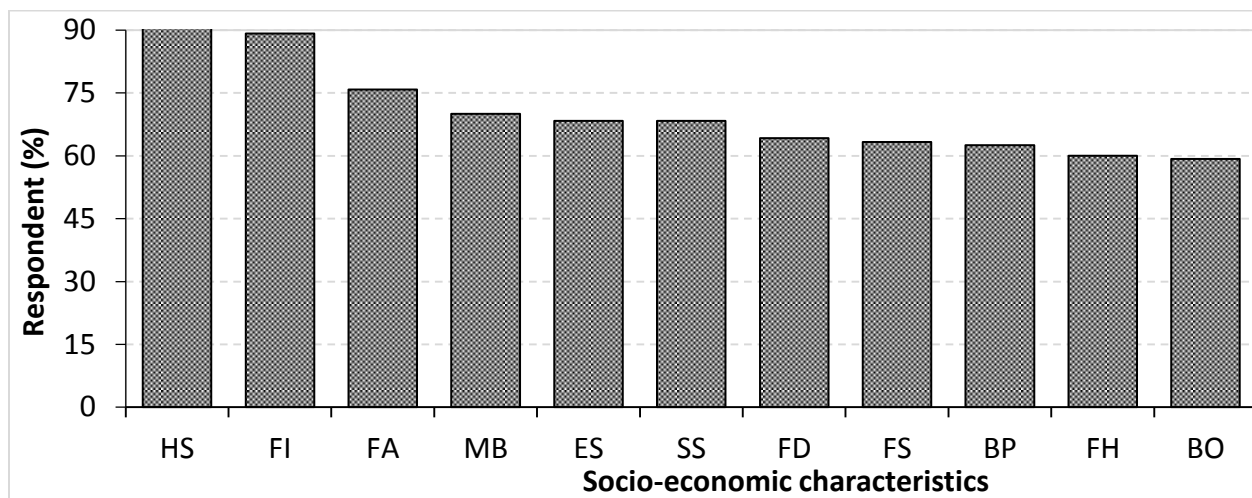

Fig. 8: A plot of the impact of PPR disease on goat herd size and on selected socio-economic characteristics of farmers in goat-rearing communities in Moyamba District, Sierra Leone. HS = herd size, FI = family income, FA = farming activity, MB = medical bill, ES = economic status, SS = social status, FS = food security, BF = business performance, FH = family health and BO = business opportunity.

Discussions

Contrary to numerous reports that women constitute the most farmers in rural Africa (Conteh et al. 2015), farmers

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in rural communities of Moyamba District are mostly men (67%) and are in the age range of 41–50 years (33%). However, the balance is fairly even along religion, with Muslims outnumbering Christians by only 12%. The dominance of male folks in farming in the study area is because the rural poor in Sierra Leone are over 80% illiterate and unskilled, and can therefore only engage in work requiring manual labor. Therefore, women stay behind to do domestic chores in the home. Also farming as it is done in Sierra Leone today, be it animal rearing or crop production, is labor intensive. Because men have dispositional attribute for this kind of work, they take the lead in farming activities in rural communities in Sierra Leone. It is also for the same labor-intensive nature that the physically strong age range of 41–50 years are more in farming than all other ages.

While land is not yet a limitation in rural areas of Sierra Leone, vegetation type and water availability could limit the type of farming that is viable. In the study area, some 66% of the land is bush with another 22% grassland. This mix favors both crop production and animal rearing. Animals are mostly reared under the free-range system of management (61%) with another 30% under tethering management system. These animals are mostly small ruminants, which are less destructive to both the vegetation and the environment. People rely heavily on stream water (70%) for virtually everything, and so are the animals. This is an indication of the abundance of surface water systems (specifically stream) in the study area, which very much blends with the predominant animal management system practiced in the region.

As goats are not the sole mode of livelihood, most farmers do not care about the traits (e.g., disease resistance, prolificacy, etc.), except perhaps size. As such, purchases are mostly made internally; i.e., in the same community (52%) or just from the neighboring communities (40%). This implies that same breeds, or even susceptible breeds, are recycled (Abubakar et al. 2009). This practice exposes the animals to the same threats (e.g., PPR disease) that rapidly become morbid and mortal soon after outbreak (Subir & Islam 2011). The management system, which is largely free-range, only but worsens the risk during epidemic conditions as the animals are little or no at all protected from such hazards.

Disease conditions in animals (especially goats) resulting from such low-level management practices can be devastating both for the animals (as death) and the farmers (as worsening socio-economic conditions). According to CFSPH (2008), some 50–90% of the herds die during animal disease epidemics in Africa. Although less than 4% of the farmers own more than 20 goats in the herd, some 81% raise goats for the purpose of generating income. This implies that a disease condition that end up wiping out the herd can infringe tremendous hardship on the rural poor (Salih et al. 2014). PPR disease condition in goats could also indirectly affect gross domestic product (GDP) of the country, decrease food security and weaken social stability (Conteh et al. 2015). It is therefore critical that local / national governments and authorities join hands to grow animal industry in developing countries like Sierra Leone. Animal diseases prevention, treatment and elimination could be critical in this effort.

Conclusions

Animals are not only food supplements, but food in themselves with an irreplaceable food value as protein. To meet demand for meat, animals are reared and sold in markets. Apart from food value, animals also have social, cultural and economic value in the spiritual, traditional and modern world. It is this trans-world element that makes animals so very critical in the human life today. In study, the effects of animal diseases on herd size and on the socio-economic characteristics of farmers are investigated.

The study covers 120 farmers in 12 goat-rearing village communities in 4 chiefdoms in Moyamba District, Sierra Leone. The study shows that PPR disease affects each and every socio-economic characteristic of the rural poor in the region. The people are very much aware of the morbidity and mortality of PPR disease, but have neither the knowledge nor the means to prevent, treat or eliminate the disease among goat herds. This expresses the need for eternal intervention, which could come from relevant stakeholders such as the private sector, government agencies, non-governmental organizations and the international community. Failure to intervene could only worsen animal disease conditions in rural communities; with negative consequences not only on the livelihoods of the rural poor, but also on nation development and social stability.

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