

03|22: Seroprevalence and economic cost of contagious bovine and caprine pleuropneumonia causative agents in cattle, sheep and goats from Amudat, Kaabong and Karenga districts; Karamoja region

Karamoja region is endemic for devastating cattle, sheep, and goat pleuropneumonia

Executive summary

Contagious pleuropneumonia of cattle [CBPP] sheep and goats-shoats [CCPP] are caused by related bacteria that infect respiratory system causing severe pleuropneumonia that often causes 70-80% mortality in susceptible cattle and small ruminant herds. Since 1956 and 1993 when CBPP and CCPP were confirmed in Uganda [Karamoja region] respectively, they have spread to other regions causing significant losses to livestock keeping communities in their initial and new foci. The losses due to CBPP have been reported to be ~3.7 million Euros while those due to CCPP for Karamoja region could approach 34.3 million Euros. These losses accrue from high mortality, morbidity, reduction in productivity as well as livestock trade limitations from endemic regions. CBPP and CCPP control is associated with positive benefit-cost ratios [2-6] in communities like Karamoja that are heavily dependent on livestock assets and prone to highest impacts due to poor veterinary infrastructure. Unfortunately, these programs are not always sustainable due to lack of human, financial and technical resources to support such programs. If such programs were to be sustainable, they would have to draw significant investment from government and developing partners. We therefore undertook CBPP and CCPP seroprevalence and socio-economic impact assessment to generate datasets that would provide blueprints for use not only to guide risk based CBPP and CCPP control programs but also to work as advocacy tools to attract government and developing partner investment in such programs.

A quarter [25.4%] of tested cattle were seropositive for MmmSC [CBPP] while 42.7% of shoats were positive for anti- Mccp [CCPP] antibodies. Increasing age, proximity to international borders, overnight stay in communal kraals, gender (male); factors that promote animal comingling were strongly associated with MmmSC [CBPP] and Mccp [CCPP] seroprevalence and should therefore be integrated in designing risk based CBPP/CCPP control programs. **CBPP contributed 16-31% of the total annual household economic cost [EC] due to cattle diseases while CCPP contributed 49-96% of the total household EC due to goat diseases across the study districts.** CBPP and CCPP endemicity in Karamoja region poses high chances of outbreaks in the region unless risk based CBPP/CCPP control programs [e.g vaccination and control of animal movements] are implemented.

1.0 Introduction

Contagious pleuropneumonia of cattle [CBPP] sheep and goats-shoats [CCPP] are caused by related bacteria; *Mycoplasma mycoides* subspecies *mycoides* small colony- *MmmSC* and *Mycoplasma capricolum* subspecies *capripneumoniae-Mccp* respectively. These bacteria infect the respiratory system causing severe pleuropneumonia that often ends fatally for 70-80% of all infected animals in naïve populations. They are both transmitted from inhalation of droplets from infected animals in close proximity. Both CBPP¹ and CCPP² are known to be endemic in Karamoja from where they have spread to other districts of Uganda since their first introduction into Uganda in 1956 and 1993 respectively. The economic impact of CBPP and CCPP is largely due to high mortality, morbidity, reduction in productivity as well as livestock trade limitations from endemic regions. The losses due to CBPP have been reported to be ~3.7 million Euros while those due to CCPP for Karamoja region could approach 34.3 million Euros by adapting the losses reported in a nearby Turkana region³ [Euros 1,713 lost for every 100 head of goats] to Karamoja small ruminant population.

Both CBPP and CCPP have vaccines that could be used to limit their impacts. However, control programs for these diseases in developing countries are not always sustainable due to lack of human, financial and technical resources to support them. However, if implemented such programs are associated with positive benefit-cost ratios [2-6] because such communities are heavily dependent on livestock assets, yet they are prone to CBPP and CCPP's extreme impacts because of poor veterinary service infrastructure⁴. To be sustainable, CBPP and CCPP control programs in developing countries have to draw significant investment from government and developing partners. As a means of raising advocacy that is requisite to attracting government and developing partner investment in sustainable risk based CBPP and CCPP control programs, there is need to generate area wide CBPP and CCPP burden and socioeconomic impact data to which this study contributed.

¹ Semadaali MA et al. Pan Afr Med J 2017

² Atim SA et al. Open J Vet Med 2016;06:9-14

³ Renault V et al. Transbound Emerg Dis 2019;66:2523-36.

⁴ Tambi NE et al. OIE Rev Sci Tech 2006;25:999-1011

2.0 Approach and Results

We screened cattle [n=2,313], sheep and goats' [n=2,296] sera for antibodies raised against causative agents of CBPP and CCPP using highly sensitive and specific competitive enzyme linked immunosorbent assays to determine their seroprevalence and distribution in cattle, sheep and goats [sheats] in the Karamoja region. **A quarter [25.4%] of all sampled cattle in the three Karamoja region districts were seropositive for MmmSC [CBPP] [Figure 1] while 42.7% of shoats were positive for anti-Mccp [CCPP] antibodies [Figure 2]. The proportion [34.0%] of Mccp seropositive goats was three times higher than that of sheep; 8.7% indicating more likely that for every 3 goats one sheep is vaccinated or that fewer sheep survive natural infections.** These seroprevalence estimates for either diseases are higher than those in literature indicating either increased CBPP and CCPP endemicity/vaccination on one hand or better sampling methods used in this study on the other. Government through the line ministry has indeed undertaken vaccination with more dose of CBPP in Kaabong [167,000] than in Amudat [80,000] doses over the past four years. Increased CBPP and CCPP endemicity with 65 % and 57% of shoats seronegative for causative agents of these diseases respectively would mean that the region is prone to CBPP and CCPP incursions unless risk based CBPP/CCPP control programs are planned and implemented.

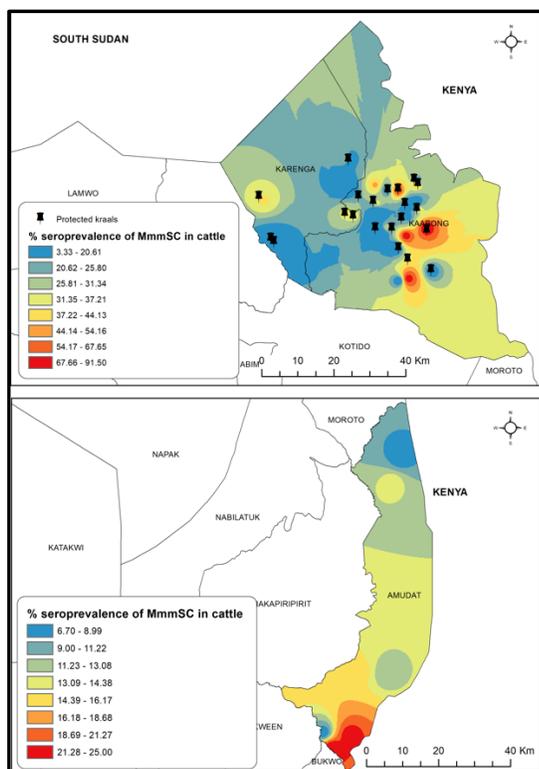


Figure 1. seroprevalence of MmmSC [CBPP] in cattle from Amudat, Kaabong and Karenga Districts, Karamoja region. Village level seroprevalence of MmmSC [CBPP] ranged from 3.3-91.5 for every 100 sheep and goats sampled

The distribution of both anti-MmmSC [CBPP] and anti-Mccp [CCPP] antibodies in cattle and shoats populations was heterogenous with more seropositive animals detected in Kaabong and Karenga [CCPP] than Amudat districts. Seropositive animals were more likely to be found along Sudan and Kenya international borders, staying in overnight kraals, older [>1 year] and males for Mccp CCPP [often get in contact with multiple females during mating]. These factors facilitate animal comingling and therefore heighten chances of infection with MmmSC [CBPP] and Mccp [CCPP]. CBPP and CCPP vaccination programs in Karamoja region should consider adopting themselves to; targeting high risk herds along the international borders, high risk sub counties, making sure that animals are vaccinated prior to being considered for overnight stays in protected kraals and harmonisation of vaccination programs across international borders.

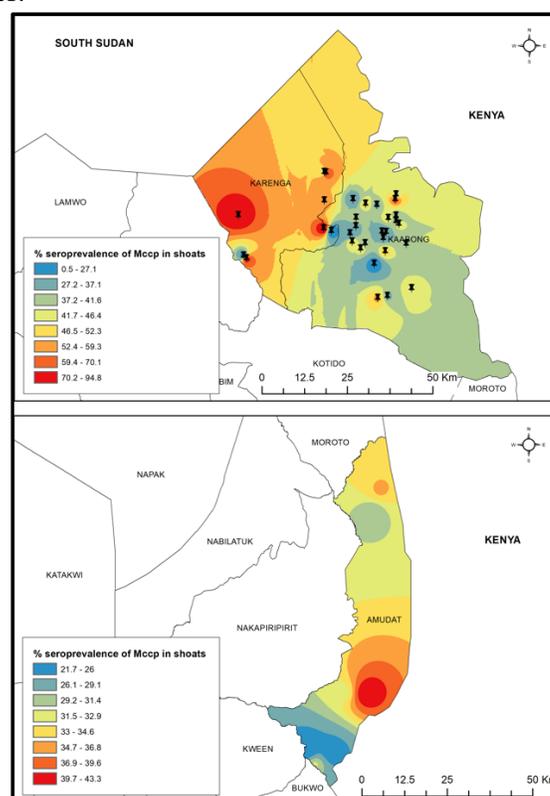


Figure 2. Seroprevalence of Mccp [CCPP] in shoats from Amudat, Kaabong and Karenga Districts, Karamoja region. Village level seroprevalence of Mccp [CCPP] varied greatly from 11.7-90.0 for every 100 sheep and goats sampled

In addition to cattle and small ruminant screening for anti-MmmSC [CBPP] and anti-Mccp [CCPP] antibodies respectively, we interviewed household heads [n=103] of the sampled cattle and small ruminant herds and animal health providers [n=63] from Amudat, Kaabong and Karenga districts to have an insight of the household economic cost [EC] due to CBPP and CCPP. They reported that CBPP was responsible for 31.1% and 16% of the total annual household EC due to cattle diseases in Amudat [USD 2,495] and Kaabong/Karenga [USD 6,835] districts respectively. As well, CCPP was responsible for 96.2% and 49% of the total household EC due to goat diseases

in Amudat [USD 136.5] and Kaabong/Karenga [USD 414.4] districts respectively. CBPP and CCPP are undoubtedly a burden to the livestock rearing households.

To help with reducing the impacts of CBPP and CCPP on the already largely income [61%] and food [75%] poor⁵ Karamojong households, it would be beneficial to design and implement a risk based-CBPP and CCPP control program for Karamoja region. This is particularly important for Karamoja region where 95% of the household livelihoods are derived from livestock whose health and productivity are constrained by a milliard of livestock diseases including CBPP and CCPP

3.0 Conclusion

Karamoja region is increasingly endemic for both CBPP and CCPP. Consequently, **CBPP contributes 31.1% and 16% of the total annual household EC due to cattle diseases in Amudat and Kaabong/Karenga districts respectively while CCPP contributes 96.2% and 49% of the total household EC due to goat diseases in the same districts.** CBPP and CCPP endemicity with 65 % and 57% of sheep and goats seronegative for MmmSC [CBPP] and Mccp [CCPP] respectively would mean that the region is very prone to CBPP and CCPP incursions unless risk based CBPP/CCPP control programs are planned and implemented. Seropositive animals were heterogeneously distributed and most likely to be males, along Sudan and Kenya international borders, to have overnight stays in communal kraals and older than 1 year. These factors are associated with optimal animal comingling and should therefore form the basis for a risk based CBPP and CCPP control program.

4.0 Implications and Recommendations

The majority of Karamojong households are income [61%] and food [74%] poor. Livestock assets from which 95% of Karamojong households derive livelihoods remain the widest gateway for their exit from income and food poverty. Unfortunately, we report here that CBPP and CCPP are endemic in Karamoja region and that large proportion of their cattle [65 %] and small ruminant herds [57%] are naïve to MmmSC [CBPP] and Mccp [CCPP] respectively making the region very prone to CBPP and CCPP outbreaks. Increased CBPP and CCPP endemicity and the fact that outbreaks of these diseases are impending would mean that both CBPP and CCPP are limiting cattle and animal health production/health in Amudat, Kaabong and Karenga to the extent that a third and 96% of the EC due cattle and small ruminant animal diseases are due to CBPP and CCPP

respectively. These economic costs would be higher if they were compounded with those that accrue from impeded market access due to CBPP and CCPP. It is therefore beneficial that risk basked and CBPP and CCPP control programs [e.g., vaccination] are planned and implemented for Karamoja region to reverse the current EC costs due to these diseases as well as prevent impending CBPP and CCPP outbreaks. **Such a vaccination program should include sheep, goats alike for CCPP vaccination.** The current practice is to vaccinate more goats than sheep against CCPP as though sheep were not susceptible or unimportant in CCPP epidemiology. Risk of MmmSC [CBPP] and Mccp [CCPP] seroprevalence increased with increasing age [>1 year], male animals [only Mccp], overnight stay in communal kraals and animals along the international borders. CBPP and CCPP Vaccination programs should be pitched to diminish transmission risk in these animal categories. For example, a vaccination program that prioritises adult animals [not protected from passive immunity] along international frontiers will create a barrier to MmmSC [CBPP] and Mccp [CCPP] transmission to naïve herds. Note that available CBPP and CCPP vaccines are neither very safe nor highly efficacious⁶ implying that vaccination programs have to be integrated with reasonable animal movement animal control to limit the extent of CBPP and CCPP incursions until highly efficacious and safe vaccines are available in the near future⁷.

5.0 For more Information

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⁵ UBOS: UNHS 2019/20

⁶ Jores, J et al. Vet Res 44, 122 (2013)

⁷ Najete S et al. Viruses. 2022 Feb; 14(2): 372.