

# Economic impact of Foot and Mouth Disease (FMD) on domestic small ruminant's production in northern regions of Cameroon

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Received on: 10/04/2023

Accepted on: 25/07/2023

Published on: 30/07/2023

## ABSTRACT

**Aim:** Main purpose of the study was to evaluate economic impact of Foot and Mouth Disease (FMD) in small ruminant's production northern regions (Adamaoua, North and Far North) of Cameroon.

**Method and materials:** In this study, 175 farmers were interviewed using well-structured questionnaires.

**Results:** Morbidity rate of FMD was 96.13% and mortality rate was 20.05% in sheep and 24.22% in goats. The total economic losses associated with the disease were high in the North and Far North regions with averages of 722.54 ± 668.12 USD and 644.80 ± 962.90 USD respectively. The cost of treating 2,716 FMD sick animals was estimated at 6,932.66 USD. Mortality losses were higher in the Far North region with an average of 424.23 ± 652.76USD and differed significantly from the other two regions. A difference was observed in terms of mortality losses by species with an average of 314.50 ± 629.46 USD for sheep and 109.73 ± 143.66 USD for goats.

**Conclusion:** It was concluded that Foot and Mouth Disease is endemic in the Northern Regions of Cameroon which causes financial losses. Socio-economic data on FMD were used to estimate the impact of FMD under endemic conditions in the Northern Regions of Cameroon.

**Keywords:** Economic impact, Foot and Mouth Disease, FMD, small ruminants.

**Cite This Article as:** Dickmu SJ, Hamidou O, Ngu Ngwa V, Noumedem RNG, Wade A, Sevidzem SL, Feussoum JM, Mbanwi CM, Niba AT and Awah Ndukum J (2023). Economic impact of Foot and Mouth Disease (FMD) on domestic small ruminant's production in northern regions of Cameroon. *J. Vet. Res. Adv.*, 05(02): 44-52.

## Introduction

Foot and Mouth Disease (FMD) is a threat to livestock industry in many countries worldwide due to its extraordinary contagiousness and preclude international trade of livestock and its products (Chanchaidechachai *et al.*, 2022). It is one of the most important economic diseases of even toed animals in the tropics, limiting animal production and trade as well as contribute towards food insecurity in regions where there is a high demand for animal protein for population growth (Kerfua *et al.*, 2023). An example of high economic loss due to the disease is devastating 2001 FMD epidemic in United Kingdom (UK) that

resulted in a total cost of over 3.1 billion pounds sterling (Thompson *et al.*, 2002). Another important and documented example is that of Uganda where the government spent 5.3 million pounds sterling and 7.5 million pounds sterling in the 2007/2008 and 2008/2009 budgetary years respectively to control FMD (Kasambula *et al.*, 2012). In Cameroon, an average economic loss of 164100 ± 18436.8 FCFA in cattle production was reported for the Northern Regions (Baikame, 2021). Till date, there is no report on the economic impact of FMD on small ruminants in Cameroon. The main objective of this study is to evaluate the economic impact associated with FMD in small ruminants in three major cattle rearing northern regions of Cameroon.

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## Materials and Methods

This study was conducted between August 2022 and January 2023 in three major livestock rearing regions notably: Adamaoua, North and Far North regions of Cameroon.

### *Characteristics of the study area*

The characteristics of the study regions were recorded (Table 1).

### *Data collection*

The sample size relied on the availability of farmers who experienced FMD outbreaks in their herds. Thus, a well-structured questionnaire was prepared and administered to 175 small ruminant breeders for data collection.

Information was collected using a semi-structured survey form, interviews and direct observation. The information collected was on the following aspects: (i) socio-demographic characteristics of the respondents such as the geographical location of the herd, the identity of the breeder (age, sex, marital status, religion, level of education), (ii) the socio-economic group to which the respondents belongs (iii) the breeding system and (iv) expenses related to FMD.

The breeders or respondents were informed of the objective of this study, their right to accept or to reject their participation was by free will, the risks and benefits associated with participation in this study and the conditions of confidentiality and privacy were clearly explained to them as well as any other concern related to this study including responses to their questions.

### *Estimation of morbidity and mortality rates*

During the interview, the main epidemiological and clinical characteristics of FMD observed in the herds were described by the farmer interviewed following the administration of the questionnaire. The number of animals at risk, affected and killed by FMD during outbreaks was recorded in order to determine the morbidity and mortality rates using the following formulae:

Morbidity rate = (Number of animals infected during outbreaks) / (Total number of animals at risk) × 100

Mortality rate = (Number of animals that died of FMD during outbreaks) / (Total number of animals at risk) × 100

### *Estimation of economic losses*

The approaches used for evaluating the economic impact of FMD on livestock were those described by Rushton (2009) and Knight-Jones and Rushton (2013). In this study, the economic impact of FMD

was focused on two main costs (treatment and mortality) as follows:

### *Losses due to treatment cost*

Economic losses due to FMD treatment cost were estimated as the algebraic sum of all losses for treatment of cases in all categories as follows:

$$P_{\text{Trait}} = \sum_{i=0}^n (T_i)$$

**P<sub>Trait</sub>** = Total financial losses due to average treatment costs

**T<sub>i</sub>** = Average cost of treating sick animals in a herdi.

### *Losses due to Mortality*

The losses due to mortality were equal to the market price of the animal reported death. Thus, the financial loss due to mortality was calculated as follows:

$$P_{\text{Death}} = \sum_{i=0}^n (N_m * P)$$

**P<sub>Death</sub>** = Financial losses due to mortality

**N<sub>m</sub>** = Number of dead animals

**P** = Normal average market price of an animal

### *Total economic losses*

The total economic losses were the sum of all losses i.e. treatment cost and mortality cost:

$$P_{\text{ET}} = \sum_{i=0}^n (P_{\text{Trait}} + P_{\text{Death}})$$

**P<sub>ET</sub>**: Total economic losses for all herds

**P<sub>E<sub>Trait</sub></sub>**: Loss due to processing cost

**P<sub>E<sub>Death</sub></sub>**: Economic losses due to mortality

The average economic loss per herd of affected animals was determined by dividing the total economic loss by the number of animals affected.

### *Statistical analysis*

The data recorded in the survey sheets (questionnaires) were entered into the "Le Sphinx Plus<sup>2</sup>" software (version 5.0) for the production of tables and graphs. Statistical analyses were conducted using SPSS<sup>®</sup> software (version 23.0).

Quantitative data were exported and processed using Microsoft Excel, which was also used for descriptive analysis and automatic calculations of losses according to the aforementioned formulae for the assessment of economic losses.

The One-way Analysis of Variances (ANOVA) was performed to compare the economic losses on small ruminants (sheep and goats) due to treatment and mortality across study variables. Tukey's test, which takes into account the Student's range statistic to perform all pair wise group comparisons, was used for multiple comparisons. For each test, the dependent variable was the categories of losses considered and the independent variables were the socio-economic characteristics of the farmers.

Table 1: Characteristics of the study regions

Region	Characteristics	Data
Adamaoua	Geographical location	5° to 8° North latitude and 11° to 14° East longitude
	Area (km <sup>2</sup> )	63701
	Climate	Sudano-Guinean
	Average temperature (°C)	22.6
	Average annual precipitation (mm)	Between 900 mm and 1500 mm of rain
	Estimated population (inhabitants)	More than 1,015,622
	Population density (inhabitants/km <sup>2</sup> )	16
	Vegetation	Guinean savannah less and less wooded towards the North
North	Geographical location	6° - 10° N and 12° - 16° E
	Area (km <sup>2</sup> )	66 090
	Climate	Sudanese
	Average temperature (°C)	31.5
	Average annual rainfall (mm)	750 - 1250
	Estimated population (inhabitants)	2.152.750 in 2012
	Population density (inhabitants/km <sup>2</sup> )	32.57
	Vegetation	Dry grassy savannah, shrubby and tree savannah
Far North	Geographical location	10° - 12° N and 14° - 15° E
	Area (km <sup>2</sup> )	34246
	Climate	Sudano-Sahelian
	Average temperature (°C)	35
	Average annual rainfall (mm)	800 - 900
	Estimated population (Inhabitants)	3111792
	Population density (inhabitants/km <sup>2</sup> )	91
	Vegetation	Thorny steppes and periodically flooded grasslands

## Results and Discussion

### *Characteristics of breeders surveyed*

During the study, a total of 175 small ruminant breeders were interviewed among which 73/175 (41.7%) were from the North, 50/175 (28.6%) from the Far North and 52/175 (29.7%) from Adamaoua. Among these breeders, individuals >30 years old were frequent (82.9%). Moreover, the breeding of small ruminants is mostly practiced by Muslims, with 86.5% of them encountered in Adamaoua, 65.8% in the North, and 80.0% in the Far North.

The majority (60%) of farmers interviewed have not been to school. Indeed, less than 40% of breeders said they were literate, whether at primary, secondary, and university level. The socio-demographic characteristics of breeders interviewed by region (Table 2).

The farmers declared having recognized lameness (99.4%), the presence of ulcers on hooves (97.7%), appearance of mouth ulcers and erosions of oral mucosa (88.0%), masticatory disorders (82.3%), nasal ulcers (59.4%), mammary gland ulcers (18.3%) and salivation (1.1%). It was the main clinical signs of FMD by farmers (Fig. 1).

### *Mortality and morbidity due to FMD by region and by animal category*

The total herd size was estimated at 5,718 herds of small ruminants comprising of 3,356 sheep and 2,362 goats. Details on mortality and morbidity due to FMD by region and by animal category were recorded (Table 3).

High morbidity and considerable mortality among young lambs (26.17%) and kids (30.49%) compared to adults were observed. Thus, morbidity rate due to FMD was 96.13%, with 44.82% in sheep and 51.31% in goats (Table 4). The mortality rate was 44.27%, with 20.05% in sheep and 24.22% in goats.

### *Morbidity losses*

These losses were related to the cost of treatment of animals affected by FMD. From an economic point of view, the cost of treating 2,716 animals affected by FMD was estimated at 4,159,000 F CFA, or 6,398.5 € with an average value of 23,765 ± 30,811 F CFA and an average of 1,531.3 FCFA per herd of the small ruminant affected by FMD. Table 5 shows losses due to the cost of treatment of the different categories of animals according to the study regions.

Table 2: Characteristics of breeders surveyed

Parameters	Adamaoua	North	Far North	Total
<b>Age :</b>				
< 30	11 (21.2)	9 (12.3)	10 (20.0)	30 (17.1)
> 30	41 (78.8)	64 (87.7)	40 (80.0)	145 (82.9)
<b>Religion :</b>				
Muslim	45 (86.5)	48 (65.8)	40 (80.0)	133 (76.0)
Christians	7 (13.5)	25 (34.2)	10 (20.0)	42 (24.0)
<b>Level of study:</b>				
None	34 (65.4)	46 (63.0)	25 (50.0)	105 (60.0)
Primaries	12 (23.1)	18 (24.7)	22 (44.0)	52 (29.7)
Secondary	6 (11.5)	8 (11.0)	3 (6.0)	17 (9.7)
University	0 (0.0)	1 (1.4)	0 (0.0)	1 (0.6)

Table 3: Mortality and morbidity due to FMD by region and animal category

Categories	Parameters	Adamaoua	North	Far North	Total
<b>Aries</b>	Numbers	163	764	287	<b>1 214</b>
	Dead (%)	10 (6.13)	93 (12.17)	34 (11.85)	<b>137 (11.29)</b>
	Morbid (%)	71 (43.56)	270 (35.34)	117 (40.77)	<b>458 (37.73)</b>
<b>Ewes</b>	Numbers	129	593	252	<b>974</b>
	Dead (%)	7 (5.43)	67 (11.30)	35 (13.89)	<b>109 (11.19)</b>
	Morbid (%)	46 (35.66)	234 (39.46)	99 (39.29)	<b>379 (38.91)</b>
<b>Lambs</b>	Numbers	144	706	323	<b>1173</b>
	Dead (%)	36 (25)	157 (22.24)	114 (35.30)	<b>307 (26.17)</b>
	Morbid (%)	95 (65.97)	334 (47.31)	238 (73.69)	<b>667 (56.86)</b>
<b>He-goats</b>	Numbers	98	412	177	<b>687</b>
	Dead (%)	13 (13.27)	73 (17.72)	27 (15.25)	<b>113 (16.45)</b>
	Morbid (%)	43 (43.88)	192 (46.60)	85 (48.02)	<b>320 (46.58)</b>
<b>Goats</b>	Numbers	127	451	189	<b>767</b>
	Dead (%)	15 (11.81)	87 (19.29)	25 (13.23)	<b>127 (16.56)</b>
	Morbid (%)	55 (43.31)	209 (46.34)	83 (43.92)	<b>347 (45.24)</b>
<b>Kids</b>	Numbers	104	495	303	<b>902</b>
	Dead (%)	30 (28.85)	154 (31.11)	91 (30.03)	<b>275 (30.49)</b>
	Morbid (%)	68 (65.38)	285 (57.58)	192 (63.37)	<b>545 (60.42)</b>

Table 4: Direct losses related to foot-and-mouth disease

Categories	Initial number of animals	Animals present	Animals affected	Animals aborted	Animals dead
Aries	1,214	1,214	458	----	137
Ewes	998	974	379	214	109
Lambs	1,173	1,174	667	----	307
He-Goats	687	687	320	----	113
Goats	793	767	347	190	127
Kids	902	902	545	----	275
<b>Total</b>	<b>5,767</b>	<b>5,718</b>	<b>2,716</b>	<b>404</b>	<b>1,068</b>

Table 5: Losses related to treatment costs for small ruminants affected by FMD according to categories and regions. A.cost.t: average cost related to treatment

Regions	A.cost.t of rams	A.cost.t for ewes	A.cost.t for lambs	A.cost.t for goats	A.cost.t for Goats	A.cost.t for Kids	A.cost.t Pregnant ewes	A.cost.t Pregnant goat	TOTAL
<b>Adamaoua</b>	157,000	103,000	127,500	87,000	98,000	98,500	55,500	57,500	784,000
<b>Far North</b>	176,500	137,000	295,500	121,100	116,000	205,500	156,500	45,500	1, 253,600
<b>North</b>	357,700	341,200	370,500	239,700	275,400	305,600	128,500	102,800	2, 121,400
<b>Grand Total</b>	<b>691,200</b>	<b>581,200</b>	<b>793,500</b>	<b>447,800</b>	<b>489,400</b>	<b>609,600</b>	<b>340,500</b>	<b>205,800</b>	<b>4, 159,000</b>

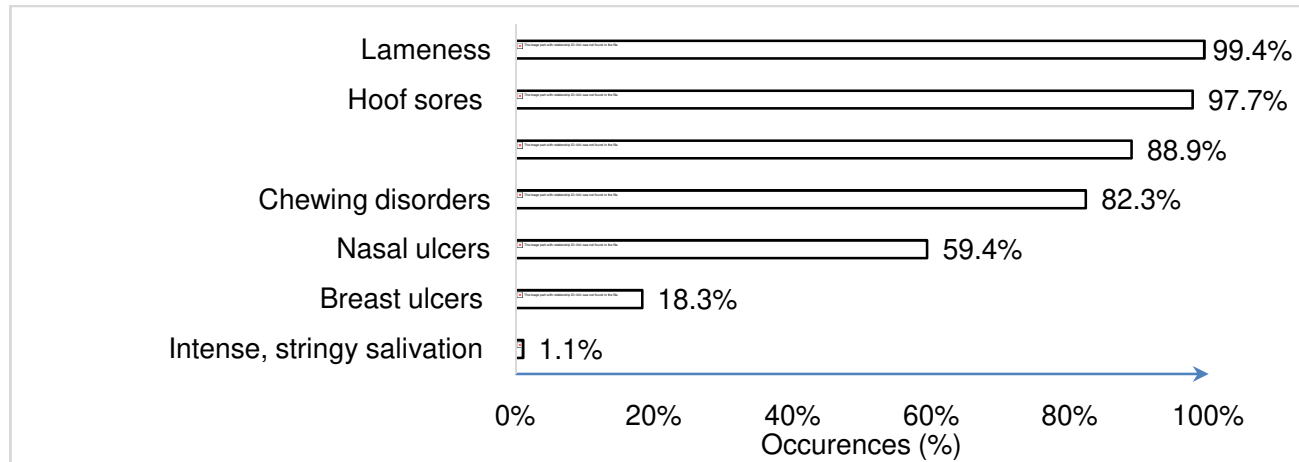


Fig 2: Knowledge of the main clinical signs of FMD by farmers, in percentages of occurrences.

Total losses were high in the North and Far North regions with averages of  $433,526 \pm 400,896$  FCFA and  $386,882 \pm 577,742$  FCFA respectively. Financial losses related to the cost of treatment are higher in the North region with an average of  $188,157 \pm 233,215$  FCFA. Differences were observed in treatment losses by species, with an average of  $118,924 \pm 211,216$  FCFA in sheep against an average of  $69,232 \pm 128,002$  FCFA in goats.

However, losses due to treatment by livestock systems were higher in semi-intensive systems ( $138,315 \pm 248,172$  FCFA) than in extensive systems ( $75,028 \pm 71,968$  FCFA) with no statistically significant difference ( $P > 0.05$ ) (Table 6). Mixed farms (small ruminants and cattle) recorded high average financial losses ( $154,293 \pm 277,957$  FCFA) than those that were not mixed ( $103,600 \pm 181,702$  FCFA) with a statistically significant difference ( $P < 0.05$ ) (Table 6).

No statistically significant difference ( $P > 0.05$ ) in financial losses between religions, level of education and the age of breeders were observed.

#### Mortality losses

Overall financial losses due to mortality were higher in the Far North region with an average of  $254,540 \pm 391,655$  FCFA and differed significantly from that of the other two northern regions. We found that average mortality losses was high in sheep ( $188,700 \pm 377,675$  FCFA) than in goats ( $65,840 \pm 86,194$  FCFA). However, a statistically significant difference ( $P < 0.05$ ) in mortality losses was observed at the regional and ruminant species levels (Table 7).

When the farming systems (semi-intensive, extensive, and intensive) were considered, average losses due to mortality were  $210,299 \pm 2,82785$

FCFA,  $86,580 \pm 78,296$  FCFA and  $77,500 \pm 9,1216$  FCFA for semi-intensive, extensive and intensive respectively. However, no significant difference ( $P > 0.05$ ) was observed according to overall losses between the semi-intensive, intensive and extensive systems (Table 7).

Mixed farms (cattle and small ruminants) had higher average financial losses ( $239,973 \pm 315,462$  FCFA) due to animal mortality than those that were not mixed ( $150,895 \pm 209,210$ ) even though no statistically significant difference ( $P > 0.05$ ) was found (Table 7).

The main clinical signs of FMD were described by almost all of the breeders (59.4% to 99.4%) and some of them include: Lameness, presence of mouth ulcers on the claws, the appearance of mouth ulcers and erosions of the oral mucosa. However, only 1.1% of breeders were able to recognize intense and stringy salivation. The high mastery of the cardinal clinical signs of FMD by the majority of farmers could be explained by its endemic nature and its socio-economic impact as already reported (Lendzele *et al.*, 2021).

The morbidity rate was estimated at 96.13%. The number of small ruminants that died due to FMD was 1,068 heads, of which the mortality rate was estimated at 44.27%. Indeed, the study of Baikame (2021) on bovine FMD in dairy farms reported low mortality (2.2%) caused by FMD. The high mortality rate reported by small ruminant farmers could be explained by the fact that breeders do not easily notice this disease in small ruminants and have neglected the implementation of biosafety measures in their farms and this observation has been reported after the interview of Cameroonian livestock farmers (FAO, 2015).

Table 6: Summary of losses according to the parameters studied

Parameter	Treatment losses (FCFA)		Mortality losses (FCFA)		Total losses (FCFA)	
	Mean $\pm$ standard deviation	P-value	Mean $\pm$ standard deviation	P-value	Mean $\pm$ standard deviation	P-value
<b>Region</b>						
Adamaoua (52)	32 634 $\pm$ 26 882 <sup>a</sup>	< 0,0001	53 940 $\pm$ 60 192 <sup>a</sup>	< 0,0001	86 574 $\pm$ 80 580 <sup>a</sup>	< 0,0001
North (73)	188 157 $\pm$ 233 215 <sup>b</sup>		245 369 $\pm$ 209 782 <sup>b</sup>		433 526 $\pm$ 400 896 <sup>b</sup>	
Far North (50)	13 446 $\pm$ 30 583 <sup>ab</sup>		254 540 $\pm$ 391 655 <sup>b</sup>		386 882 $\pm$ 577 742 <sup>b</sup>	
<b>Religion</b>						
Musulim (133)	125 433 $\pm$ 245 790	0,900	173 153 $\pm$ 216 446	0,2288	298 586 $\pm$ 412 271	0,296
Christian (42)	129 814 $\pm$ 17 840		247 974 $\pm$ 378 841		377 778 $\pm$ 470 185	
<b>Study level</b>						
None (105)	140 547 $\pm$ 271 038	0,602	168 703 $\pm$ 199 867	0,761	309 251 $\pm$ 434 499	0,926
Primary (52)	190036 $\pm$ 113 372		221932 $\pm$ 369 437		311 969 $\pm$ 425 117	
Secondary (17)	148700 $\pm$ 234 428		231852 $\pm$ 261924		380 552 $\pm$ 415 518	
University (1)	167 500 $\pm$ NC		248 000 $\pm$ NC		415 500 $\pm$ NC	
<b>Age</b>						
< 30 (145)	165 743 $\pm$ 382 377	0,5123	17 7650 $\pm$ 264 304	0,7761	343 393 $\pm$ 557 328	0,717
> 30 (30)	118 362 $\pm$ 185 943		193 892 $\pm$ 266 559		312 254 $\pm$ 396 757	

*a,b,c: the parameters assigned the same letters do not differ significantly.*

The negligence in the implementation of biosafety protocols in farms in the northern regions is similar to the report from Cameroon (Lendzele et al., 2022) and elsewhere (Chepkwony et al., 2021). It is well known that FMD is characterized by low mortality rates in calves (Jemberu et al., 2014).

From an economic point of view, the cost of treating 2,716 animals affected by FMD was estimated at 4,159,000 F CFA or 6,398.5 € with an average value of 23,765  $\pm$  30,811 F CFA and an average of 1,531.3 FCFA per head of small ruminant affected by FMD. However, differences in treatment losses was observed at the ruminant species level, where it was high in sheep than in goats. Given that in the northern region, sheep are more valued than goats due to their religious side (sacrificial animals) of the slightest economic loss is felt by breeders. This explains its high cost of treatment compared to that of goats. In this same region of Cameroon, cattle recorded an economic loss of 164,100  $\pm$  18,436.8 FCFA (Baikame, 2021). Losses due to treatment by livestock systems were higher in semi-intensive systems than in extensive systems. Statistically, there is a difference in these losses compared to other systems. Furthermore, there was no difference in the economic losses reported between religions, level of education and the age of breeders. This shows that FMD and other vesicular diseases are frequently encountered and poses serious economic losses to livestock breeders who are mostly muslims and a greater

fraction of the population not reaching high level of education, reason why responses were not statistically significantly different among this indigenous populations across different ages. Furthermore, a nationwide survey conducted in 2012 within the framework of the development of the national strategic plan for FMD control in Cameroon, it was found that each herder incurs an average annual expenditure of 80 000 F CFA on drugs to treat FMD implying the total average annual expenditure of 40% of the estimated 100 000 herders is 32 000 000 000 F CFA (32 Billion F CFA). This is equivalent to 20 000 000 000 F CFA (20 Billion FCFA) and 10 000 000 000 F CFA (10 billion FCFA) respectively (FAO, 2015). However, to reduce the economic loss due to ruminant treatment, an Australian wound dressing formulation, Tri-Solfen® (TS) (Medical Ethics Pty Ltd, Australia; TS) is registered for use in cattle and small ruminant husbandry in Australia and New Zealand, and for FMD therapy in Laos (Windsor et al., 2019) and Cameroon (Lendzele et al., 2020). This product could be used as a cheaper alternative to the more expensive antibiotics that have been observed to be frequently used by livestock farmers to treat FMD in the northern regions (Lendzele et al., 2020). A single treatment of 1ml per lesion for TS, at US\$ 0.50 per ml, the cost of treatment per animal is estimated between US\$ 1.50-2.50. The use of this cheaper formulation could reduce treatment cost of small ruminants with FMD.

Table 7: Economic losses by species according to regions, farming system and association with cattle

Parameter	Processing losses (FCFA)						Mortality losses (FCFA)					
	Sheep Mean ± standard deviation	P- value	Goats Mean ± standard deviation	P- value	Total Mean ± standard deviation	P-value	Sheep Mean ± standard deviation	P- value	Goats Mean ± standard deviation	P-value	Total Mean ± standard deviation	P- value
<b>Region</b>												
Adamaoua (52)	20,134 ± 21,975 <sup>a</sup>		12,500 ± 14,649 <sup>a</sup>		32,634±26,882 <sup>a</sup>		27,969 ± 40,933 <sup>a</sup>		25,971 ± 33,751 <sup>a</sup>		53,940± 60,192 <sup>a</sup>	
North (73)	118,924 ± 211,216 <sup>b</sup>	0.0023	69,232 ± 128,002 <sup>a</sup>	0.054	188,157 ± 233,215 <sup>b</sup>	<0.0001	159,821 ± 184,810 <sup>b</sup>	0.0011	85,547±92,723 <sup>b</sup>	<0.0001	245,369 ± 209,782 <sup>b</sup>	<0.0001
Far North (50)	72,020 ± 130,608 <sup>ab</sup>		62,026 ± 197,843 <sup>a</sup>		13,446± 30,5839 <sup>ab</sup>		188,700 ± 377,675 <sup>b</sup>		65,840 ± 86,194 <sup>b</sup>		254,540 ± 391,655 <sup>b</sup>	
<b>Breeding system</b>												
Extensive (25)	37,604± 30,909	0.342	37,424 ± 53,550	0.86	75,028 ± 71,968	0.0415	49,960 ± 46,750	0.191	36,620 ± 43,208	0.171	86,580 ± 78,296	0.0809
Intensive (2)	9,702 ± 2,041		32,500 ± 43,133		42,202 ±45,534		57,000 ± 62,225		20,500 ± 228,991		77,500± 91,216	
Semi-intensive (148)	85,581 ± 190,893		52,734 ± 146,143		138,315 ± 248,172		143,198± 261,595		67,101 ±85,647		210,299 ± 282,785	
<b>Cattle association</b>												
Yes (79)	95,582 ± 184,098	0.142	58,711 ± 143,456	0.46	154,293 ± 277,957	0.149	162,638 ± 292,594	0.0963	239,973 ± 315,462	0.0268	239,973 ± 315,462	0.0268
No (96)	60,192 ± 132,673		43,407 ± 120,440		103,600 ± 181,702		101,125 ± 191,132		150,895 ± 209,210		150,895 ± 209,210	

Financial losses due to mortality were higher in the Far North Region than in the other two regions. At the small ruminant species level, the average economic losses due to mortality was high in sheep (188,700 ± 377,675 FCFA) than in goats (65,840 ± 86,194 FCFA). An epidemiological investigation on the occurrence of FMD in goats and sheep in the Northern regions revealed that sheep were highly infected than goats, hence the reported high mortality losses reported in sheep by farmers was not surprising. The possible reason why this economic loss due to mortality caused by FMD is highly felt by farmers of the Northern regions because this ruminant species is most raised as it is highly demanded during religious and cultural feasts of Muslims that constituted the most frequent group involved in the rearing of this ruminant species.

### Conclusion

In conclusion, Foot and Mouth Disease is endemic in the Northern Regions of Cameroon which causes financial losses. Socio-economic data on FMD were used to estimate the impact of FMD under endemic conditions in the Northern Regions of Cameroon. During FMD outbreaks, some farmers lost at least one small ruminant. This resulted in high economic losses for some farmers. The economic aspects of these losses are of great importance to both the livestock farmers and the country. The monetary value of the losses for the three regions was estimated at 4,159,000 CFA or 6,398.5 euros. Controlling FMD would be essential to limit losses and increase the income of livestock farmers and reduce gaps in national production and demand.

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