### The challenge

Contagious bovine pleuropneumonia (CBPP) is a highly contagious disease that affects cattle throughout most of sub-Saharan Africa, where it consistently ranks as one of the most serious livestock diseases. CBPP directly impacts economies through cattle mortality and morbidity: up to 60% of infected animals die in naive herds, lactation yields of infected cows are reduced by up to 90%, infected animals grow more slowly and produce less meat, and infected draught oxen have a reduced capacity to work. At the household level, treating infected animals incurs high costs (more than €10 per animal) and has only limited success. At the national level, vaccination campaigns and other control measures stretch already under-resourced national veterinary authorities. CBPP is also a barrier to trade and reduces the value of livestock and the income of value chain stakeholders in many African countries. Current control measures, like diagnostic tests and vaccines, are suboptimal in controlling CBPP in most of sub-Saharan Africa.

### Our approach

To develop the proof-of-principle required for a new generation of vaccine, two approaches will be tested. Firstly, a protein-based subunit vaccine consisting of Mycoplasma mycoides subspecies mycoides (Mmm) membrane-associated proteins that are expressed in African Mmm strains or proteins expressed in vivo will be tested. To assess their vaccine potential, groups of cattle will receive an immunisation and boost of a cocktail comprising five recombinant proteins before challenge. Secondly, in a different vaccine development approach, (i) the membrane fraction of Mmm and (ii) secreted proteins for their ability to mount a protective immune response in cattle should be tested.

Additionally, the role of carbohydrates in host-pathogen interactions using in vitro lung slice models and defined mutants engineered using synthetic genomics will be invest...
The host immune responses using in vivo and in vitro experiments will be characterized in order to identify the protective arm of immunity by correlating host responses with protection.

Finally, a laboratory diagnostic test will be converted into a lateral-flow point-of-care (POC) test. The project will involve intensively exchanging project staff in order to maximise capacity building in the region and three African scientists will be directly linked into the project through fellowships that guarantee capacity development and ownership of the research.

The benefits

The immediate users of the improved vaccine generated by this project will be pharmaceutical companies or national vaccine producing laboratories in Africa that will conduct further testing, satisfy registration requirements, scale up manufacture and establish distribution networks. Informal discussions with the Pan African Veterinary Vaccine Centre (PANVAC) of the African Union and the Global Alliance for Livestock Veterinary Medicines (GALVmed) indicated an interest in a better vaccine if robust proof-of-concept is achieved. Agreements with commercial partners will be structured to ensure that the vaccine will be available to poor farmers in Africa at affordable prices, one option being a dual pricing arrangement.

The data on novel candidate antigens and immune responses elicited by various cell types will be a global public good to all scientists involved in mycoplasma-related vaccine development. This could lead to the development of a next generation vaccine that is likely to be thermostable, cheap and safer than current live attenuated vaccines.

The direct beneficiaries of an improved POC diagnostic test will be the company producing the test, livestock owners, animal health workers, private veterinarians, traders, national veterinary services and national agricultural research systems (NARS), which will be able to assess disease prevalence in individual animals. Such knowledge is essential to make informed decisions on the treatment, trading and housing of individual animals.

Expected impact

Key outputs will be: (A) the proof-of-principle for an improved CBPP vaccine; (B) the characterisation of host-pathogen interactions; (C) a lateral-flow type POC diagnostic test; (D) increased human capacity in Africa for research on diseases caused by Mycoplasma; (E) the initiation of interactions with potential users.

The above outputs, which are positioned towards the discovery end of the research-development continuum, can be generically used for developing livestock vaccines using a variety of strategies. These outputs will be crucial for successfully developing an improved vaccine to control CBPP.

The Advisory Service on Agricultural Research for Development (BEAF) manages Germany’s contribution to international agricultural research. Instruments for implementation are project funding, small grants and liaising between German and international researchers. BEAF is part of GIZ and acts on behalf of the Federal Ministry for Economic Cooperation and Development (BMZ).