**Project Title:** Development of a Universal Protein-based Vaccine for Effective Control of Contagious Caprine Pleuropneumonia in Kenya

**Annual Report Period Covered:** October 2020 to September 2021.

**KCSAP livestock Applied Value chain:** Red Meat

**Duration:** 18 Months

**Start Date:** Oct 2020

**Lead Institution:** Kenya Agricultural and Livestock Research Organization (KALRO)
Dairy Research Institute, Naivasha

**PI and contacts:** Dr. Alexander K. Kipronoh
kkalexdoc@gmail.com; Alexander.Kipronoh@kalro.org

**Collaborators and their contacts:**

**Collaborators:**

1. Peter Ndirangu - KALRO – Veterinary Science Research Institute, Muguga
2. Harrison Lutta - KALRO - Biotechnology Research Institute
3. Henry Kiara - International Livestock Research Institute, Nairobi
4. Jackson Ombui - University of Nairobi, CAVS - PHPT Department
5. County Staff - Project Counties (Machakos, West Pokot, Baringo and Kajiado)

**Background:**

*Maximum – One Page*

Goats contribute to people’s livelihoods in many ways, and their contributions tend to be particularly important for poorer people. These include source of cash income, liquid asset, inputs to crop production (manure), diversification of risk/ buffer to crop production, and as sources of food. Sale of live goats and their products can help meet immediate family needs such as food, clothing, medical expenses, school fees etc. Goats are more adaptable to the climatic conditions in the arid and semi-arid lands (ASALs) due to their inherent features that allow them to survive on browse material. They also recover faster following drought episodes and other climatic effects which make them to integrate well with the prevailing harsh environment where scarcity and variation of natural resources limit alternative uses (Peacock, 1996). The feeding habits and body sizes of goats make them be the most suitable animals for food production in of Kenya. As climate change continues to negatively impact on feed resource availability, the importance of goats will increase within the incrementally fragile ecosystems (GoK, 2016).

Kenya has approximately 28 million goats with a greater population in the ASALs (KNBS, 2010). Despite the existence of the high potential for exploiting goats in Kenya, their contribution to the meat industry is hampered by the numerous constraints such as low genetic potential of breeds, low adoption of improved technologies, poor marketing facilities and prevalence of diseases among others.
Diseases, in particular Contagious caprine pleuropneumonia (CCPP), pose the highest risk (KARI, 2009; Matios et al., 2014; GoK, 2016). It has been demonstrated that CCPP is a rampant and highly contagious trans-boundary disease of goats caused by *Mycoplasma capricolum* subsp. *capripneumoniae* (*Mccp*) formerly known as *Mycoplasma sp.* type F-38 (MacOwan and Minette, 1976). The disease is global in distribution particularly in countries having extensive goat farming and causes major economic losses in Africa, Asia and the Middle East, where it is endemic and is responsible for trade restrictions in live goats and their products (OIE, 2018). It is one of the commonly reported diseases in pastoral production systems in Kenya where it has persistently remained endemic despite the existence of a vaccine which is produced in the country.

Previous genome-based studies have grouped *Mycoplasma capricolum capripneumoniae* isolates into lineages which correspond to geographic regions and hence multiple strain lines. Kenya shares borders with many other African countries that have reported the disease (Heldtandler et al. 2001). The nomadic nature of its pastoralist communities contribute to spread of CCPP in flocks and into other areas. Mixing of herds from different geographic origins poses a risk of introduction of new strains to particular region that may not be effectively covered by current vaccines in use (Atim et al., 2016).

### Objectives
2. Identify and characterize *Mccp* field strains in CCPP outbreaks and compare their antigenic variability with the F38 vaccine biotype.
3. Identify immunogenic proteins in *Mccp* isolates that are candidate molecules for development of a universal protein-based CCPP vaccine.

### Expected Outputs
1. Risk maps of CCPP developed and disease hotspots identified for targeting disease control interventions.
2. Circulating *Mccp* field strains responsible for CCPP outbreaks characterized and antigenic variability with the vaccine biotype determined.

## ACHIEVEMENTS

### 1.0 Introduction
Implementation of the project started with a planning meeting which was held at KALRO AMRI-Katumani on 11th September, 2020. The meeting brought together the project administrators, principal scientist and collaborators provided an opportunity to the collaborating institutions and scientists to understand the project and plan adequately for its implementation. In addition, the participants made suggestions to be included in the project in order to make maximum use of the resources during disease mapping and sample collection. A discussion on the samples to be collected and the kind of maps to be developed including the extent of coverage in the project counties were also discussed.

Field equipment and specific laboratory reagents to be procured for the project were discussed and agreed upon during the planning meeting held at KALRO - VSRI, Muguga on 22nd September, 2020. Thereafter, some of the required items and reagents were procured in readiness for field work and laboratory analysis.
Between 28th September and 2nd October 2020 the project counties were sensitized. The recommendations from the KALRO AMRI- Katumani meeting were explained to the project counties during the sensitization period whence they were required to report outbreaks of the disease for hotspot mapping and sample collection. During this time, the County Directors of Veterinary Services and KCSAP coordinators were briefed on the planned activities to be implemented by project. They were also advised to direct the Sub county Veterinary Officers and Ward-level personnel to be on the lookout for CCPP outbreaks as this was the basis for implementation of the project.

Tools for data collection were refined during a meeting held on 15th January, 2021 which was attended by the principal investigator collaborating scientists.

1.1 **Objective 1:** Develop CCPP risk maps for identifying disease hotspots for targeting interventions in Kenya.

1.1.1 **Activity 1.1:** *(state the activity and what was to be done as planned)* *Contagious Caprine Pleuro-pneumonia outbreak investigations*

The plan was to carry out CCPP of outbreak investigations in order to geo-reference areas reporting CCPP in the project counties and collect biological samples to determine prevalence of the disease by end of quarter 3 of year 2 of the project.

1.1.2 **Achievement 1.1:** *(Briefly give the achievements against what was planned)*

Outbreak investigation was conducted in Machakos County during the months of September and October, 2021 while that of Baringo County was done during the month of November, 2021.

*a) Study sites in Machakos County*

The exercise was carried out in Yatta and Masinga Sub-counties in response to reports of the disease by the County Director of Veterinary Services. Table 1 shows a summary of the villages, number of animals and samples collected for laboratory analysis.

<table>
<thead>
<tr>
<th>Sub County</th>
<th>Ward</th>
<th>No. of farms</th>
<th>Samples collected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Visited</td>
<td>With Cases</td>
</tr>
<tr>
<td>Yatta</td>
<td>Matuu</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Masinga</td>
<td>Muthesya</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Masinga Central</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Kivaa</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Kithyoko</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Mavoko</td>
<td>Athi River North</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

*b) Study sites in Baringo County*

In Tiaty Sub-county, samples were collected from four farms for laboratory analysis in Kolloa ward. Table 2 shows the type of samples collected.

<table>
<thead>
<tr>
<th>Sub County</th>
<th>Ward</th>
<th>No. of farms</th>
<th>Samples collected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Visited</td>
<td>With Cases</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1.2 Activity 1.2: Mapping of CCPP hotspots.
The plan was to develop spatial maps of CCPP outbreaks by end of quarter 3 of year 2 of the project to guide in planning for effective control of the disease.

1.2.1 Achievement 1.2: Records Global Positioning System (GPS) coordinates for farms with cases of CCPP.

Global Positioning System (GPS) coordinates were recorded for all the farms that had cases of CCPP as shown in table 3 and 4.

### Table 3: Location of farms with cases of CCPP in Machakos County

<table>
<thead>
<tr>
<th>Sub County</th>
<th>Ward</th>
<th>Owner</th>
<th>Farm GPS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Latitude</td>
</tr>
<tr>
<td>Yatta</td>
<td>Matuu</td>
<td>Patrick Mboti</td>
<td>-1.1396251</td>
</tr>
<tr>
<td>Masinga</td>
<td>Muthesya</td>
<td>Justus Mbithi</td>
<td>-0.8792877</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Peter Mutiso</td>
<td>-0.872655</td>
</tr>
<tr>
<td></td>
<td>Masinga Central</td>
<td>Fredrick Kiogo</td>
<td>-0.9553733</td>
</tr>
<tr>
<td></td>
<td>Kivaa</td>
<td>Francisca Nzuki</td>
<td>-1.0327368</td>
</tr>
<tr>
<td>Mavoko</td>
<td>Athi River North</td>
<td>Elizabeth Belibengi</td>
<td>-1.4589115</td>
</tr>
</tbody>
</table>

### Table 4: Location of farms with cases of CCPP in Baringo County

<table>
<thead>
<tr>
<th>Sub County</th>
<th>Ward</th>
<th>Owner</th>
<th>Farm GPS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Latitude</td>
</tr>
<tr>
<td>Tiaty</td>
<td>Kolloa</td>
<td>Thomas Limo</td>
<td>1.234945</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kichoria Locholianyang</td>
<td>1.32805167</td>
</tr>
</tbody>
</table>

Summary of achievements under objective 1:
The achievements under this objective include:
1. Identification of CCPP hotspots in Machakos and Baringo counties.
2. Collection of epidemiological data for determination prevalence and risk of CCPP in Machakos and Baringo counties.
3. Recording of GPS coordinates for developing spatial maps for CCPP hotspot.

In general, there was under achievement from what was planned.

1.2 Objective 2: Identify and characterize Mccp field strains in CCPP outbreaks and compare their antigenic variability with the F38 vaccine biotype.

Activity 2.1: Culture and isolation of Mccp in lung tissues and pleural fluid

Achievement 2.1: Samples collected during CCPP outbreak investigation were submitted to KALRO-VSRI Muguga Laboratory for analysis. Preliminary results indicate that the samples processed for culture did not yield any Mccp growth. The samples will be tested again using...
Polymerase Chain Reaction and Deoxyribonucleic Acid (DNA) will be obtained from positive samples.

**Activity 2.2:** Genome sequencing and bioinformatics

**Achievement 2.2:** (The activity depends on the results of activity 2.1)

**Summary of achievements under objective 2:**

A notable achievement under this objective was a collection of samples (tissues and pleural fluid) for culture of Mccp and DNA extraction). Again, this was an under achievement.

**II Other achievements:** NONE

**III Constraints and how they were overcome**

1. *Delays in procurement of equipment and laboratory consumables.* This significantly affected the implementation of the project activities and in many instances, the scientist had to borrow some of them from other projects.

2. *Change of the PI work station.* During this time, the PI was transferred from KALRO – VSRI – Muguga to KALRO – DRI – Naivasha. This meant that the resources allocated for the project were to be moved to the PI’s new work station for ease of operations and coordination of the project activities. There was time lapse in transferring of resources which caused significant delay in commencement of the planned field activities.


**NB:**

Due to the above delays, the planned field activities for this project started during the month of September, 2021 when the year 1 quarter 2 resources meant for fieldwork were disbursed sometime in late August, 2021.

**IV Summary of funds received, accounted for and balance**

<table>
<thead>
<tr>
<th>Project Amount (KES)</th>
<th>Amount Received (KES)</th>
<th>Amount accounted for (KES)</th>
<th>Balance (KES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,000,000.00</td>
<td>2,762,510.66</td>
<td>2,015,145.00</td>
<td>2,500,454.67</td>
</tr>
</tbody>
</table>

**IV Way Forward**

Activities Planned for the Period October 2021-June 2022

1. Contagious Caprine Pleuro-pneumonia outbreak investigations in the remaining counties (and other wards in Machakos and Baringo counties that will report outbreaks during this period).
2. Mapping of CCPP hotspots in the remaining counties (and in other wards in Machakos and Baringo counties).
3. Culture and isolation of Mccp in lung tissues and pleural fluid samples to be obtained from cases of CCPP.
4. Genome sequencing and bioinformatics
5. Gene cloning and expression.