Luke Sanders
A&M Consolidated High School
College Station, TX, USA
The Republic of Chad, Animal Health

The Republic of Chad: Combating Peste des Petits Ruminants

My name is Oumar and I live in the rural region of Chari-Baguirmi, a region in southern Chad. Living in Chad, one of the most impoverished and food-insecure countries in the world, is not easy. I live in a rural community of around two dozen other families. Our home is a small, clay brick house, with one central room for me, my three siblings, and two parents. Traditional gender roles dominate our rural lifestyle as my father and eldest brother tend our herd of sheep, goats, and camels. My mother manages the house, hopes to find water at the local watering hole, and prepares what little food we have for dinner. Going to sleep hungry is a daily occurrence for us, as it is for 3.7 million others facing food insecurity in Chad. (Chad: World) The family herd consists of camels for transportation as well as sheep and goats for milk, meat, and fiber. Besides rearing livestock, our family has no other means of income. The livestock are herded throughout the rural lands in search of vegetation for food and clean water. Drought is common, as is disease among the herds in the community. However, we have no way, or financial means, to treat them. Our livestock, used for domestic use and consumption, prove vital to me and my family (Chad - Agriculture). Without these animals, we have no food, no income, and no life.

Oumar is a typical teenager living in The Republic of Chad, a landlocked country in central Africa. The country is geographically divided into the Saraha, Sahel, and Sub-Saharan regions. The southernmost, Sub-Saharan, region is the most densely populated and home to the capital, N'Djamena (N'Djamena, Chad Population). The Republic of Chad is a presidential republic where the president serves as the head of the state and executive branch, the National Assembly holds power in the legislative branch, and the chief justice and councilors lead the judicial branch. The educational and economic development of the nation struggles significantly. The literacy rate in Chad is a bare 22.3%, down over 60% from the global percentage (*Central Intelligence Agency*). This demonstrates the lack of proper education within Chad. Economic disparity can be seen through the low gross domestic product per capita of $1,500 compared to the world average of over ten thousand dollars. Additionally, Chad consistently ranks in the top five poorest and most food-insecure nations in the world (Chad: World). 40% of the population lives under the poverty line. With 76.5% of the population living in rural regions, many suffer from a lack of food and adequate nutrition, resulting in 2.2 million individuals facing malnutrition and 43% of children under five facing stunted growth (Chad: World). In the Republic of Chad, oil and livestock industries dominate the economy; however, most of the rural population significantly relies on subsistence agriculture, primarily pastoral livestock rearing.

With only 3.9% of the total land in Chad considered to be arable, crop production has little role in Chadian life compared to livestock rearing (*Central Intelligence Agency*). In rural communities, rearing livestock is necessary for survival and income. Sheep, goats, cattle, and camels rank as the top livestock animals. In Chad, there are currently more than 37 million goats, 31 million sheep, 29 million cattle, and 8 million camels. (Chad - Agricultural Sectors). These animals function as dual-purpose animals providing milk and meat, while sheep also produce fiber for clothing. Camels serve primarily as transportation but also can provide nutritional supplementation through milk. Livestock proves vital for rural populations as many are too poor to meet nutritional and clothing needs without them. Typical livestock herds are multi-specie in order to meet the nutritional needs of each family. In addition, the rearing of animals allows for an additional source of income, typically through a rural barter economy that is better able to sustain families. Pastoral movement of animals is common as many herders move animals to fresh water

and adequate pastures. This leads to high levels of livestock movement throughout the country, often to water sources like Lake Chad, the Chari River, and the Logone River (Rivers).

Even though families like Oumar's have livestock herds, over 60% of the rural population faces severe food insecurity and extreme poverty. While this is partly due to factors concerning the availability of resources as well as practical herd management skill, deadly diseases destroy Chadian livestock herds, specifically Peste des Petits Ruminants.

Peste des Petits Ruminants, or PPR, is a highly contagious infectious disease common throughout the Middle East, South Asia, and Africa that has been detected in animals in over 75 countries (Continued). PPR is defined as an "acute or subacute viral disease" most commonly found in sheep and goats (Saliki). Transmission occurs through close contact as PPR is airborne with the ability to spread through herds and regions at an alarming rate. The most recent transmission of the disease has occurred from the movement of livestock across borders and the interregional trade of small ruminants. An outbreak can rapidly destroy a herd of sheep or goats with symptoms such as a rise in internal temperature, nasal discharge, oral lesions, diarrhea, and dehydration which likely results in death in 5-10 days. (Saliki) Mortality rates of 50-80% are common, yet they can reach higher figures in regions densely inundated with the disease (European). Globally, PPR causes annual economic losses of $1.2-1.7 billion (Jones). Today, PPR ranks as one of the most concerning diseases facing small ruminants due to its threat to millions of small subsistence farmers and hundreds of millions of sheep and goats.

PPR, also called sheep and goat plague, was first isolated in Chad in 1995 and has rapidly spread throughout the country. In 2017, a research study was conducted to determine the prevalence of PPR in Chad. It determined a 52.9% seroprevalence rate, indicating virus transmission in over half of the small ruminant population. (Mahamat). Additionally, the study concluded transhumance, or seasonal movement of livestock, accounts for the majority of transmission. The regions with the highest concentrations of PPR include Chari-Baguirmi, Ouaddia, and Logone-Oriental (Mahamat). As expected, major rivers being the destination of transhumance routes, fall in the center of these regions. As farmers lead sheep and goats to major watering sites, they are leading their herds into highly infected regions of PPR.

Currently, the PPR Global Control and Eradication Strategy (PPR GCES) is a worldwide program created by the Food and Agriculture Organization (FAO) and the World Organisation for Animal Health (OIE) (Global). The program consists of a multi-stage process including assessment, control, eradication, and post-eradication with the goal of global eradication by 2030 (Global). The PPR GCES applies strategies including biosecurity, seroprevalence tracking, identification, and vaccination programs (Global). PPR vaccines prove very effective since they provide long-term immunity, and both intranasal and subcutaneous routes of administration are effective (Mahapatra). However, vaccination coverage needs to reach at least 60-80% to become effective at preventing clinical signs and spread of PPR. Additionally, vaccination must occur prior to infection in order to effectively achieve desired results (Mahapatra). Many countries have participated in the complete four-stage process of PPR eradication or similar nationwide programs. However, the global eradication strategy falls short in many nations. For example, Nepal conducted a nationwide eradication program similar to the stages of the PPR GCES. During the study, it was concluded that major flaws in eradication programs include transhumance practices across borders, insufficient vaccination production and administration, non-compliance, and lack of tracking and disease information (Acharya). In 2015, vaccination coverage was only at 22% in Nepal, indicating a failed vaccination program (Status). These insufficient methods of action against PPR do not combat the issue at hand. The PPR GCES has also reported issues concerning compliance, vaccination rates, and

coverage (Global). With limited success in current eradication programs, food insecurity and extreme poverty in countries continue to pose a major threat to millions of civilians. In Chad, families like Oumar's live with the constant threat of disease ravaging what little they have.

With over 80% of Chad's population dependent on livestock and agriculture, actions must be taken to ensure a more stable food supply and decrease food insecurity (Chad - Agricultural Sectors). The solution is as follows; by enacting a series of proactive measures, PPR can be minimized, increasing food security. These include vaccination hubs located at major bodies of water, overwatch of transhumance movement and livestock trade across national borders, and the dissemination of herd management education through local and regional leaders.

Vaccination hubs located at major bodies of water, including Lake Chad, Lake Fitri, and the Logone and Chari Rivers, would increase the number of vaccinated sheep and goats in the country. Previous tactics to control PPR have been to follow livestock throughout the country in order to vaccinate for PPR herd by herd. However, as seen in Nepal, it brings minimal success due to the lack of enough vaccines over many regions (Acharya). Instead of tracking down herds, sheep and goats will continue traditional transhumance routes to water sources, thus resulting in mass quantities of Chad's small ruminant population arriving at vaccination hubs.

In Chad, transhumance routes of sheep and goats follow seasonal freshwater sources and pastures with adequate nutrition. Livestock, in the Sahel region and south, are herded regularly from their homelands to these bodies of water. Livestock herds in the most westward area of Chad migrate to Lake Chad or the mouth of the Chari River, while central herds move to Lake Fitri and the Chari, and eastward herds move to the Logone and Chari Rivers, in addition to smaller watering holes more central in the Sahel region (Pastoral). Sheep and goat herds regularly move in and out of the regions, making them ideal for vaccination hubs due to the advantages of stationary programs that spend resources to make the vaccines more effective and mass administered, rather than on travel.

Since the PPR vaccine is a cold chain vaccine, meaning it must be kept between 2°C-8°C, stationary vaccine hubs would allow for increased vaccine efficacy (Mahapatra). Refrigeration trucks would provide a cold environment for the vaccines while being entirely mobile and running off of gasoline or diesel fuel. Secondly, due to seasonal migration, these hubs could remain stationary for months at a time, vaccinating tens of thousands of animals, all decreasing the damages of PPR in Chad. Planting these hubs along rivers and lakes would not only increase the number of small ruminants per herd that are vaccinated but increase total regional vaccination rates, preventing future outbreaks of PPR. Dozens of vaccination hubs would be funded by the Food and Agriculture Organization (FAO). Since this program aligns with PPR Global Eradication Strategy stages two through three, control and eradication, complete FAO funding will financially support this endeavor (Global).

Additionally, regions with the highest PPR prevalence are also home to these major rivers and lakes. The Chari-Baguirmi region is home to the Chari River, while Logone-Oriental and other surrounding regions with high seroprevalence lie in the path of the Logone River. Other significant concentrations of PPR prevalence are in the regions immediately surrounding Lake Chad and Fitri (Mahamat). By planting vaccination hubs at these water sources, regions with the highest PPR presence will see a drastic decrease in PPR and disease transmission.

Secondly, controlling livestock movement across borders proves a vital step in limiting PPR in Chad. By setting up PPR checkpoints along major roads and transhumance routes between Chad and neighboring countries, the spread of PPR from the mixing of native and non-native herds would decrease by only allowing for healthy herds to cross national borders. In addition to transhumance routes, controlling international livestock trade from neighboring countries with PPR outbreaks will also limit transmission. Chad, bordered by the Central African Republic, Cameroon, Sudan, Niger, Libya, and Nigeria, faces major transboundary transmission concerns. Major transboundary concerns can be seen in the Ouaddai region of Chad, one of the top three most infected regions in the country (Mahamat). High numbers of the Kababich sheep, a popular sheep breed in Chad, imported from Sudan have caused an extreme increase of PPR cases into the Ouaddai region. As seen in this example, poor regulation of livestock and overwatch of small ruminant health across borders result in the spread of PPR. By enlisting the support of the regional government, regional leaders will be able to enforce health checkpoints on major roads and livestock migration routes. By implementing herd health checks which report alertness, normal urination and defecation, and overall attitude, health checks will differentiate unhealthy herds from the healthy, allowing an advanced layer of biosecurity (Recognizing). On a regional level, the Chadian government is generally cooperative and will support the establishment of herd health checkpoints along borders. While not all minor transboundary routes and roads will be covered, major roads and livestock routes will be utilized to promote the eradication of PPR. The road between Margibir, Sudan and Adre, Chad in the eastern region will limit livestock flow from Sudan. The road to Nadele, Chad from the Central African Republic will limit transboundary viral spread from the south and the road crossing over the Logone River into N'Djamena will limit the spread into the capital city (*Google Maps*). The regulation of herd movement along national borders will decrease the spread of PPR in Chad. By eliminating transmission risks, PPR will be better controlled, allowing for eradication while providing increased food and nutrients to the vast majority of rural Chadian families.

The final component to minimize and eliminate PPR is the education of herdsmen on small ruminant management and benefits of PPR vaccination. In Chad, 52% of the population is Muslim and 44% is Christian (*Central Intelligence Agency*). Even though there are no religious or cultural taboos regarding the administration of vaccines to small ruminants, many rural herding communities are hesitant about PPR vaccination. As seen in the study in Nepal, many patriarchs in rural regions opted not to comply with vaccination efforts, significantly decreasing the effectiveness of the eradication program (Status). To prevent this, sufficient education must be employed. By educating regional governments and prominent herdsmen on the benefits of the PPR vaccine, societal acceptance and support would increase. Additionally, educating these individuals about clinical signs, transmission, possible prognosis, isolation and prevention techniques would decrease the spread of PPR and gain additional support for vaccination programs. From here, regional leaders are to disseminate this information and practices to local leaders, who share it with community leaders, thus resulting in general herdsmen knowledge. This information would also be disseminated at vaccination hubs and border herd health checkpoints to educate herdsmen as they move throughout the country. General education will contribute to overall vaccination coverage due to societal approval and increased herd management techniques.

Peste des Petits Ruminants threatens millions of lives each day in Chad, where food insecurity is among the most extreme in the world. By reorienting current PPR eradication techniques, food security and herd health can be reestablished. By educating herdsmen about herd management and PPR information, establishing vaccination hubs around major water sources, and ensuring herd health checkpoints along national borders, PPR can and will be minimized to a great extent. Life and survival in Chad should not be threatened by the loss of small ruminants due to this disease. Dr. Borlaug said it best, "Food is the moral right of all who are born into this world." By combatting PPR head-on, Oumar, and families like his, will not be robbed of their ultimate moral right.

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