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Study of the Factors Associated with Domestic Ruminants Rift Valley Fever Epidemic in Mauritania, 2020

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Abstract:- Background: Rift Valley Fever (RVF) is a vector-borne zoonosis that severely affects different species of domestic and wild ruminants and humans. RVF is on the list of diseases to be notified to the World Organization for Animal Health due to its zoonotic nature and its economic importance, linked to direct losses in animals and restrictions on animal trade. on feet resulting from the declaration of outbreaks.

Methods : A retrospective analytical cross-sectional study in livestock in Mauritania, on RVF surveillance data in 2020. The study population consists of all the animals sampled and analyzed in the virology laboratory at the National Office of Livestock Research and Development in Nouakchott during the year 2020. The analysis was carried out using Epi-info® 7.4 and the Excel® 2019 spreadsheet. Proportions, frequencies, ORs with their 95% CI and P value were calculated. The results were presented in the form of tables and figures.

Results : Out of 1110 notified cases of RVF in cattle, 208 cases were confirmed including 94 camels (45.19%), 55 goats (26.44%), 39 sheep (18.75%) and 20 cattle (9. 62%). The age group from 0 to 5 years was the most represented (735/1110), or 52.2% of cases, and 359/1110, or 32.34% of cases were between 6 and 9 years old. The average age was 4.6 years. RVF foci are more observed in the regions of Tagant, Brakna, Trarza and Hodh Chergui. The RVF varied significantly ($p<0.05$) with the state of rainfall, the state of the ponds and the mosquito pressure.

Conclusion: The overall prevalence of RVF in the country was 17.24%. The highest prevalence was recorded in the regions of Tagant, Assaba, Trarza and Hodh Chargui. Multivariate analysis revealed that there is a significant association between rainfall status, pond status and mosquito pressure with RVF seropositivity.

Keywords:- *Domestics ruminants, Associated factors, Rift Valley Fver, Mauritania.*

I. INTRODUCTION (STUDY OF THE FACTORS ASSOCIATED WITH DOMESTIC RUMINANTS RIFT VALLEY FEVER EPIDEMIC IN MAURITANIA, 2020)

Rift Valley Fever (RVF) is a vector-borne zoonosis that severely affects various species of domestic and wild ruminants, including sheep, cattle, goats, Camels, as well as humans [1].

RVF is on the list of diseases notifiable to the OIE (World Organization for Animal Health) due to its zoonotic nature and its economic importance, linked to direct losses in the animal and restrictions on trade in live animals resulting from the declaration of outbreaks. In South Africa between 1950 and 1951, RVF caused 500,000 abortions and the death of 100,000 sheep. [2].

Then, in 1976, RVF appeared further north, in Sudan, and in 1977 in Egypt, where it spread from cattle to humans, causing over 200,000 cases and nearly 600 deaths. Following this epidemic, RVF became a major public health concern. [2].

Since then, the disease has persisted in the form of an enzootic in the latter country, with a few resurgences, notably in 1993 and 1997. [3].

In 2000, RVF was first reported outside Africa in Yemen and Saudi Arabia, where a large number of disease-related deaths were recorded.[4].

In West Africa, more numerous epidemics, although relatively small in scale, have been observed in Mauritania (2013, 2015 et 2020), Senegal (2013), Niger (2016) and Mali (2017) [5]. Various recent serological surveys conducted in 2008, 2009 and 2014 in Maghreb countries suggest that the virus may be present in certain regions of Morocco, Algeria and Tunisia [6-8].

In Mauritania, between 1987 and 2020, there were six RVF epizootics/epidemics causing hundreds of human deaths and considerable economic damage due to direct and indirect animal losses, bearing in mind that there is no safe and effective vaccine against RVF. During the winter of 1987, more than 1,200 human clinical cases, including 224 deaths, occurred between September and December. [9].

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In 1993, 1998 and 2003, outbreaks of varying magnitude occurred, with both human and animal cases. [10]**.** In 2010, Mauritania notified WHO of a total of 63 human cases, including 13 deaths [10]**.**

In 2012, the Ministry of Health declared an epidemic of Rift Valley fever (RVF) that began in September. A large number of ruminants and 34 human cases, including 17 fatalities, were reported in 6 regions (Assaba, Brakna, Hodh Chargui, Hodh Gharbi, Tagant and Trarza). The majority of human cases have been in contact with animals, some of which were sick. No RVF viruses could be isolated from captured mosquitoes. [6]**.**

Subsequently, RVF epidemics occurred between 2013-2014 in dromedaries and small ruminants in 5 regions [6,7]. In 2015, the diagnosis of 31 patients hospitalized in Mauritania with a severe form of Rift Valley fever (RVF) was confirmed by the laboratory, resulting in eight human deaths. The clinical cases originated from the regions of Kiffa, Magta lahjar, Tidjikja, and Aleg [8].

As part of the national strategy to combat RVF, a great deal of effort has been made by the government through the veterinary services and partners in the fight against this disease, with the system recording cases practically every year and in almost every region of the country. In view of the above data, Rift Valley Fever remains a public health problem in Mauritania. No studies have been carried out at national level to identify the factors associated with the emergence and prevalence of RVF. It is within this framework that we conducted this study, which focused essentially on identifying the factors associated with RVF and its prevalence in the country. The recommendations resulting from this study will help stakeholders to improve the surveillance system and control this disease, which represents a real threat to the region. This work will serve as an advocacy tool for decision-makers to provide better support in the fight against RVF.

II. RESEARCH HYPOTHESIS

The hypothesis is that the virus is more virulent under certain conditions combining climate and, as indicated in the literature, torrential rains following a period of drought (case of Mauritania 1998, 2010) leading to flooding, which favours the proliferation of vectors and their persistence. Our research question is therefore as follows: **Could heavy rainfall be responsible for rift valley fever?**

III. OBJECTIVES

A. *General objective*

Study the factors associated with the emergence of the Rift Valley Fever virus.

B. *Specific objectives*

- Describe cases of RVF in terms of time, place and animal;
- Identify factors associated with rift valley fever.

IV. METHODS

A. *Study framework*

Our study took place at the National Office for Research, Livestock Development and Pastoralism, specifically in the infectious pathology department.

B. *Type and period of study*

A retrospective analytical cross-sectional study was conducted in cattle in Mauritania, on RVF surveillance data, 2020.

C. *Study population and case definition*

The study population was all animals meeting the case definition, sampled and tested at ONARDEP during the study period. We carried out an exhaustive sampling of all cases meeting the criteria set out in the case definition (below).

➢ *Definition of a suspect case :*

In animals, signs of RVF involvement include (according to REMEMA):

- A sudden wave of abortions in domestic ruminants;
- Nearly 100% mortality in small ruminants less than a week old;
- Severe hyperthermia, lymphadenitis, oculonasal discharge (in adults);

However, clinical signs vary according to the age, species and breed of the host animal.

➢ *Definition of confirmed case :*

Laboratory-confirmed suspected case (RT-PCR or serological IgM/IgG antibody test) or epidemiologically linked to confirmed cases or an epidemic.

D. *Sampling*

We used Schwartz's formula to calculate our sample size.

$$N=Z\alpha^{2}*P*(1-P)/d^{2}$$

N= sample size, α=5%, p = prevalence of RVF (12%), d = desired precision (5%). Considering a 10% non-respondent rate, the minimum sample size was 1487 animals. In the database, we had only 1208 suspected and confirmed cases of RVF, so our sample was exhaustive and comprised all animals sampled and tested by ONARDEP in Mauritania during the year 2020.

E. *Inclusion and non-inclusion criteria*

Our study included all cases meeting the case definition (all cases sampled and analyzed at the virology laboratory of the National Office for Research, Livestock Development and Pastoralism in Nouakchott), during the study period.

Animals sampled and analyzed with incomplete information on variables of interest were excluded.

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F. Data collection

The data are already collected in the ONARDEL database at the Ministry of Livestock (ME). Data are exported in Excel files for modality decoding.

We extracted data from the RVF epidemiological surveillance database using Excel software® 2019.

G. Data processing

The dependent variable: confirmed cases of RVF, Independent variables: age, sex, species, pond condition, grazing condition, mosquito pressure...

Using the Excel export option we obtained a data table with the variables to be studied for all cases notified and registered on the Mauritanian RVF database in cattle during the 2020 period.

After collection, missing information was filled in using the notification forms available from ONARDELP. Cases with a high number of missing values and duplicates were searched for and deleted. Outliers were identified and corrected using available sources (registers, notification forms, ONARDEP monthly reports, etc.).

H. Data analysis

Data were analyzed using Épi-info software® version 7.4. Qualitative variables were summarized by their proportions and 95% confidence intervals (95% CI). Quantitative variables were summarized by their means and standard deviations. Logistic regression was used to identify factors associated with RVF in cattle in Mauritania, and Odds Ratios (ORs) with their 95% CIs and p-values were calculated. Results are presented in tables and figures.

I. Ethical considerations

Our study protocol was approved by ONARDEP management, in the absence of an opinion from the animal health research ethics committee. The data were extracted from the database of the RVF surveillance system at ONARDEP, a structure attached to the Ministry of Livestock.

V. RESULTS

A. Sample description

➢ *Distribution of suspected and confirmed RVF cases according to individual animal characteristics*

A total of 1208 suspected and confirmed cases of Rift Valley Fever (RVF) were reported in cattle in Mauritania in 2020. Missing data on all variables was 98.8%. Of 1110 notified and confirmed cases of RVF in cattle nationwide in 2020, 208 cases were confirmed, including 94 dromedaries (45.19%), 55 goats (26.44%), 39 sheep (18.75%) and 20 cattle (9.62%). The age range 0 to 5 years was the most represented (735/1110), i.e. 52.2% of cases, and 359/1110, i.e. 32.34% of cases were between 6 and 9 years old. The mean age was 4.6 years, and the median age in the 0 to 5 age group was 4 years (Table 1).

Table 1: Distribution of notified and confirmed cases of rift valley fever by livestock characteristics, Mauritania 2020.

Variables		**Notified case**		**Confirmed cases**			
	Workforce	**%**	**IC à 95%**	**Workforce**	**%**	**IC à 95%**	**P_value**
Age range	**N=902**			**N=208**			**<0.0001**
0 à 5 ans	596	66,08	[62,92-69,09]	139	66,83	[59,98-73,2]	
6 à 9 ans	299	33,15	[30,15-36,3]	60	28,85	[22,79-35,5]	
10 à 16 ans	7	0,78	[0,38-1,59]	9	4,33	[2-8,05]	
Gender	**N=902**			**N=208**			**<0.0001**
Female	714	79,16	[76,39-68]	157	75,48	[69,05-81,2]	
Male	188	20,84	[46-69,49]	51	24,52	[18,83-30,9]	
Species	**N=902**			**N=208**			**<0.0001**
Goat	236	26,16	[23,4-29,13]	55	26,44	[20.58-33]	
Ovine	263	29,16	[26,28-32,21]	39	18,75	[13,69-24,7]	
Dromedary	24	2,66	[1,79-3,93]	94	45,19	[38,3-52,22]	
Cattle	379	42,02	[38,84-45,27]	20	9,62	[5,97-14,46]	

➢ *Describe confirmed RVF cases over time*

As the rainy season is only in the winter season (July-November), we have only represented this period of the year. The proportion of RVF cases rises with the onset of the wintering period (July-August). It rose from 68 confirmed cases in September 2020 to 99 confirmed cases in October (a peak), then fell in November (41 confirmed cases).

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➢ *Geographical distribution of RVF by region*

The geographical breakdown shows that almost all regions reported RVF cases during this epidemic between September and October 2020.

Outbreaks of RVF are most prevalent in the regions of Tagant (41/208), Brakna (40/208), Trarza (37/208) and Hodh Chergui (36/208) which recorded the highest prevalence rates in anti-FVR IgM in 2020 are 19.7%, 19.2%, 17.8% and 17.3% respectively.

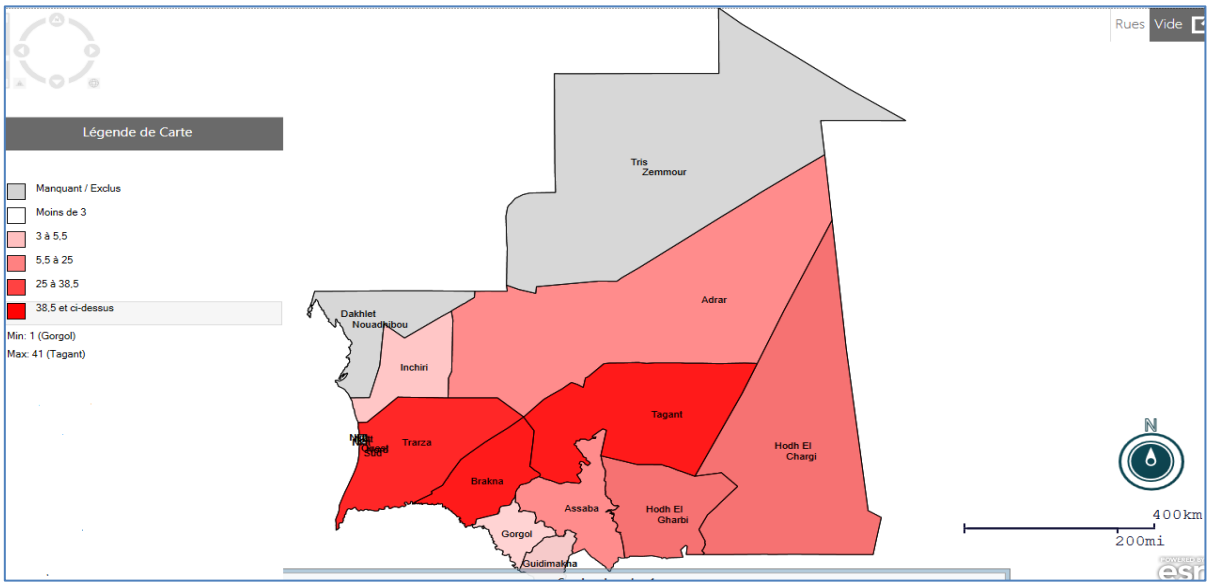

Fig. 1: Number of confirmed cases of rift valley fever by region, Mauritania, 2020.

B. Univariate analysis

Univariate logistic regression is performed to identify the independent variables that are associated with RVF (Dependent variable).

The sex of the animals was not significantly associated with RVFV seropositivity.

Table 2: Independent factors associated with RVF in livestock in Mauritania, 2020.

Variable	OR	IC (95%)	p-value
Age rang (Years)			0.0018
0-5	1		
6-9	5,51	[2,017-15,05]	
10-16	6,4	[2,3-17,86]	
Rainfall status			<,0001
Wrong	1		
Meduim	0,874	[0,356-2,14]	
Good	0,874	[0,312-2,44]	
Very good	0,386	[0,161-0,922]	
Mosquito pressure			0,0014
Low	1		
Average	0,212	[0,028-1,587]	
Strong	0,123	[0.017-0.912]	
Status of ponds			<,0001
Wrong	1		
Medium	0,493	[0,211-1,149]	
Good	1,07	[0,448-2,558]	
Very good	0,256	[0,115-0,572]	
Gender			0,245
Femelle	1		
Male	0,811	[0,569-1,155]	
Species			<,0001
Goat	1		
Ovine	1,57	[1,006-2,45]	
Cattle	4,416	[2,58-7,55]	
Dromedary	0,06	[0,035-0,102]	

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VI. MULTIVARIATE ANALYSIS

The final model is the one that contains only variables with a p-value below 5% or variables that have been forced.

Independent variables with no significant p-value (p<5%) from the bivariate analysis were entered into a multivariate logistic regression model.

Three variables were associated with rift valley fever: pond condition, rainfall and mosquito pressure.

Our final regression model showed that the risk factors for exposure to RVFV were pond condition (OR = 0.084, 95% CI = 0.024-0.29, p = 0.0001) and mosquito pressure (OR= 0.2, 95% CI= 0.07-0.51, p= 0.001).

Heavy rains increased the risk of contracting RVF compared with light rains (OR = 4.42, 95% CI = 2.06-9.47, p = 0.0001).

The potential risk factors in the final model are presented in the following table.

Table 3: Adjusted associations between livestock characteristics and rift valley fever, Mauritania, 2020.

Variable	OR	IC	p-value
Region			0,91
Northest	1		
South-west	1.02	0,69-1,45	
Status of ponds			0,0001
Medium	1		
Very good	0.084	0,024-0,29	
Rainfall status			0,0001
Medium	1		
Very good	4.42	2,06-9,47	
Mosquito pressure			0,001
Strong	1		
Average	0.2	0,07-0,51	
Age			0,99
Small ruminants	1		
Large ruminants	2,23	0,00-10^{12}	
Species			0,99
Small ruminants	1		
Large ruminants	1,8	0,00-10^{12}	

VII. DISCUSSION

RVF has become a major human and animal health concern for dairy farmers, wildlife managers and veterinarians due to frequent outbreaks in domestic and wild ruminants. [11,12].

The various epidemics that have occurred in Mauritania between 1987 and 2020 (1987 in Trarza, 1998 in Hodh EL Gharbi, 2003 circulations in the majority of sentinel sites, 2010 in Adrar and Inchiri, 2012 in the southern and southeastern wilayas, 2020 in the southern, southeastern and northern wilayas) show that the virus responsible for this disease is present and circulating in the majority of the country's wilayas.

Despite the number of epidemics that have occurred in Mauritania, it has not been possible to pinpoint the risk factors associated with these outbreaks. This state of affairs has also been observed in other countries such as Egypt [13] and South Africa [14].

The overall prevalence of RVF in 2020 was 17.24%, varying by location, species and age. A similar prevalence was found in Kabale district, south-west Uganda [15].

The present study revealed that age was not significant in relation to disease. This finding is in contradiction with other results reported in Cameroon and Tanzania [16,17].

The highest anti-RVF IgM prevalence rates were observed in Tagant (19.71%), Assaba (19.2%) Trarza (17.8%) and Hodh Chargui (17%), the most affected animal species were dromedary and small ruminants, similar results had reported s in Mauritania in 2014 [18].

This study showed a strong association between climatic factors (such as rainfall and pond condition) and mosquito pressure, and these results were similar to those of Raphaelle Métras in South Africa [19].

VIII. CONCLUSION

In conclusion, we can say that the RVF virus is actively circulating in Mauritania and in certain preferential biotopes depending on the species, as observed in previous epidemics in the country and in other West African countries.

The overall prevalence of RVF in the country was 17.24%. The highest prevalence was recorded in Tagant, Assaba, Trarza and Hodh Chargui regions, while the lowest prevalence was recorded in Guidimaga and Gorgol regions. Multivariate analysis revealed a significant association between rainfall status, pond status and mosquito pressure with RVF seropositivity.

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IX. RECOMMENDATIONS

In the light of these results, we feel it would be useful to make some recommendations for improving RVF surveillance data. These include :

- Vaccinate cattle to interrupt vector-ruminant epidemiological cycles and limit/avoid transmission to humans.
- Plan entomological surveys at the start of the rainy season (June-July);
- Raising farmers' awareness of the dangers of RVF.

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