

Research Article

The Socio-Economic Impact of Foot and Mouth Disease (FMD) on Livestock Farming in Sierra Leone, an Empirical Evidence from Six (6) Districts

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Abstract

As a highly infectious disease, Foot and Mouth disease (FMD) has been eradicated by many wealthy nations but remains endemic in most of the world especially countries in Sub-Saharan Africa¹. When FMD outbreaks occur in disease free countries and zones that produce livestock for export, the economic impact is clear to see; however, the impact of the disease in endemic countries is more controversial, particularly when compared to diseases that cause greater mortality. Taking into account the limited resources of veterinary services for the implementation of animal disease surveillance anywhere and anytime in Sierra Leone, a socio-economic impact assessment study was conducted to quantify the impacts, spread and occurrence of the disease, in order to target and put in place precautionary control measures including targeted surveillance. The main socio-economic impact question of the study was “What is the social and economic impact of FMD in the districts under review. The study was conducted in 6 districts in the North and East of Sierra Leone. A total of 240 respondents using purposive sampling were interviewed to elicit information on the main socio-economic variables that informed the study. The study established (80%) of the sampled farmers are livestock farmers, while 32 people (13.3%) are crop farmers who mainly practice subsistence farming. The study proved that the yearly income from the sales of livestock both especially large ruminants increase to 154 (64.2%). This percentage plummeted when FMD struck in 2018-2019. The study showed that (55.8% of the household indicated that their cattle suffered from Foot and Mouth Disease (FMD) during the outbreak of July-August 2018-2019, while goats and sheep suffered Peste des Petits Ruminants (PPR) with households reporting (70.8%) and 162 (68%) of Infection rates before the commencement of this study. The study recommended that the veterinary division of maintain and improve on active surveillance of FMD, update surveillance plan targeting priority districts and hotspots of FMD outbreak such as livestock markets to maintain the current status of Low risk to prevent social and economic impacts’

Keywords

Foot and Mouth Disease, Ruminants, Veterinary, Sierra Leone, Paddocks

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1. Introduction

The Sierra Leone (SL) livestock sector represents a promising economic opportunity for poverty reduction, growth, diversification, and income generation, especially for small scale farming households, as well as means of providing food safety and nutrition benefits. [1] However, the sector's contribution to GDP has stagnated at 3% in recent years (ref). Livestock production is low, driven largely by traditional production practices and low yielding local animal breeds, and troubled by poor animal nutrition, inadequate production facilities, limited veterinary services and poor management practices. [1] Only 29.4% in rural households engage in livestock production, and livestock is the main source of livelihoods for only 5.9% of rural households (WFP, 2015). In addition, the livestock sector was devastated by EVD outbreak in 2014 as numbers declined across species; goats, - 28.9%, sheep - 43% and chickens - 28.6%, exposing people to greater food and nutrition insecurity (source) [2] The Sierra Leone livestock sector is inundated by persistent structural inadequacies, including inadequate extension capacity, limited knowledge of high yielding animal husbandry or diversification, and poor disease control.[2] Production facilities are of poor quality, with the absence of processing, hatching, breeding and storage infrastructure. Farmers are not adequately organized, trained and informed on animal production techniques. [3] Ninety six percent (96%) of the farmers in targeted districts have little or no knowledge on animal production. Farmer-based organization (FBOs) lack and technical and organizational capability and the absence of farmer networking on production and marketing. Markets are limited in number and under-developed, characterized by irregular information dissemination, insufficient transport and storage facilities. Both public and private veterinary services are abysmally inadequate. There are no formalized institutional mechanisms or platforms to ensure participation, oversight and accountability by farmers. The Livestock and Veterinary Services Division (LVSD) of the Ministry of Agriculture and Forestry (MAF) that has the mandate of providing livestock services has a shortage of staff. The Division also faces protracted resource shortages, receiving only 4% of the ministry's allocated budget (GOSL, 2020) As a result, it contributes to the low performance of the Division except for intermittent vaccination campaigns. Quality standards in livestock are non-existent and there is limited regulatory or certification framework to ensure minimum standard is adhered to. There is hence a clear need for better sector governance and integrated sectorial policymaking for improving and diversifying livestock production. FMD constitutes one of the biggest threats to the attainment of these objectives and it is an important animal disease whose automatically limits the trade of cattle, sheep, goats and pigs, as well as their products. [3]

The demand for livestock products greatly surpasses domestic supply; as a result, imports of livestock and livestock

products are high. The majority of imported livestock from the neighboring countries are transported by trucks and offloaded at designated livestock centres then transported to the paddocks, slaughter house/abattoirs, and livestock markets. [4]

1.1. Aim and Objectives of the Study

The main aim of this study is to assess the social and economic impact of Foot and mouth Disease in Sierra Leone with specific reference to the districts under investigation.

1.2. The Study Was Carried Out to

1. Examine the contribution of livestock on the socio economic status of farmers with special reference to the communities under investigation
2. Determine the Effects of FMD on ruminant production within the study area
3. Assess the economic loss to the farmers as a result of animal deaths due to FMD within the study area
4. Identify appropriate strategies for the control, eradication and prevention of FMD in order to boost livestock production within the study area.

2. Review of Relevant Literature

2.1. An Overview of Foot and Mouth Disease (FMD) - A Theoretical Framework

Foot-and-mouth disease (FMD) is a viral disease that has negative impacts on farmers and stakeholders along the value chain in prevalent countries and when introduced into previously free countries. [5] Impacts encompass direct losses that limit livestock production (such as decreased milk production, lower weight gains, decreased fertility and increased mortality mainly in young animals).[5] The costs associated with the response to disease or infection (such as treatments, vaccination, movement controls and stamping out is enormous. [6] Accordingly, Countries with endemic FMD are denied access to some potentially lucrative export markets for livestock and animal products, giving governments a clear incentive to chain resources to control the disease. [7] It is often assumed that by controlling the disease and according to the World Organization for Animal Health (WOAH), free without vaccination" status, all animal holders (regardless of the production system, size, and access to markets) would benefit, either by increasing their income or increasing availability of animal-source food (ASF), such as milk and meat, in the household. [8]. However, the benefits of controlling the disease in low- and middle-income countries (LMIC) are complex and not well quantified. [8] Further-

more, impact of FMD and consequences of the control program on animal holders' livelihoods and food security is rarely explored. Studies have focused on quantifying the impact of the disease in mixed crop-livestock systems in Africa and Asia, and large-scale commercial or pastoral systems in Africa. [9]

Foot and Mouth Disease can severely affect and disrupt national, regional and international trade in animals and animal products. [10] The burden of FMD in developing countries like Sierra Leone involves the loss of animals and lowering of production efficiency. [11] FMD outbreak in Sierra Leone threatened food security and the livelihoods of smallholders and prevents animal husbandry sectors from devel-

oping their economic potential. [11] Since FMD outbreak was reported in 1958 (VSD) and reoccurred in 2018, no comprehensive vaccination has taken place. [12] The outbreak investigation undertaken for reported FMD outbreak by MAF, FAO-ETAD and Njala University in Tonkolili, Kono, Kambia and Koinadugu Districts in August and September 2018 shows that there was cattle mortality of 15.5% in Kambia district, 2.4% in Koinadugu district and 19.6% in Bombali district [11]. Thus, there was reduced production and productivity and loss of income to farmers, food security and nutrition. If a comprehensive social and economic impact campaign is conducted the tendency for devastating impacts as a result of the disease will be curtailed. [12]

2.2. An Overview of Agriculture and Livestock Sector in Sierra Leone- An Empirical Framework



Figure 1. Map of Sierra Leone.

Sierra Leone is a low income country, and has a Human Development Index of 183/1875. [13]. The country witnessed a devastating civil war that began in 1991 and ended in 2001 (13). In 2017, GDP was estimated at current 3.8 billion US\$ while per capita GDP was 520 current US\$. Sierra Leone's economy annually grew at an average rate of 7.8% (2003-2014); 6.3% (2016) and 4.3% (2017). [13] In 2018,

the growth was expected to grow at 3.7% 8 The country's main economic activity is agriculture that employs slightly more than two thirds of the population and accounts for 40% of gross domestic product (GDP). Crop alone accounts for 29% of the national GDP. Livestock sector contributes about 5.7% of the agricultural GDP, representing 3% of the national GDP [14]. Approximately 70% of the national population

live below the national poverty line. Key challenges to economic development remain – continued effects of the long civil war and other shocks such as Ebola outbreak and COVID-19, characterized by high youth unemployment, poor infrastructure, widespread rural and urban poverty and fragile governance structure. [13]

Sierra Leone is endowed with abundant natural resources. [14] Out of the total country land area, only 58% or 41,300 square kilometres is suitable for agriculture. Of these, only 25% are considered as arable. Most of the human population live in the rural areas mostly engaged in agricultural productivity. The farming system is predominantly subsistence [14]. From data on the 2015 Sierra Leone Statistics, human population census, except in Western Area, and depending on the District, between 64 and 89% of the households practice subsistence agriculture - at least one family member is involved in crop farming, livestock production or fishery activity. In all areas combined, nearly threequarters (73.6%) were

engaged in livestock production- cattle, small ruminants and sheep), poultry (chickens and ducks) amongst others. [14].

Rice is the most cultivated crop followed by cassava. Tree crops such as palm oil are also grown [15]. The livestock breeds reared are local and managed through traditional practices and for subsistence purposes. The main cattle breed in Sierra Leone is the N'Dama which is a dual purpose breed (meat and milk) and also trypanotolerant [15]. The cows produce 2-3 litres of milk daily for a lactation of 7-8 months [15]. The average live weight is 250-330 kgs (cows) and 320 to 360kg (bulls). The small ruminants are of the typical Dwarf breeds - Djallonké sheep and West African Dwarf (WAD) goats Koinadugu District holds 66%, 33% and 26% of the cattle, sheep and goat population respectively. Sheep and goats are kept for various purpose [15]. Goat meat is precious for most people. Sheep are mostly used for Islamic religious purposes of the Eid-ul Adha and other religious ceremonies [16].

Table 1. Livestock Population.

	Number of households	% involved in agriculture (crop and animal husbandry)	% of agricultural households involved in animal husbandry	#cattle	#sheep	#goat	#pigs	#chickens	#Ducks
Kailahun	83,348	89	76	3,289	36,173	75,090	8,645	363,690	48,386
Western Rural	91284	29	85	5,241	10,763	13,876	6,603	203,106	16,950
Western Urban	229,951	4	91	2,014	4,407	3,883	4,343	65,644	6,189
Koinadugu	56,108	88	79	309,291	191,788	212,634	2,892	374,373	22,298
Port Loko	111,701	74	81	20,105	68,581	92,740	4,801	602,327	57,607
Tonkolili	86,840	76	74	9,852	41,473	68,086	4,380	384,659	56,268
Bo	102,723	62	69	4,931	13,303	30,643	6,166	307,955	23,511
Bombali	105,902	63	74	47,592	56,684	78,727	3,190	335,298	17,025
Bonthe	32,538	82	69	1,584	9,967	20,369	1,588	191,121	13,719
Kambia	53,826	84	85	16,375	50,719	63,983	1,755	402,805	34,167
Kenema	111,734	64	63	2,308	19,799	27,272	2,493	284,730	33,193
Moyamba	61,880	84	78	2,464	15,206	42,286	4,918	346,812	21,434
Pujehun	51,514	77	66	720	10,206	15,598	1,338	220,030	18,563
Kono	86,119	67	62	40,051	45,637	69,082	4,765	233,799	26,793
National	1,265,468	57.9		465,871	574,706	814,269	57,877	4,316,349	396,103

Source: Secondary data, 2023.

Note: The yellow shaded districts were regarded as the focus of this study

3. Methods

3.1. Study Design

The study employed a descriptive survey methodology. A mix method of quantitative and qualitative schemes were used for data collection to arrive at empirical conclusion. In order to get varied sources of information that are accurate and coherent, a triangulation of methods and data was also utilized. To get information from the targeted respondents the research instruments used was the structured and semi-structured questionnaires with close and open-ended questions. The structured questionnaires were administered to target households that keep livestock in the respective communities, while the semi-structured questionnaires targeted Key respondents and groups in the form of Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs) to elicit both individual and group perspectives.

3.2. Population and Sample Size

The population of the study comprised all actors along the livestock value chain in the communities visited. A total of 240 participants in 48 communities within 24 chiefdoms were recorded. Four (4) chiefdoms were randomly selected in each district and 2 communities selected in each chiefdom with five (5) household interviewed in each of the selected communities. A focus group discussion taking onboard livestock farmers, and livestock traders in each community was done. Also one (1) Key Informant Interview for one Livestock officer in each district was conducted. The interviewees comprised of 150 Livestock farmers, 50 Livestock traders and 40 butchers. The data collection tools were pre-tested in one of the communities to ensure quality assurance before actual field work which lasted for 6 days. (From the 18-23 October, 2023).

Table 2. Study districts and sample sizes.

District	Number of Focus Group Discussions	households	Key informants
Kono	8	40	1
Portoloko	8	40	1
Bombali	8	40	1
Kambia	8	40	1
Koinadugu	8	40	1
Falaba	8	40	1
total	48	240	6

3.3. Sampling Strategy

A combination of purposive and systematic random sampling techniques with a sampling interval of three (3) structures were used to recruit respondents for the household interviews. The sampling interval was done at opposite directions of houses in a particular community. Unless represented by a member of the household, the head of the household was targeted as the principal interviewee. A purposive sampling was used to recruit only livestock farmers. These respondents were purposely selected as key informants for the study.

3.4. Data Collection and Analyses

The data collected was analyzed quantitatively and qualitatively. Descriptive statistics to analyze the questionnaires was the main type of analysis used for the quantitative data. The Statistical Package for the Social Sciences (SPSS- 20)

and Excel are the softwares employed to produce frequency tables, Bar charts, Pie charts from cross tabulations and correlation techniques. Content and Thematic analyses were done for the qualitative data. Before analysis, the data collected was transcribed to produce transcripts which are coded based on the overarching themes of the study. Manual coding was done to track the various information which was later transformed to quantitative data through codes. All interviews except in cases of local language translation were conducted in krio and some in the local languages. With the assistance of the Ministry of Agriculture, and Forestry through the District Livestock Officers in each of the districts, data collection was done in an atmosphere of cordiality and frankness. The DLOs coordinated and informed the targeted respondents about the survey upon which the researcher was able to execute the study. The collected data was also analyzed though ArcGIS to create maps, especially those that have to do with the study area and the movement of livestock within the area under review. Most of the map data was obtained from vector available on the website.

3.5. Limitations/Challenges Faced During Data Collection

Some of the challenges that were faced by research team during the interviews were:

1. Some of the participants recruited refused to participate in the interviews for the scheduled days and time. The researcher had to either find other participants who suited the criteria or postponed the interview to dates appropriate to the interviewees.
2. The Mountainous and rough terrains of the study area posed some constraints that somehow slowed data collection in some communities that resulted in missing out some respondent who had gone to their farms by the time the researchers got to the communities.
3. Limited information from Epidemiology and laboratory units.
4. Preferably, socio-economic analysis like this, should be followed by epidemiological analysis to describe, the dominant diseases and biological impacts such as morbidity, abortion, and mortality rates.
5. Inadequate literature or data on FMD and other animal

disease and surveillance with regards morbidity and mortality in Sierra Leone.

6. Interface between livestock keepers and veterinary services is weak. Both conditions have led to a situation where communities manage most of the diseases on their own without a good understanding of the disease control.
7. During data entry, the species and clinical signs using a checklist were used to identify the closet disease. This may have led or either over or under estimation of mortality rates.

4. Results

4.1. Demographic Characteristics of the Households

It is interesting to note that majority of the respondents across the six (6) districts are male. These men are so desirous to give information related to the study because they believed that they are more connected to their livestock as compared to their female counterparts.

Table 3. Gender of Respondents.

	frequency	percent	Valid percent	Cumulative percent
Male	209	87.1	87.1	87.1
Female	31	12.9	12.9	100.0
total	240	100.0	100.0	

Source: Field data, 2023.

It is apparent from [table 3](#) that 209 people (87.1%) out of the total population sampled are men. This finding is attributed to the fact men were more accessible and ready to grant interviews because there is the belief that they are closer to their ruminants and anything that has to do with their animals should not be trivialized. It is interesting to note that most of the women at the communities visited could not grant interviews as a result of their business schedules while

others refused to grant interviews, this is why the number of men interviewees surged up.

4.2. Primary Occupation

In order to identify the main occupation of the people interviewed in all the districts, respondents were asked record their main source of economic activity.

Table 4. Primary Occupation of Respondents.

		Name of District						total
		Kono	Koinadugu	Falaba	Kambia	Bombali	Port Loko	
Respondent Primary Occupation	Livestock Farming	31	35	36	22	33	35	192
	Crop farming	8	3	3	8	4	6	32
	Petty trading	1	2	1	4	4	1	13

	Name of District						total
	Kono	Koinadugu	Falaba	Kambia	Bombali	Port Loko	
Civil servant	0	0	1	1	0	0	2
others	1	0	0	0	0	0	1
Total	41	40	41	35	41	42	240

Source: Field Data, 2023.

Table 4 gives a clear indication of the fact that the main occupation of the sampled farmers in the 6 districts is farming. 192 responses (80%) of the sampled farmers are livestock farmers, while 32 people (13.3%) are crop farmers who mainly practice subsistence farming. The higher percentage of people who are livestock farmers in all the districts in the

selected communities could be attributed to targeted sample of this category in these communities. Who solely rely on their livestock. There was a clear evidence of lack of job opportunities in the communities and this explains the fact their choice of farming as the only viable economic activity to eke a living.

"We are cattle farmers, we don't have jobs in this community and our children cannot find jobs after college so this trade is our only source of economic activity" FGD- Livestock farmers Gbindi, Falaba district

Figure 2. FGD, Livestock farmers.

This is illustrated on the chart below:

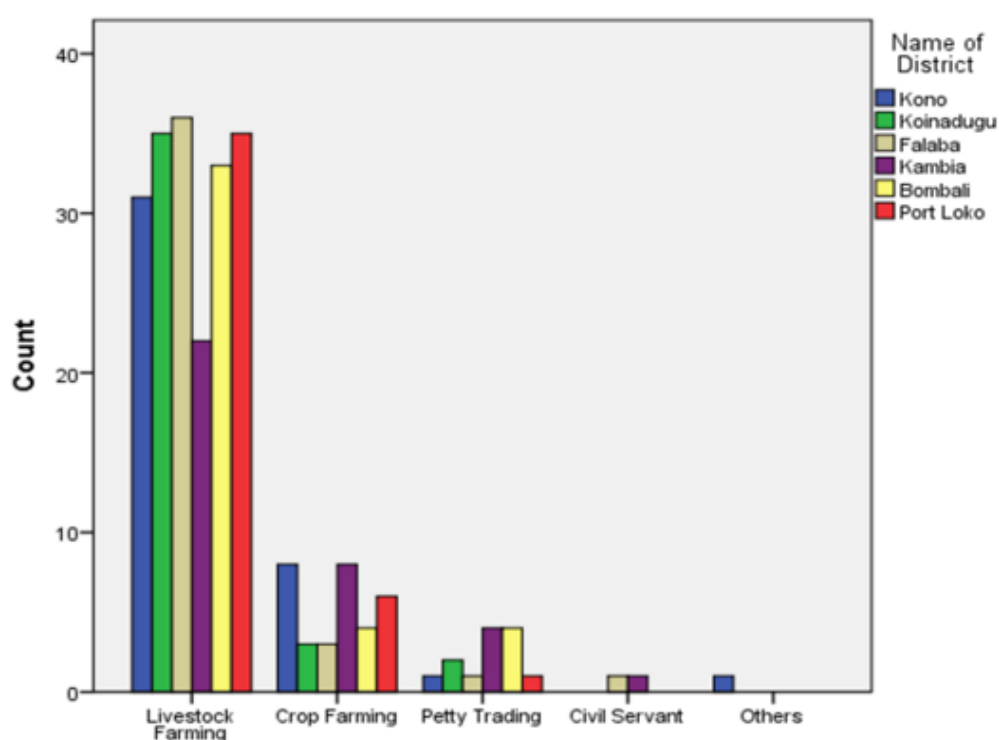


Figure 3. Primary occupation of respondents.

4.3. Educational Status

Since it has to do with education, the research wanted to know the level of education of sampled farmers in the three districts to determine the level of passion for education in the study area. Interestingly the study showed that Arabic education (Others) with 226 responses (94.2.7%) of the people interviewed is the main educational status, with 12(5%) had some formal education.

Table 5. Educational Level of respondents.

		Name of District						Total
		Kono	Koinadugu	Falaba	Kambia	Bombali	Port Loko	
Educational level of respondents	Teachers Certificate	2	0	1	5	1	1	10
	Bachelors	0	0	0	0	0	1	1
	PhD	0	2	1	0	0	0	3
	Others	39	38	39	30	40	40	226
Total		41	40	41	35	41	42	240

Source: Field Data, 2023.

Table 6. Age Category of Respondents.

	frequency	percent	Valid percent	Cumulative percent
15-21	3	1.3	1.3	1.3
21-25	10	4.2	4.2	5.4
25-30	84	35.0	35.0	40.4
35-40	48	20.0	20.0	60.4
40-45	15	6.3	6.3	66.7
45-50	21	8.8	8.8	75.4
50-55	21	8.8	8.8	84.2
Above55	38	15.8	15.8	100.0
Total	240	100.0	100.0	

Source: Field Data, 2023.

This is not a surprising finding because of the ethnic composition of the communities visited especially in Koinadugu, Kambia and Falaba districts. The predominant religion is Islam according to personal observation by the researchers because respondents would abandon the interviews to attend Muslims Prayers. There is a strong correlation between Islam and Arabic education. In Kono district, especially in Gbense Chieftdom the sturdy area, there is a considerable number of Muslims and most of the inhabitants are muslims.

4.4. Age Category of Respondents

The analysis from [table 7](#), above illustrates that 84 (35%) of the farmers who engaged into livestock farming fall under the age bracket of 25-30 years. Only 20% (48) fall under the age of 35-40 years. This explains the fact cattle rearing and other small ruminants is the predominantly done by young people who see the business as a viable economic activity. This is shown on the pie below:

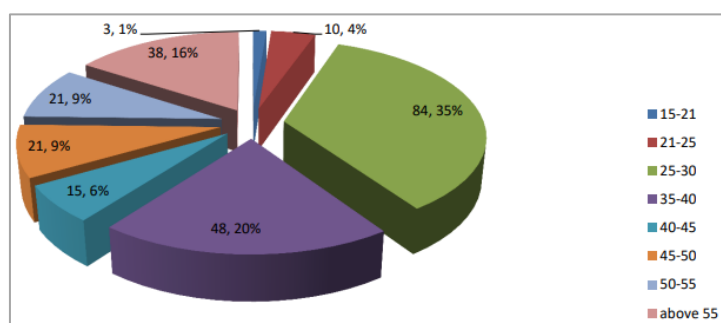


Figure 4. Age category of respondents.

4.5. Economic Status of Farmers Prior to FMD and Livestock Ownership

In a bid to assess the economic status of respondents in the districts, the researcher was able to ask questions regarding the economic wellbeing of livestock farmers so as to understand their income pattern.

Table 7. Yearly income of respondents.

	Kono	Koinadugu	Falaba	Kambia	Bombali	Port Loko	Total
House hold income per year							
Less than Le1,000,000	3	0	1	5	7	3	19
Le 1,000,000	7	3	4	7	2	1	24
Le2,000,000	7	0	1	4	1	7	20
Le3,000,000	2	1	6	3	7	4	23
Above le 3,000,000	22	36	29	16	24	27	154
Total	41	40	41	35	41	42	240

Source: Field data, 2023.

From [table 7](#) above, respondents opined that their yearly income from the sales of livestock both especially large ruminants increase to 154 (64.2 %). This percentage plummeted when FMD struck in 2018-2019, sales dropped as a result of the reluctance of traders to buy livestock with the belief that these animals have been affected.

"Our yearly income was over Le 3,000,000 and this has been able to help us take care of our family, FMD outbreak in 2018 saw a drastic reduction in incomes with serious consequences"- [FGD- Livestock traders and farmers in Kambia](#)

Figure 5. FGD, livestock traders.

It is interesting to note that the present situation as the study revealed is that sales are still slow due to the depreciation of the Leone as against the Franc. Livestock farmers and traders lamented that traders from Guinea are paranoid about the danger to selling their livestock into Sierra Leone since they cannot be guaranteed of profits. However, there is still a booming livestock market that is controlled by the forces of demand and supply. The demand for meat is still high in the districts and this has contributed to most farmers having

more incomes, something they did not enjoy during the FMD days.

4.6. Livestock Ownership

The results on [table 8](#) show that 164(68.3%) of the farmers owned cattle and 62(25.8%) owned goats, and 6(3%) owned chicken. It is important to note that cattle's rearing is predominant in all the districts visited especially in Kono,

Koinadugu and Kabala. From the observation of the researcher this type of animal husbandry is known to be the trade of the Fullahs, albeit other tribes have joined trade too. Respondents avowed that cattle rearing is more lucrative s

compared to sheep and goats and that the price of one Cow or Bull cannot be commensurate to that of a Goat or Sheep. So the more cattle one has the more the income. This is explained further below.

Table 8. Livestock ownership.

		Names of District						Total
		Kono	Koinadugu	Falaba	Kambia	Bombali	Port Loko	
Number of Live-stock Owned by Community People	Cattle	11	36	32	26	28	31	164
	Sheep	4	0	0	0	0	0	4
	Goats	22	4	8	9	8	11	62
	Pigs	4	0	0	0	0	0	4
	chicken	0	0	1	0	5	0	6
Total		41	40	41	35	41	42	240

Source: Field Data, 2023.

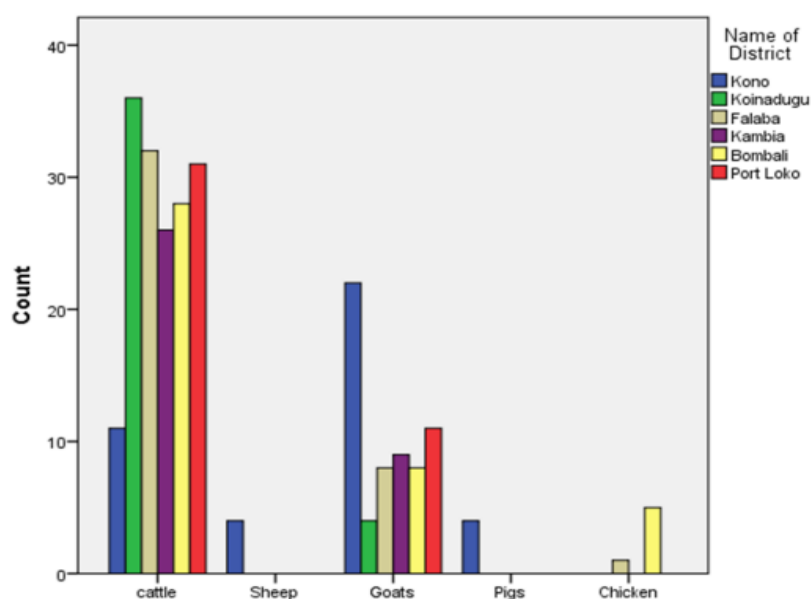


Figure 6. Number of livestock owned by farmers.

Table 9. Chi square test for livestock ownership and income.

	Value	df	Asymp. Sig. (2-Sided)
Pearson Chi-Square	89.651 a	20	.000
Likelihood Ratio	76.739	20	.000
Linear-by-Linear Association	3.650	1	.056
N of Valid Cases	240		

Value

df

Asymp. Sig. (2-Sided)

18 cells (960.0%) have expected count less than 5. The minimum expected count is .58.

The Pearson Chi-Square in the above table 9 gives a significant relationship between Livestock ownership and the incomes of the farmers. P value= 0.000 significant at 0.05 in a 95% confidence interval. Farmers who owned more cattle, Goats and Chicken got more incomes from the sales and were able to finance much needed household responsibilities such as; Education, Health, Food, shelter and clothing. This illustrated on the chart below:

4.7. Contribution of Livestock to Household Income

Data from key informant Interviews (KIIs) on cattle sheep, goat and poultry marketing, discovered that the animals are traded at weekly (Trade fairs) or daily markets (at larger trading centres). The markets are selected for sale of food and other household commodities. Few if any markets are designated as livestock. In addition, on Fridays, animals are sold informally and mostly purchased by Muslims. Both farmers and primary traders participate at the primary markets, while traders are key actors at secondary and tertiary markets. Buyers at markets include local communities and butchers. However, as shall be seen in later in the section presenting livestock development challenges, undeveloped livestock markets are mentioned. Local communities mostly used crop income to acquire the animals for rearing or for sociocultural reasons. This implies that if FMD epidemics happened, farmers who had surplus food or cash crops to sell are likely to replace the animals that would die from the dis-

eases. Chicks, growers, and eggs are rarely sold at markets. The price ranges for different species of live animals sold at the markets are potted in the table below.

Table 10. Contribution of livestock to household income.

Species/category	Lowest price	Highest price
Adult cocks-	30,000	60,000
Adult hens	20,000	40,000
Adult male sheep-	600,000	1,200,000
Adult male goat	30,000	800,000
Adult female sheep	300,000	800,000
Adult female goat	200,000	500,000

Source: Field Data, 2023.

As things get normal the sales of these ruminants become an important economic activity of the people. FMD outbreaks however will practically thwart the effort of the trader the communities. These prices are just normally in the short run and could be changing from time to time depending on the demand schedule of the buyers This LowHigh price relationship for these ruminants is shown below.

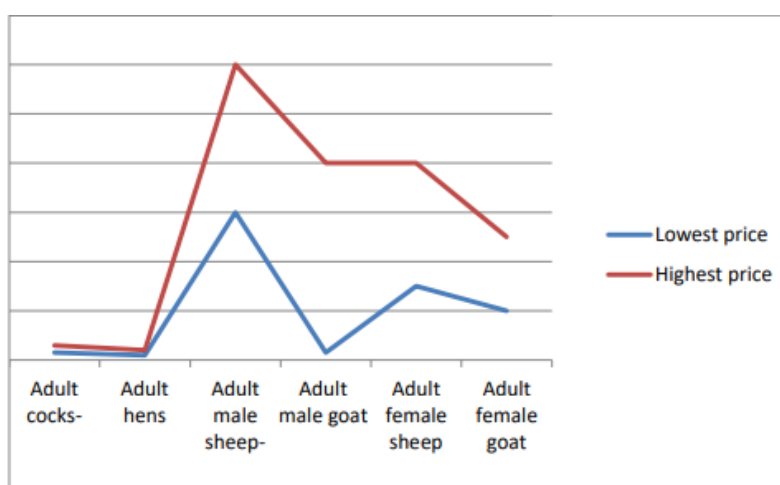


Figure 7. Contribution of livestock to household income.

Sale of sheep and goats, as well as chickens overlaps with religious celebrations of the Christian (April and December) and Muslim communities (August to September). Livestock keeping household data shows that of the total household income, 41% originated from crops while 34% originates from livestock. 16% originated from petty trading/business.

4.8. Consumption of Animal Source Foods and Contribution to Food Security

In Sierra Leone, animal source diets contributed only 4% to the total calories (2130) intake¹⁵. It is interesting to note that majority of the households interviewed consumed less goat, sheep, beef and poultry meat. According for FGDS in the communities, most of the livestock especially chickens are used in exchange for other food items like grains. Family livestock are hardly consumed by household members and in some cases presented to strangers either as food or live birds.

Table 11. *Percentage of households who reported consumption of animal source foods.*

% household that reported consumption	
Beef	10%
Cow milk	26%
Sheep meat	5%
Goat meat	5%
Poultry meat	96%
Eggs	70%

Source: Field data, 2023.

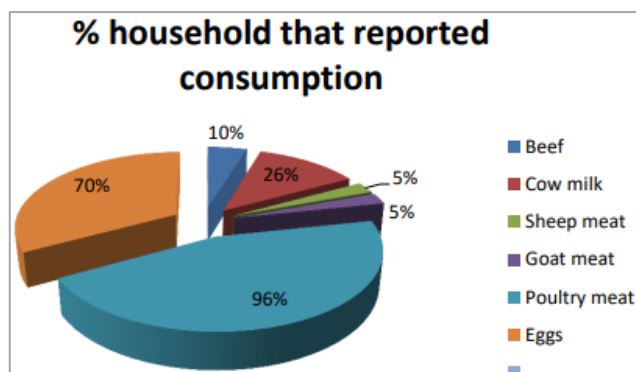


Figure 8. *Percentage of households that consume animal products.*

Table 11 gives a clear indication that 96% of the people in the communities consume poultry meat as part of their die-

tary needs, 70% eat eggs, and Cow milk consumption is more in fullah dominated localities.

Social-Cultural Uses

As indicated earlier, ruminants such as sheep and Goats are predominantly used for social and cultural undertakings such as naming events, marriage, functions of secret societies. Most of the functions executed in these communities require traditional obligations by the members to appease certain deities, and ancestral worship. Small ruminants such as Sheep, Goat and Chicken are caught in the cross-fire of tradition.

4.9. Challenges to Livestock Production and Productivity

From the Focus Group discussions, livestock farmers enumerated key challenges that affect livestock health and production. It was made clear that households live in communal villages where animals are not contained, communal crop land is not fenced, and animals are left to forage on free range in lands near the villages and cropping areas. The production system implies that animals congregate freely as a sure-bet for diseases like FMD to thrive. Even though FMD incidences are low in terms of risk in these communities, however, there are some diseases and issues that also affect livestock and livestock production. The table gives an illustration of challenges and their percentage of occurrence.

Table 12. *Challenges to livestock production and productivity.*

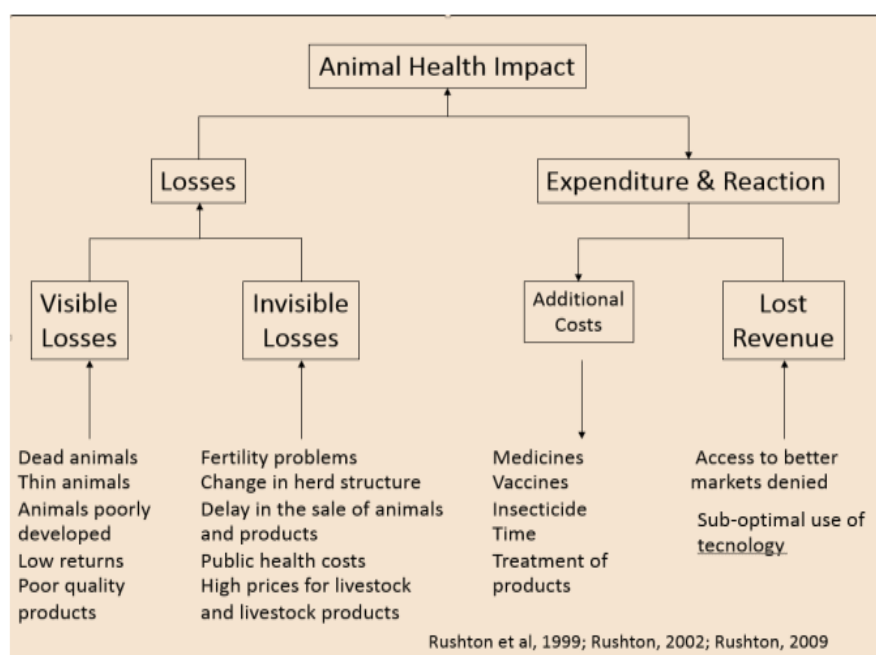
challenges	(% of Occurrence)
Animal diseases	90
Livestock theft	80
Predators (snakes, hawks, rodents, wild animals)	75
Poor animal husbandry and disease management	60
Crop-livestock conflicts	80
Accidents-vehicles and motor bikes (Okada)	30
Availability of feeds-Dry season	60
Low yielding breeds	5
Poorly developed livestock market	4
Land tenure/no land set aside for livestock	3

Source: Field Data, 2023.

The farmers reported that their livestock are normally subjected to strange ailments that lead to mortality, especially during the dry season when less pasture is experienced. Because of their transhumance activities animals especially

cattle are subjected to skin diseases as a result of bites from Tsetse flies which most times rendered them anemic. The pathetic animal health service is mirrored in the animal health service seeking behavior of the communities. When animals fell sick as espoused in the focus group discussions, respondents stated that they utilized unusual medical products or relied on traditional services. The unconventional products applied either topical or oral included: pepper, cassava leaves, salt, alcohol, Kerosene, used oil, petrol, lime, palm oil, cigarettes filters, herbs, bush yams, banana stems, and battery's contents. These unconventional drugs were

seen as cheap and easily available but with mixed efficiency outcomes. In general, poultry owners did not seek animal health services when the birds fell ill. They used unconventional products. In some cases, tetracycline's, chloramphenicol, and ampicillin capsules and human drugs such as paracetamol were used as conventional poultry medications. During the FMD outbreaks, most dead animals were thrown away as they are regarded as illegal to eat according to Islamic law. This is widely practiced by the Fullahs. Some community people will take advantage of the situation to consume dead livestock.



Source: Secondary Data- Rushton et al, 1999.

Figure 9. Socio-economic impact of FMD.

Data from FGDs and Household interviews established that FMD has huge impact on the social and economic livelihoods of the respondents by:

Decreasing the number of livestock (Cattle, sheep and goats) reared by families. Many families reported 100% loss of large small ruminants in which majority of these families depend on them to take care of their families such as paying fees for their children and settling other household bills.

"This is a disaster for us in this community, we have lost all our animals and we don't have any other source of livelihood to pay fees for our children"

FGD_Livestock farmers_Koinadugu

Figure 10. FGD Farmers, Kionadugu.

1. Drastically reducing household income and therefore homes are compelled depend on other sources of income like crop farming and dependent on overseas remittances as a coping strategy.
2. Increasing expenditure of buying alternatives to cattle, goat and sheep meat to satisfy dietary needs of their families.
3. Looking for alternative income to purchase sheep and goat for sociocultural and religious ceremonies.
4. Reducing purchases of farm inputs,
5. Reduced travelling and other sociocultural activities.
6. By consuming or compulsory sale of livestock for fear of being infected sale.
7. Reverting to petty trading as a means to eke a living.
8. Indiscriminate borrowing from others and from cooperatives and associations with huge interest rates.
9. Expenditure on animal drugs, vaccines and other medications.

4.10. Impacts of FMD on Household Consumptions and Expenditure During the 2018/2019 Outbreak

As presented in Table 13 below the impact of FMD led to a reduction of animal products consumed by 50% and purchase of drugs and vaccines when traditional health seeking behavior fails increased by 27.1%. While Panic sales during the outbreak increase by 14.2%. Among other impacts these are the predominant impacts unearthed by the study in

the districts and chiefdoms under review. Research Participants opined that the FMD scourge robbed of the much needed revenue to increase animal produce and production and according to them consuming animal produce such as milk came to stand still for fear of the milk being contaminated, and could not make sales because of the disruptions in markets and the volatility in prices. So this made them to engage into panic sales by accepting any price for a mature bull and cow meant to be sold at higher prices creating a situation of forgone revenue.

"Not that we wanted to sell our cattle at lower prices but we have no choice because we have to survive and pay fees for our children".

FGD_ Livestock farmers_ Port Loo

Figure 11. FGD Livestock farmers Port Loko.

Table 13. Impact of FMD on household consumption and expenditure.

Impacts	Frequency	Percent	Valid Percent	Cumulative percent
Reduced volume of product consumed	119	49.6	49.6	49.6
Increased Consumption of sick Animals that show no Signs of recuperating	8	3.3	3.3	52.9
No change in Consumption	9	3.8	3.8	56.7
Reduced animal Source of food Related to forgone Revenue	5	2.1	2.1	58.8
Panic sales during The outbreak	34	14.2	14.2	72.9
Increased purchase Of drugs and Vaccines when Traditional health Seeking behaviour Fails	65	27.1	14.2	100.0
Total	240	100.0	100.0	

Source: Field data, 2023.

4.11. Stakeholder Compliance to FMD Control Policy and Measures

The study was not only conducted to look at the main socio-economic impact of FMD in the study districts but also to look at the overall acceptance and compliance of control measures by community stakeholders as to direct policy objectives that could yield dividend. The table below gives an illustration of the nature of stakeholders in the respective communities.

Table 14. Stakeholder compliance to FMD control measures.

Do you think the stakeholders or the farmers will comply to any FMD control measure in this community? – IF yes why and if no why not?				
Reasons for complying to control measures	frequency	percent	Valid percent	Cumulative percent
We will be ready to work with the government	16	6.7	6.7	6.7
We are all cattle rearers so we will comply	30	12.5	12.5	19.2
Because they also have farm so it for everybody benefit	23	9.6	9.6	28.8

Do you think the stakeholders or the farmers will comply to any FMD control measure in this community? – IF yes why and if no why not?

Reasons for complying to control measures	frequency	percent	Valid percent	Cumulative percent
Because when the sick normally comes everybody suffer	29	12.1	12.1	40.8
Benefit for the town as it to solve our problems	13	5.4	5.4	46.3
Because it for us all	10	4.2	4.2	50.4
Because it will help to reduce the occurrence of FMD	119	49.6	49.6	100.0
Total	240	100.0	100.0	

Source: Field data, 2023.

From the table above, 50% of the farmers believed that the stakeholders will accept and comply to any FMD control policies or measures in their communities because it will help to reduce the occurrence of FMD. This explains the fact that people in the respective localities are ready to comply to any program available from the Ministry through the veterinary division to stop the menace of FMD. There was a concern from the people that these measures can only work if the stakeholders are consulted and respected and be involved in any decision concerning the control of FMD.

5. Discussion and Conclusion

Animal husbandry and secondary production plays a vital role in the economies of developing countries; through providing protein sources, income, employment and foreign exchange. For low income produces, livestock also serve as a store of wealth. Trans-boundary diseases such as FMD are becoming ever more important since they can spread throughout an entire region, and have impacted trading. It also imposes major social and economic costs and risks to infected countries, and to their neighbors TADs reduce production and productivity, disrupt local and national economies, increasing vulnerability to poverty particularly for small-scale producers and threaten human health. With rapidly increasing globalization; an associated risk of movement of trans-boundary diseases is emerging. During increasing movement of human population, livestock and livestock products within and across countries, together with climate changes, threat from trans-boundary diseases is intensifying. The primary responsibility to control the spread of animal disease belongs to both the country of origin and the receiving country. Regional and international organizations like FAO, give service for the countries in better prevention and control of these diseases. control programme against trans-boundary disease are to establish the “optimal” level of disease presence to meet a country’s goals, and then choose the most cost-effective way to achieve that level of control. So regional and international prevention and control of TADs are the best way to stop transmission and its

emergence through the country even though it have several challenges.

Foot-and-mouth disease is highly contagious and easily breaks out again after claims it is eliminated in Sierra Leone. FMD was discovered in Sierra Leone in 1958 and later raised its ugly head in 2018/2019 with an avalanche of social and economic consequences that crippled the household consumption and expenditure patterns. The economic burden caused by FMD cannot be overemphasized because most the countries that suffered from the disease had bitter experiences to share to the world especially emerging economies. Sierra Leone as a developing country is grappling with the stake economic realities with a feeble veterinary system that needed urgent upgrade to stand the test of time in the event of another outbreak. A country whose economy is partly dependent on agriculture should be ready to invest into its infrastructure and one of these is animal disease control and prevention. A resilient economic is determined by the ability of a country’s readiness to invest in agriculture and all its attendant tributaries like the veterinary branch,

5.1. Conclusion

The study was conducted to measure the impacts of FMD in Sierra Leone in which 6 districts were used as case studies to draw empirical conclusions. It is therefore logical to state that there are devastating impacts of FMD in the areas of this study during the outbreak in 2018/2019. There is a strong correlation between FMD outbreaks and socio-economic impacts. The current situation as the study discovers, is that of low risk of FMD and therefore low socio-economic impacts. The impacts quantified in this study were those the respondents reported during the outbreak two (2) years ago, and could be the same impacts if another outbreak occurs. Empirical evidences showed that FMD has the potential of thwarting the economic gains of farmers thereby rendering them incapable of meeting their household responsibilities.

5.2. Recommendations

From the results generated, it is imperative that the following recommendations are taken into consideration. From the results generated, it is imperative that the following recommendations are taken into consideration.

To the veterinary division

1. Maintain and improve on active surveillance of FMD, update surveillance plan targeting priority districts and hotspots of FMD outbreak such as livestock markets to maintain the current status of Low risk to prevent social and economic impacts.
2. Capacitate surveillance process by training and allocating resources to quarantine officers at active point of entry and paddocks.
3. Deploy trained personnel to undertake surveillance activities in the potential risk areas revealed by the assessment so as to prevent future economic impacts.
4. Update and operationalize the FMD emergency plan and collaborate with farmers to mitigate the risk of social and economic impacts of FMD.
5. Prioritize veterinary work over bribes and kickbacks

for vaccines and other animal drugs and respond adequately when alerted of potential outbreaks.

To the Livestock Farmers

1. Cooperate with the government through the veterinary division of the Ministry of Agriculture, and Forestry on matters related to animal health and disease control to avert the risk of social and economic impacts.
2. Report all animal health related issues to to mitigate occurrence and spread of TADs thereby ensuring minimal effect on social and economic impacts.

Abbreviations

FMD: Foot and Mouth Disease

FAO: Food and Agriculture Organization

WOAH: World Organization of Animal Health

GOSL: Government of Sierra Leone

Conflicts of Interest

The authors declare no conflict of interests.

Appendix



CATTLE GRAZING LAND-WORREH IN FALABA

Figure A1. Cattle grazing at Falaba District.



PADDOCK FACILITY IN KONO

Figure A2. Paddock facility at Kono.



Figure A3. Non- intensive grazing of ccattel at port loko.

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