



# Economic Implication of *Peste des Petits Ruminants* (PPR) Outbreak On a Small-Scale Farm in Ibadan, Nigeria

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## Abstract

*Peste des Petits Ruminants (PPR), a global menace and threat to the survivability of the sheep and goat industry in West Africa and many other parts of the world has significantly hampered livestock production. This study illustrates the economic implication of a PPR disease outbreak on a typical small-scale farm in Ibadan, Nigeria. The costs due to mortality, medications used to manage the morbid ones, as well as personnel costs were estimated to produce an outlook of what the farmer lost in financial terms to the outbreak.*

**Keywords:** Economic, Outbreak, PPR, Red Sokoto, West African Dwarf.

## Introduction

*Peste des Petits Ruminants* (PPR), also known as sheep and goat plague, is an acute or subacute, highly contagious and economically important transboundary viral disease that poses a great threat to sheep and goat production in Africa and Asia. (FAO, 2023). A disease caused by the PPR virus (PPRV) of the genus *Morbillivirus*, family *Paramixoviridae* (other members of the family cause diseases like rinderpest in cattle, measles in humans, and distemper in dogs), which when introduced into the herds, can cause morbidity of up to 100% and mortality of up to 90%, though mortalities can stay at 70% in areas where the infection is endemic. (OIE, 2022). The disease negatively impacts the livelihood, economy, and food security of affected individual farmers, communities, and countries. Topping the production losses (relating to meat, milk, and hide production) associated with the mortality, morbidity, and high costs incurred in treating, preventing, and controlling PPR; the disease also hampers local and foreign trades, sabotaging the development of intensive small ruminant production. (Jemberu *et al.*, 2022). PPRV (PPR Virus) has been identified as one of the diseases and health challenges that reduce small ruminant production and is currently considered to be the main animal transboundary disease that poses a threat to livestock production in West Africa (Nakayima *et al.*, 2018).

Nigeria having the largest small ruminant population in Africa with a population of 73.8 million goats and 42.1 million sheep – mainly indigenous breeds that are kept majorly for meat, hides, wool, and to a lesser extent, milk. Of this population, 44% are reared in the North-Western part of the country, 14% in the North-Eastern part, 19% in the North-Central part, and 24% (second highest) in the Southern part of the country. (CSIRO, 2020). PPR continues to pose significant constraints to small ruminant production in Nigeria hereby, abating the potential of the small ruminant industry to meet up with the animal protein needs of the country's people. As seen in other countries, PPR clinically presents with fever, depression, serous ocular and nasal discharges, erosive lesions on mucous membranes, stomatitis, and gastroenteritis (Esonu *et al.*, 2022). Deaths could be linked to primary bronchopneumonia and/or severe dehydration from acute diarrhea. Infection of pregnant animals has also been reported to feature abortions (Esonu *et al.*, 2022). It is very important to note that there is a paucity of information on the current epidemiological status of PPR in Nigeria, and the estimated economic implication of disease outbreaks, both of which are crucial to its effective control in the country.

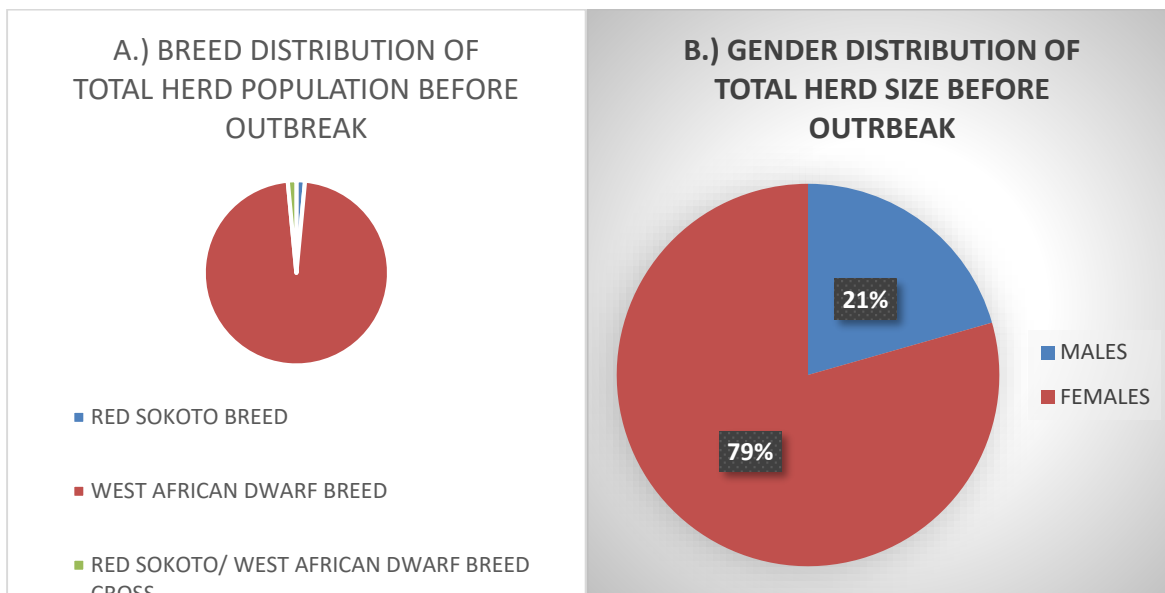
## Materials and Methods

### Case Study

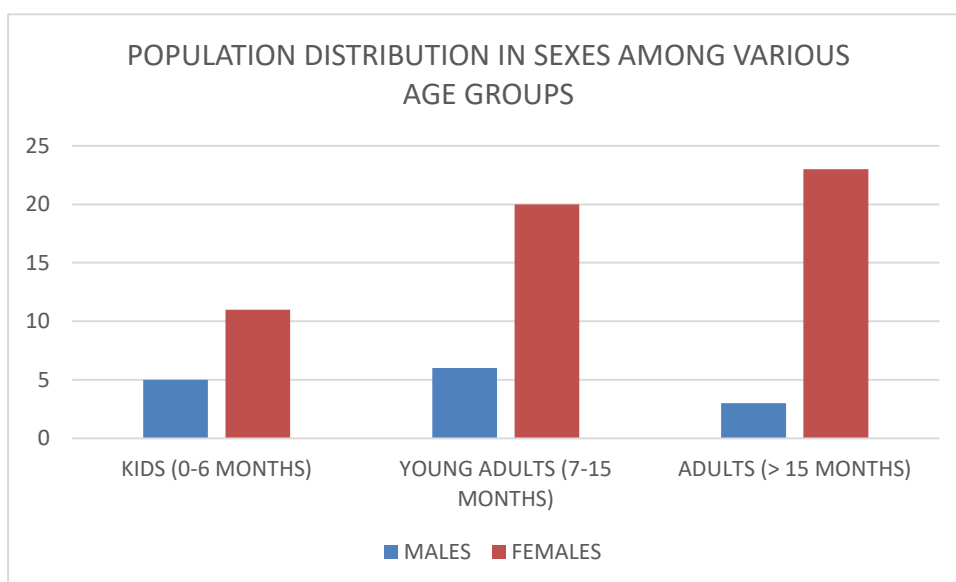
This study captures a series of events that took place after a suspected PPR outbreak on a small ruminant farm owned by a veterinarian, situated in Ibadan, Oyo State, South-Western Nigeria. The whole crisis occurred post-introduction of two newly acquired adult male goats (one of the Red Sokoto breed and the other, a cross of both Red Sokoto and West African Dwarf breeds). Both new bucks were quarantined for about two days before being introduced into the pen to join the already-existing herd.

**Table 1:** Population distribution in the herd before the outbreak.

	Number of males	Number of females	Total number of animals per age group
<b>Kids (0-6 months)</b>	5	11	16
<b>Juveniles/ young adults (7-15 months)</b>	6	20	26
<b>Adults (&gt;15 months)</b>	3	23	26
<b>Grand total of animals in herd before outbreak =</b>			<b>68</b>



**Figure 1:** (A) breed distribution of total herd population before outbreak; (B) the gender distribution of total herd size before outbreak.

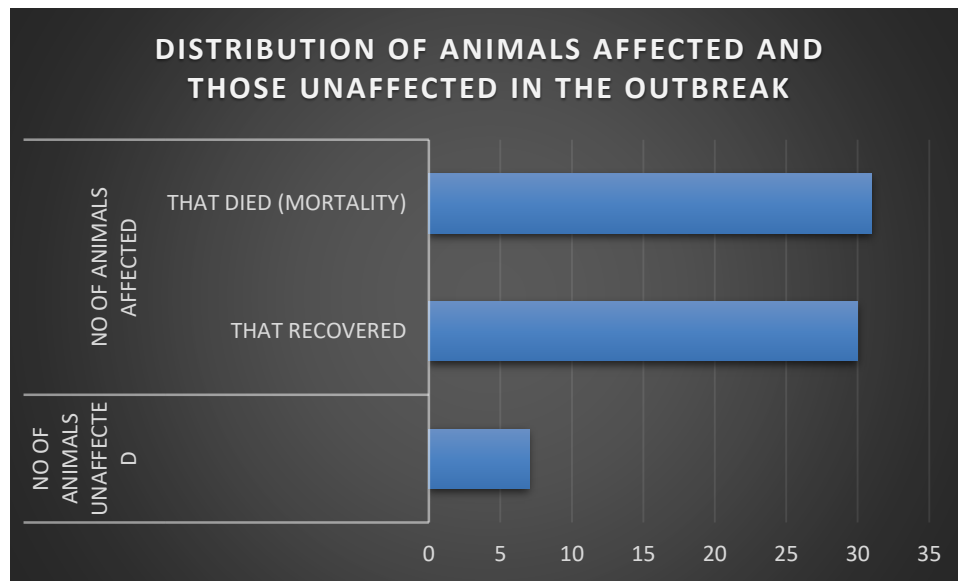


**Figure 2:** population distribution in sexes among various age groups

The outbreak was first noticed about 2 weeks after the introduction of the two newly-bought bucks to the herd with dullness and nasal discharges observed with one of the newly-introduced, precisely the pure breed Red Sokoto buck. The health condition of this buck deteriorated rapidly into severe inappetence, lethargy, anorexia, weight loss, and loss of body condition. After unsuccessful management with antibiotics (of Cephalosporin class- Ceftriaxone injection for 5 days), dextrose saline infusion- administered subcutaneously and intravenously, and Vitamin B Complex injection- administered intramuscularly, the buck died. The second newly introduced likewise, took ill a few days after the first took ill, exhibited the same clinical signs as the first, and died in short succession.

Within the first month of the observed clinical signs first seen in one of the two new bucks, 22 goats were lost-involving 14 kids, 5 young adults, and 3 adults; and with most of the mortalities being females. 9 more goats died over the next month, totaling 31 mortalities. Of the initial 68 goat population, 61 goats (about 90%) became morbid out of which 31 died, and 30 recovered from the infection. The significantly reduced mortalities recorded in the second month of the outbreak was due to a decrease in the overall morbidity rate since there was increased medical intervention, and more sensitive cephalosporins (antibiotics) were administered to prevent secondary bacterial

infection. The morbidity observed across the herd featured varying degrees of clinical signs of anorexia, ruffled coat, dyspnea, diarrhea, ulcerative stomatitis, fever, and abortion.



**Figure 3:** Number of animals affected in the outbreak and the outcomes

## Results

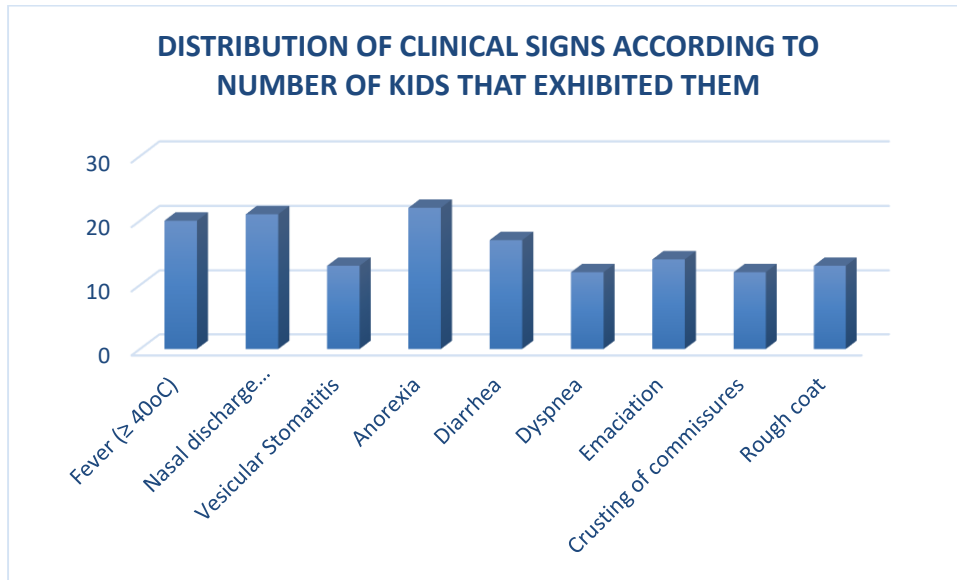
The breed mortalities distribution pattern comprised 29 West African Dwarf (WAD) goats and 2 Red Sokoto goats. Of the 14 (8 adults and 6 juveniles) previously pregnant WAD goats, 9(4 juveniles and 5 adults) aborted a total of 15 fetuses (6 twins and 3 single fetuses), most of the abortions occurring at mid-term. 4 of the 15 fetuses were WAD breeds while the remaining 11 were of mixed (WAD and Red Sokoto) breeds. The breeds were speculated from the morphological appearance of the fetuses' ears and legs- the mixed breeds having longer ears and legs than the WAD fetuses; and the history of the Red Sokoto male bucks introduced to specific females.

**Table 2:** Disease distribution pattern across the herd.

Age	Sex	Total Herd Size	Not Affected	Affected-Morbid	Mortality	Recovered	Pregnant	Not Pregnant	Aborted
Kids	Males	5	0	5	4	1	0	0	0
	Females	11	1	10	10	0	0	0	0
Juveniles	Males	6	1	5	1	4	0	0	0
	Females	20	2	18	6	12	6	14	4
Adults	Males	3	1	2	2	0	0	0	0
	Females	23	2	21	8	13	8	15	5
<b>Grand Total of Animals in Herd</b>		<b>68</b>							

**Table 3:** Distribution of clinical signs among the affected kids in the herd

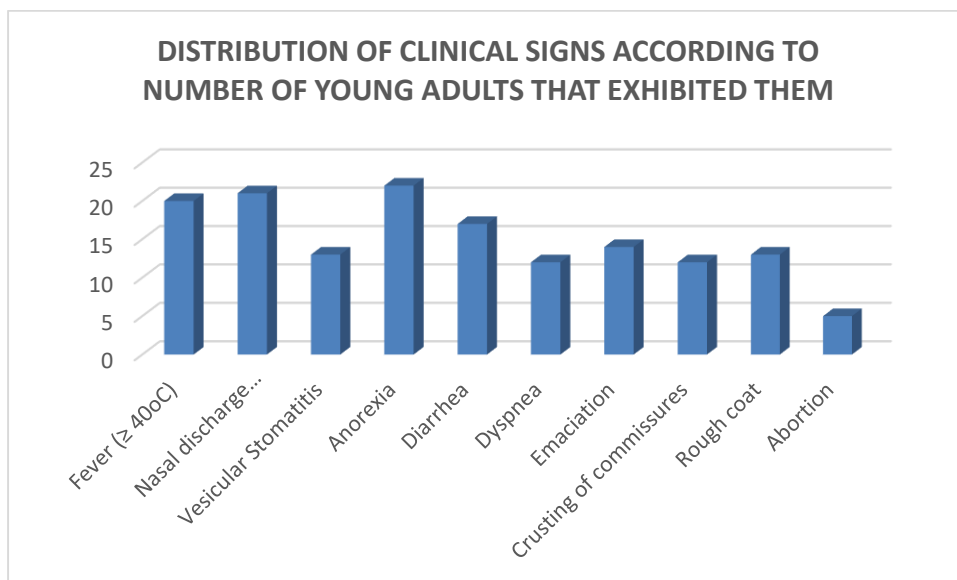
Clinical Signs	Number of Kids that exhibited the clinical signs
Fever ( $\geq 40^{\circ}\text{C}$ )	15
Nasal discharge (mucopurulent)	15
Vesicular Stomatitis	12
Anorexia	15
Diarrhea	15
Dyspnea	13
Emaciation	5
Crusting of commissures	9
Rough coat	5



**Figure 4:** Showing the distribution of clinical signs according to the number of Kids that exhibited them.

**Table 4:** Distribution of clinical signs among the affected young adults (juveniles) in the herd

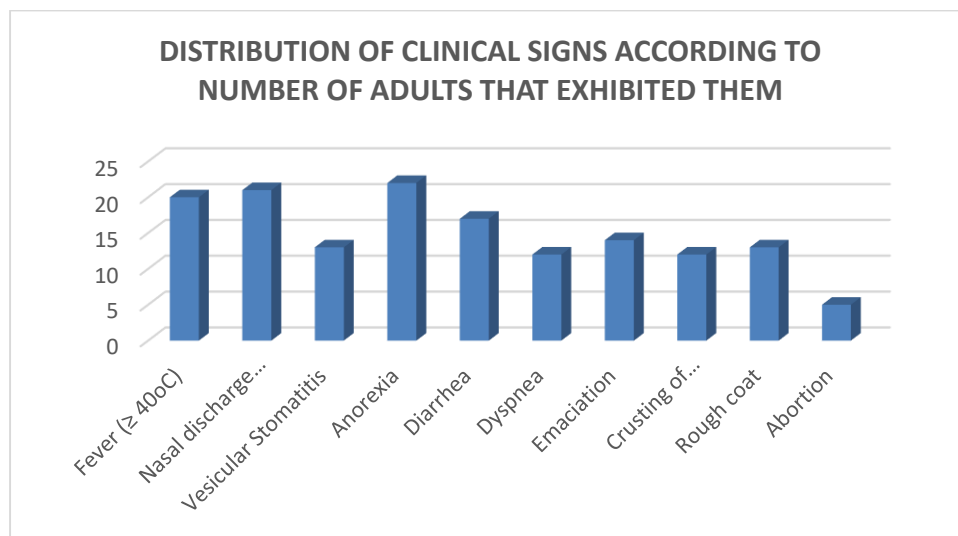
Clinical Signs	Number of Young Adults that exhibited the clinical signs
Fever ( $\geq 40^{\circ}\text{C}$ )	20
Nasal discharge (mucopurulent)	18
Vesicular Stomatitis	18
Anorexia	23
Diarrhea	20
Dyspnea	14
Emaciation	17
Crusting of commissures	17
Rough coat	19
Abortion	4



**Figure 5:** showing the distribution of clinical signs according to the number of Young Adults that exhibited them.

**Table 5:** Distribution of clinical signs among the affected Adults in the herd

Clinical Signs	Number of Adults that exhibited the clinical signs
Fever ( $\geq 40^{\circ}\text{C}$ )	20
Nasal discharge (mucopurulent)	21
Vesicular Stomatitis	13
Anorexia	22
Diarrhea	17
Dyspnea	12
Emaciation	14
Crusting of commissures	12
Rough coat	13
Abortion	5

**Figure 6:** showing the distribution of clinical signs according to the number of Adults that exhibited them.

### Post Mortem Findings

8 animals were posted (4 adults, 2 juveniles, and 2 kids). An aborted male fetus with an enlarged head and shortened jaw was also posted. Lesions identified in their orders of severity are in the table below:

**Table 6:** Post-mortem findings in the posted carcasses

Animal	Sex	Age	Breed	Vesicular stomatitis	Nasal Discharge (mucopurulent)	Hemorrhagic enteritis	Broncho-pneumonia	Acute rhinitis and sinusitis	Pasting of perineum
1	Female	Adult	WAD	++	++	+++	+++	+++	++
2	Male	Adult	R.S	+	++	+++	++	++	++
3	Male	Adult	R.S	++	+++	++	++	+++	+
4	Female	Y. A	WAD	+++	+++	+++	+++	++	+++
5	Female	Adult	WAD	++	+	+++	++	++	++
6	Female	Y. A	WAD	+	++	+++	+++	+++	+++
7	Female	Y. A	WAD	+++	+++	+++	+++	+++	+++
8	Female	Kid	WAD	+	+++	+++	++	++	+++
9	Male	Fetus	MIX-ED	-	-	-	-	-	-

KEY: += mild; ++= moderate; +++= Severe; WAD: West African dwarf; R.S: Red Sokoto; Mixed: Red Sokoto and WAD cross; Y. A: Young Adult

## Discussion

As a case study, the resultant effect of the economic impact of this disease on the farm considered is high and cannot be undermined. As earlier mentioned, the farm recorded a mortality of 31 goats (both young and old), apart from the aborted fetuses. On average, a WAD adult buck, non-pregnant doe, and pregnant doe in the typical southwestern market is valued at ₦35,000, ₦40,000, and about ₦45,000 respectively; while an adult Red Sokoto buck, non-pregnant doe, and pregnant doe are averagely valued at ₦45,000, ₦50,000, and about ₦55,000 respectively. The total adult mortality cost based on the market value of each animal was estimated to be ₦430,000 (as shown in Figure 7 below). Similarly, Figure 8 shows the average market values of juvenile WAD *vis-a-vis* Red Sokoto male, non-pregnant female, and pregnant female goats as well as their total mortality cost valued at ₦220,000; and Figure 9 shows the average market values of WAD *vis-a-vis* Red Sokoto male and female kids as well as their total mortality cost valued at ₦190,000. In total, all mortalities (of adults, juveniles, and kids) cost ₦840,000.

**Table 7:** Average market values of adult WAD *vis-a-vis* Red Sokoto male, non-pregnant female, and pregnant female goats as well as their total mortality cost value.

Adults (> 15 months)				
Breed	Sex	Unit cost of purchase (₦)	No. Of mortalities	Total cost of mortalities (₦)
West African Dwarf	Male	35,000	0	0
	Female (non-pregnant)	40,000	4	160,000
	Female (pregnant)	45,000	4	180,000
Red Sokoto	Male	45,000	2	90,000
	Female (non-pregnant)	50,000	0	0
	Female (pregnant)	55,000	0	0
			<b>Grand Total</b>	<b>₦ 430,000</b>

**Table 8:** Average market values of juvenile WAD *vis-a-vis* Red Sokoto male, non-pregnant female, and pregnant female goats as well as their total mortality cost value.

Juveniles (7- 15 months)				
Breed	Sex	Unit cost of purchase (₦)	No. Of mortalities	Total cost of mortalities (₦)
West African Dwarf	MALE	25,000	1	25,000
	FEMALE (NON-PREGNANT)	30,000	3	90,000
	FEMALE (PREGNANT)	35,000	3	105,000
Red Sokoto	MALE	30,000	0	0
	FEMALE (NON-PREGNANT)	35,000	0	0
	FEMALE (PREGNANT)	40,000	0	0
			<b>Grand Total</b>	<b>₦ 220,000</b>

**Table 9:** Average market values of WAD vis a vis Red Sokoto male and female kids as well as their total mortality cost value.

Kids (0- 6 months)				
Breed	Sex	Unit cost of purchase (₦)	No. Of mortalities	Total cost of mortalities (₦)
West African Dwarf	MALE	10,000	4	40,000
	FEMALE	15,000	10	150,000
Red Sokoto	MALE	15,000	0	0
	FEMALE	20,000	0	0
			<b>Grand Total</b>	<b>₦ 190,000</b>

## Conclusion and Recommendation

Sustainable and consistent vaccination programs should be employed and implemented by farms. Vaccines should be sourced from reputed manufacturers and suppliers. The government can also embark on free PPR vaccination campaign programs to make the vaccine available for rural and small-scale livestock farmers who may not be able to afford commercial vaccinations of their herd. Good biosecurity measures such as quarantine should be practiced by farmers especially when new stock is procured. Through appropriate biosecurity measures, wild ungulates/ruminants should also be prevented from accessing farms as they are carriers of the virus.

## Contribution by Authors

Equal contribution. All authors declared that ‘written informed’ consent was obtained from the approved parties for the publication of this article and accompanying images.

## Conflict of Interests

There is no conflict of interest.

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