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## Factors contributing to the introduction and spread of Peste des Petits ruminants virus in the Republic of Chad

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### Abstract

Peste des petits ruminants (PPR) is an infectious, contagious and inoculable disease. It is widely distributed in Africa, the Middle East and Asia. It was described for the first time in Côte d'Ivoire by Gargadennec and Lalanne in 1942. This pathology, similar to rinderpest at the clinical and antigenic level, reveals a capital and growing importance and constitutes a brake on the development of the breeding of small ruminants because the economic losses are considerable (morbidity is 100% and mortality 90%). The pathogen is a virus belonging to the genus *Morbillivirus*, the family Paramyxoviridae. This widespread and devastating disease of small ruminants causes very significant losses to the economy, food security and the livelihoods of pastoralists. Globally, it is one of the priority diseases indicated in the five-year of global action plan of the FAO-OIE Global Framework for the Progressive Control of Transboundary Diseases (GF-TADs). The Republic of Chad, like other countries has joined this line with an ambition of its eradication by 2025. The existence of PPR in Chad has been demonstrated for a long time, but no data exists for the moment on the factors of its introduction and spread in the country. This article describes the main factors behind its introduction and spread in the country.

**Keywords:** Peste des petits ruminants; Virus; Factors; Introduction; Spread; Pastoralism

### 1. Introduction

Located at the crossroads of Saharan Africa, West Africa and Central Africa, The Republic of Chad covers an area of 1, 284,000 km<sup>2</sup> for an estimated population of 14, 519,850 [1]. It extends from 7<sup>th</sup> to 24<sup>th</sup> degrees north latitude and from 14<sup>th</sup> to 24<sup>th</sup> east longitude. Chad's climate is tropical dry characterized by two seasons: a dry season and a rainy season. The dry season is subdivided into two seasons: a hot dry season and a cold dry season. The distribution of rainfall and plant cover allows the territory to be subdivided into three major ecological zones: Saharan or desert zone, Sahelian pastoral and agro-pastoral zone and Sudanian zone. Rainfall varies from North to South between 100 and 1200 mm per year, consequently and these conditions are right for pastoralist livestock system and outbreak of PPR and its maintenance on animals whose maintenance is generally not satisfactory.

In The Republic of Chad, livestock is one of the main sources of income because it generates an annual cash-flow of more than 140 billion F/CFA, an added value of 210 billion F/CFA and contributes up to 35% of the agricultural GDP. It supports 40% of the rural population and employs 80% of the active rural population [2]. Apart from the oil sector, it contributes 30% to 50% of national exports [2]. This breeding is 80% dominated by mobility (transhumance/nomadism). It is an extensive and mixed breeding system where cattle, camels, sheep and goats are kept and driven to

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pasture together. The pastoralist livestock system promotes the introduction and spread of transboundary diseases, especially PPR virus. Small ruminants occupy an important place in livestock farming, especially in the Sahelian zone of Chad. According to the last general livestock census [3], Chad has nearly 129 090 134 million head of cattle of all species, of which 57 million (60.6%) are small ruminants. Goats and sheep are prolific and hardy animals that adapt more easily than cattle to the difficult conditions encountered in the Sahelian zone. The breeding of these animals constitutes a significant nutritional contribution because their milk and meat provide an important part of the protein ration of rural populations. They constitute cash that can be easily mobilized for current expenses. Finally, they allow breeders a capitalization often used during an epizootic phenomenon decimating the cattle herd, namely the rinderpest episode of 1983-1984 [10]. Thanks to their high level of adaptation, ease of maintenance, adaptation to difficult conditions and their socio-cultural role, sheep/goats are reared in almost the entire national territory. However, several factors limit the development of this breeding, in particular peste des petits ruminants (PPR), which is one of the main priority diseases indicated on the list of diseases monitored by Epidemiological Surveillance system (REPIMAT) in The Republic of Chad implemented in 1995 [5].

In fact, peste des petits ruminants is an infectious, contagious and inoculable disease widely spread in Africa, the Middle East and Asia [6]. It was first described in Côte d'Ivoire by Gargadennec and Lalanne [4]. It is an acute febrile viral illness affecting mainly goats and sheep. It is characterized by mucopurulent nasal and eye discharge, erosive and necrotizing stomatitis, enteritis and pneumonia. It is widespread, virulent and devastating with significant impacts on the economy, food security and the livelihoods of pastoralists [14]. The losses caused by PPR are estimated at more than 2,972.5 million US dollars per year [11]. According to Njeumi [15], all African countries located between the Sahara and the equator, from the Atlantic Ocean to the Red Sea, are in the PPR enzootic zone.

In The Republic of Chad, the existence of the disease was confirmed by serological surveys [12, 13] and then by isolation of the pathogen [7]. Analysis of the epidemiological situation indicates that PPR is enzootic in The Republic of Chad [17]. Furthermore, the examination carried out by the IRED virology laboratory of sera (986) collected from small ruminants revealed that the prevalence of antibodies against the PPR virus was 34.5%; this prevalence varied according to the species (goats, 15.21% or sheep, 19.25%), age groups and geographic areas [8]. The PPR virus infection rate was higher in the sheep population (34.67%) than in goats (27.37%); the study also showed a much higher seroprevalence in sheep than in goats [8]. Another study, conducted in 18 out of 23 provinces in the country, revealed an overall seroprevalence of PPR at the individual level of 52.9% for sheep and goats [16]. The aim of this article is to generate information from bibliographic data in order to highlight the various main factors of introduction and spread of the PPR virus in The Republic of Chad.

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## **2. Different factors of introduction and spread of the PPR virus**

### **2.1. Transhumance/nomadism**

Although pastoral systems are very diverse, they are often characterized by low population density, high mobility and high dynamism of complex information systems and high dependence on local knowledge. Pastoral communities are often socially, economically and politically marginalized. However, they play a significant role in national economies, in the achievement of objectives of development and in maintaining the goods and services of the ecosystems of collective rangelands. As users of collective pathways dependent on the supply of many ecosystem services (water, food, fodder), in many countries of the world pastoral systems are based on a close association between humans, domestic animals and natural environments. They historically contribute to the satisfaction of the food, economic and cultural needs of their populations. Recent developments in societies (monetarization, globalization, land pressure, etc.) and environments (desertification, climate change, etc.) have called into question the interest of these systems. However, the new global challenges of sustainable development, the fight against poverty, the preservation of ecosystems, the development of arid zones and the ecological intensification of agriculture, put these systems back in the debate on the identification of new ways of development and new modes of agricultural production [9]. Indeed, mobility allows pastoralists to seek the best pastures, water points and to optimize the productivity of their herds. It is also an essential part of their business strategy. In most African countries, pastoralism evolves according to an extensive system where most of the population is constantly on the move in search of favorable natural conditions. This system is partly responsible for the introduction or development of diseases in the region and by several factors namely: water points, pastures, movements, legal and/or illegal trade in livestock, etc.).

### **2.2. Water points**

Animals drink water from different sources throughout the year, this is more or less a source of contamination of livestock by microbes. The risk of contamination increases considerably during the rainy season through the

consumption of surface water, including at the start and end of the season when animals are concentrated around water points. A high density of animals whose urine and feces already pollute the water constitute disorders, stagnant conditions for the proliferation of certain microbes and parasites. Aware of this, some Chadian breeders only water their animals with half a barrel, collecting the water themselves without following the edge of the heavily polluted pond, etc.)

### **2.3. Pasture**

Despite the advantages of pastoralism, it still faces many constraints that considerably limit development. These are:

- The degradation of natural resources due to the various cyclical droughts in the Sahel region and to strong human and animal pressures;
- The increased competition for the available resources resulting in a dysfunction of the traditional links between pastoralists and farmers, thus causing recurrent and sometimes deadly clashes;
- The lengthening in space and time of the duration of the transhumance, which wastes enough energy, reduces the performance of the animals and disrupts the pastoralists on a socio-economic level;
- The increased vulnerability of pastoralists who cannot provide solutions to the crises they face.

Note that after grazing, the animals are taken to the village where they are kept in an enclosure; there, they receive the additional food in the form of concentrate (peanut or cotton cake, feed, etc.) served in half a barrel, which promotes close contact between the animals, a source of transmission of microbes, especially PPR virus.

### **2.4. Movements**

Certain categories of herders move up to more than 400 km each season in search of pasture and water (great transhumance). Transhumance is at the origin of diseases in different aspects. Besides the stress caused by long journeys, animals expend a lot of energy, which weakens their resistance to various microbial and parasitic attacks. The temporary interruption of transhumance by natural factors such as the crossing of oases and rivers, leads to gatherings and therefore the forced proximity of herds of varied origin and gives rise to contamination by various pathogens.

### **2.5. Livestock markets**

Animals from different horizons remain in constant contact for long days in livestock markets. Unsold animals that return to herds after having been in contact with others represent a major risk of contamination by various pathogens, including PPR virus.

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## **3. Conclusion**

Peste des petits ruminants affects small domestic and wild ruminants as well as camels. The main sources of the virus are sick animals. Infected animals shed the virus present in conjunctival, nasal, oral, lacrimation, faeces.

The PPR virus is transmitted primarily by direct contact from a sick animal to susceptible healthy animals. Transmission occurs through the respiratory tract. Healthy animals become infected by inhaling the virulent materials. The mode of transmission of the peste des petits ruminants virus is always direct horizontal.

Pastoralism is a practice of herding property linked to climate change by the pastoral community. The dynamic adaptation of pastoral policies should promote better management of the agricultural system and the fight against diseases.

Transhumance or nomadism, legal and/or illegal trade in live animals, water points, livestock markets, and grazing are the main factors in the introduction and spread of pathogens in Sahelian countries in general and in The Republic of Chad in particular.

Cross-border movements linked to the international trade in live animals, transhumance, as well as insecurity due to hotbeds of tension that exist in the sub-region, are leading to massive movements of herders and animals.

In The Republic of Chad, pastoral systems represent 80% of livestock systems. In the livestock system in Chad, it is not uncommon to see animals mixed by species (cattle, sheep and goats). Sometimes we see camels and small ruminants brought together to pasture and all along the transhumance route.

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## Compliance with ethical standards

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### *Disclosure of conflict of interest*

By this we declare that there is not conflict of interest

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