Mapping Risks Associated with Peste des petits ruminants (PRR) infections in Sheep and Goat Herds of Marsabit County, Kenya

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Research Brief

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Abstract

Sheep and goats are an important food and income source for 10 million pastoral and agro-pastoral communities in Kenya. However, the contribution of these animals to pastoral livelihoods is limited by infectious diseases such as Pestes de petis ruminants (PPR). Following PPR's introduction to Kenya in 2006, control measures in place have failed to prevent its spread throughout Northern Kenya. A risk-based surveillance study was conducted to identify the underlying factors that trigger PPR outbreaks in select vulnerable areas of Kenya. Data was collected through random sampling of 90 goats and sheep and surveying of their owners from 9 sedentary and 2 satellite sites in the Laisamis sub-county of Marsabit. Results indicated a strong, positive correlation between an owner's decisions to vaccinate his herd, and a weak, positive correlation between an animal's age and presence of PPR virus antibodies. The most important determinant of an animal's PPR status was the owner's decision to present his herd for government sponsored PPR vaccination campaigns. Survey and GIS analysis indicated that access to government sponsored animal health personnel and vaccines are inadequate to meet the demands of the remotely located small ruminant herds.. We suggest that county veterinary officials use geographic information systems (GIS), existing livestock census, and foster partnerships with neighboring counties to improve planning and delivery of veterinary services. Governments should also consider expanding vaccination to include other high-risk diseases such as contagious caprine pleuropneumoniae (CCPP), target young and juvenile animals and equip laboratories with simple equipment to improve diagnostic and passive surveillance capabilities.

Peste des petits ruminants (PPR) poses a risk to pastoral livelihoods

Figure 1: Young goats (under 1 year of age) from a satellite manyatta grazing at Kargi/SouthHorr in Marsabit, Kenya. (Photo credit: Pauline Gitonga)

Small ruminants—such as sheep and goats—serve as an important food and income source for 10 million pastoral and agro-pastoral communities living in the arid and semi-arid lands of Kenya. However, the contribution of sheep and goats to pastoral livelihoods and economies is being limited by the frequent occurrence of disease. Diseases such as peste des petits ruminants (PPR) increase the vulnerability of pastoralists in three main ways: 1) causing death of livestock; 2) reducing livestock production levels; and 3) limiting market access. PPR is an acute viral disease of goats and sheep, characterized by fever, necrotic stomatitis, gastroenteritis, and pneumonia. It is highly contagious and can spread among animals. The first PPR outbreak in Kenya was confirmed in August 2006 in Turkana district. PPR gradually spread to neighboring districts and by 2008, had affected all the Northern districts of Kenya. PPR control strategies began in the same year with the implementation of a 5-year vaccination program combined with restrictions on livestock movement in areas with active cases. Despite these control measures, PPR continues to be reported in ASAL areas of Northern Kenya.

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Little information currently exists on the risk factors associated with this disease or the role co-infecting parasites may play in determining the immune response of small ruminants to PPR vaccination. A risk-based surveillance study was conducted to identify the underlying factors that trigger PPR outbreaks in selected vulnerable areas of Marsabit in Kenya. Through sampling of livestock and surveying of their owners, researchers worked to determine why PPR continues to spread in Northern Kenya despite prevention activities. Investigators hypothesized that heterogeneous husbandry practices related to disease control and co-infection with helminthes and protozoan blood parasites may increase the susceptibility of small ruminant herds to PPR infection. They further proposed that geographic information system (GIS) spatial techniques could be used to inform PPR control and surveillance. The study attempted to address these hypotheses through characterization of husbandry practices, estimation of sero-prevalance of PPR virus antibodies and parasitic co-infections in sampled sheep and goats, and the use of GIS spatial techniques to develop recommendations for PPR surveillance and control strategies.

Researchers sampled 90 sheep and goats to be analyzed and tested for PPR

The study was carried out in August 2014 in Loiyangalani and Kargi/ South Horr wards of Laisamis sub-county in Marsabit. Chosen for its active reporting of PPR, Laisamis is the only area in Marsabit that has consistently reported the disease since its introduction to the area from Samburu in March 2008. The study area is predominately inhabited by Rendille and Samburu pastoral communities. Community households are split into two groups: the core households that remain behind in sedentary settlements around watering points and infrastructure such as schools, medical stations, and shops, and the highly mobile satellite households that track pasture and water throughout the year.

Investigators randomly sampled a total of 90 goats and sheep from 9 sedentary sites and 2 satellite sites, recording their geographic coordinates using a geographical position system instrument. Collected fecal and blood samples were taken for analysis to laboratories at the University of Nairobi, Faculty of Veterinary Medicine. Using simple floatation technique, fecal samples were examined with light microscopy for helminth eggs and coccidian oocysts to test for parasitic infections. Blood samples were examined using haematocrit centrifugation technique (HCT) and thin blood smears to check for intra- or extracellular haemoparasites. Serum from the whole blood was analyzed for PPR virus antibody using the c-ELISA procedure as recommended by the OIE. In addition, small-ruminant owners were selected for interviews using a structured questionnaire. Questionnaire responses and laboratory findings were analyzed using descriptive (frequencies) and inferential (chi-square and logistic regression) statistics. Significant predictor variables associated with seroprevalance of PPR virus antibodies were further subjected to spatial analysis.

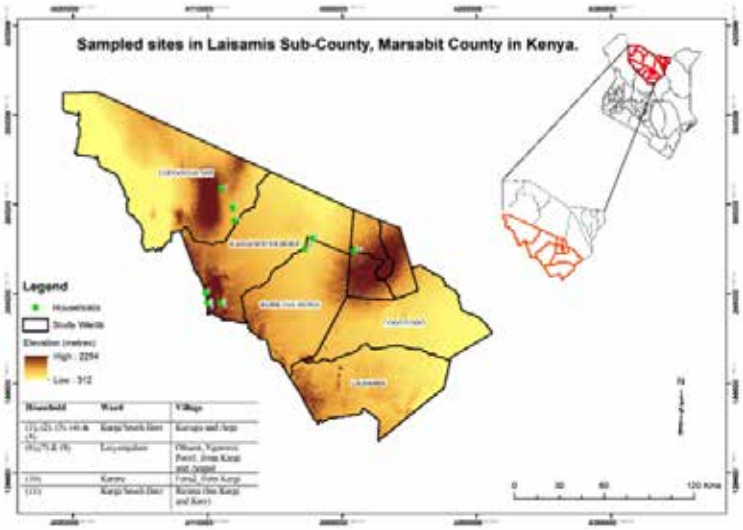

Figure 2: Sites sampled during the August 2014 PPR risk based surveillance study in SouthHorr, Marsabit County, Kenya. (Source: Pauline Gitonga)

Sampling analysis revealed an association between seroprevalance and risk factors

Approximately 40% of all sampled animals were confirmed as seropositive reactors for PPR

Of the 90 sampled sheep and goats, 37 (41%) were positive by the PPR ELISA while 53 (59%) were negative. There was a strong, positive correlation between an owner's decision to vaccinate his small ruminant herd and presence or absence of PPR virus antibodies. Regression models indicated that when an owner's decision to vaccinate was raised by one unit, the odds ratio of his small stock herd having protective PPR virus antibodies was raised 152 times. A weak, positive correlation with species (goat or sheep), breed, and age of animal was also noted. Adult animals (over 3 years of age) were 4.70 times more likely to have protective PPR virus antibodies when compared to other age groups (juvenile 1-2 years and young under 1 year). Species and breed were not significant predictors.

The prevalence of co-infecting parasitic infections was low and did not show association with PPR seroprevalance. Only 20% and 40% of sampled animals had helminth eggs or coccidian oocysts present in fecal samples. Additionally, all sampled animals were negative for intra- or extracellular haemoparasites. The low prevalence of helminth parasites could have been due to the fact that data collection was conducted during the long dry season when environmental contamination with infective larvae or eggs is low. It may also be an indication of the ability of the animals to be resistant to high levels of parasitic infestation given that all sampled animals were of breeds indigenous to the area.

Vaccination status is the greatest predictor of disease risk

The most important determinant of animals having protective antibodies against PPR virus was the livestock owner's decision to present his small livestock herd for the government sponsored PPR vaccination campaigns. Although livestock owners ranked PPR second to contagious caprine pleuropneumoniae (CCPP) in importance regarding mortality losses. They indicated that PPR vaccine was effective in reducing morbidity and mortality during outbreaks. This was supported by statistical analysis revealing that animals receiving

Figure 3: Researchers administer questionnaire to small ruminant livestock owners. (Photo credit: Pauline Gitonga)

the vaccine in the last 2 years were protected against PPR virus. Despite this acknowledgement, livestock owners noted that they did not routinely invest in disease control strategies such as vaccination or deworming due to a lack of readily available drugs and, for those that were available, prohibitive costs required to treat large herds of livestock. Overall, the two main challenges identified as hindering disease control by livestock owners were: 1) high incidences of small ruminant disease compared to the past; and 2) lack of affordable veterinary drugs and clinical services. Hence, while farmers acknowledge the effectiveness of vaccines in preventing PPR, the lack of or decision not to access government PPR vaccination campaigns and related resources limits the impact of this preventive strategy.

The underlying risk factors influencing a farmer's decision to present their herds to government-sponsored vaccination campaigns, as identified through key informant interviews, were availability of vaccines and animal health personnel to carry out vaccination. During the data collection period, the Laisamis area was served by only five government animal health personnel. A veterinarian and four animal health technicians were responsible for an area of approximately 20,290 square kilometers with an estimated small livestock population of close to 780,000 animals. During the February 2014 outbreak, the county government purchased 200,000 doses of PPR vaccine for the whole of Laisamis sub-county. The only mode of transport provided for disease outbreak response were motorbikes that can travel approximately 300 kilometers of flat terrain with a single, full tank of fuel. It was therefore a daunting task to effectively respond to PPR outbreaks given the terrain and distance from the main veterinary office at Laisamis ward to the rest of the sub-county. As a result, during the outbreak, only 7 livestock owners from the 11 sites sampled were able to access the government sponsored PPR vaccines for their sheep and goat herds. Of those 7, one site from Kurugu village accessed the free vaccinations from the neighboring Samburu County.

A spatial analysis technique (spider web mapping) was used to identify which veterinary office should have been equipped to effectively respond to the February 2014 PPR outbreak. From the spider web map, it is clear that response from the Vet Laisamis office—which is the current situation—is longer and requires more resources to manage outbreaks in the sampled area as compared to other office locations. The Mt. Kulal office would be the ideal location to respond to disease outbreaks for most herds located in the study area given that the motorbike mode of transport at most distances were less than 80 kilometers one way. However, the terrain of the area may pose challenges for this mode of transportation.

Increased access to government-sponsored PPR vaccinations is needed to help control and prevent PPR in pastoral herds

In conclusion, PPR status is highly correlated to vaccination status, with younger goats showing a slightly increased risk for the disease. PPR vaccination is an effective control strategy against the disease and can be used to improve herd health and pastoral livelihoods. While PPR is an important disease in goats and sheep, survey of livestock keepers suggest that CCPP in goats is viewed as a more important cause of disease-related losses. The pneumonia-like disease also causes significant losses in sheep, necessitating further research to determine if this is due to parasitic or infectious agents. Nevertheless, survey and GIS data suggest that current PPR vaccination campaign coverage is low due to a lack of human capacity and vaccines as well as undocumented small ruminant population numbers. The poor infrastructure, roads, and lack of appropriate vehicles are also hindrances to effective response during outbreaks. In light of these findings, the following should be considered to reduce disease burden and increase productivity of goats and sheep in Northern Kenya:

1. County veterinary officials should consider vaccinating goats against CCPP.

2. County governments should carry out a livestock census to allow for proper planning of vaccine control strategies.

3. County governments should liaise with neighboring counties when carrying out vaccine campaigns as communities located at border town freely move across these borders.

4. Annual PPR vaccination campaigns should target juvenile and young animals, as they are the group at highest risk.

5. Passive disease surveillance is effective in disease monitoring but should be supplemented with simple laboratory techniques that require low cost equipment—such as light microscopes—to detect parasitic infections in blood and feces. The County government should also purchase test kits for field diagnosis for PPR and CCPP, as they would be useful to confirm diagnosis and lessen response times.

6. GIS is a useful tool that can support decision making when planning disease surveillance and control activities as well as determining where to direct resources. Mt. Kulal veterinary offices should be equipped with more staff, veterinary equipment, and drugs.

Further Reading

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