

International Livestock Research Institute

Developing vaccination strategies for Rift Valley fever in East Africa

Workshop process and outcome report



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Abbreviations and acronyms

AU-IBAR	African Union–Interafrican Bureau for Animal Resources
CDC	Centers for Disease Control and Prevention
DVS	Directorate of Veterinary Services
EAC	East African Community
FAO	Food and Agriculture Organization of the United Nations
IGAD	Intergovernmental Authority on Development
IgG	Immunoglobulin G
ILRI	International Livestock Research Institute
KEMRI	Kenya Medical Research Institute
KES	Kenya shillings
KEVEVAPI	Kenya Veterinary Vaccines Production Institute
PANVAC	Pan-African Veterinary Vaccine Centre
RVF	Rift Valley fever
OIE	World Organisation for Animal Health
USAID	United States Agency for International Development
WHO	World Health Organization

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Executive summary

Background

Rift Valley fever (RVF) is an important disease threat to animal and human health in most countries in sub-Saharan Africa. It is caused by the mosquito-borne RVF virus and is associated with major debilitating epidemics that occur every 5 to 15 years following periods of above-normal and persistent rainfall. Endemic RVF virus transmissions have also been observed in riverine or irrigated areas and forested habitats. Its geographical range has slowly expanded from sub-Saharan Africa to the Arabian Peninsula, Madagascar and Mayotte, and recent risk analyses suggest there is potential for the disease to spread to temperate regions.

Whereas progress has been made on the development of new RVF control technologies such as vaccines, there is lack of knowledge on how these tools should be used at the community level. In East Africa, for instance, vaccines are usually administered as part of the emergency response measures following warnings of heightened risk of the disease. These emergency vaccination campaigns often fall short of achieving critical levels of coverage that are required to establish protective immunity partly because (i) rainfall-driven risk of RVF evolves rapidly and, therefore, there is usually not enough time to plan and execute vaccination campaigns and (ii) RVF-endemic areas get inundated during these periods, limiting their accessibility and hence the distribution of vaccines and other humanitarian interventions.

To address some of these challenges, the International Livestock Research Institute (ILRI) is implementing a project titled *Developing vaccination strategies for Rift Valley fever in East Africa*. The project is funded by the United States Agency for International Development (USAID)'s Office of U.S. Foreign Disaster Assistance. A two-day regional workshop was held on 4–5 October 2017 at the Lake Naivasha Country Club in Naivasha, Kenya to introduce the project to the stakeholders and design a framework for RVF vaccination in East Africa.

Workshop purpose and expected outputs

The purpose of the workshop was to design a framework for RVF vaccination and identify institutions, policies and capacities that could be used to support the implementation of the proposed strategies. The expected outputs of the workshop were:

- Project stakeholders **sensitized** on the RVF risk status in the region and country-level preparedness **reviewed**.
- RVF vaccination strategies **designed** and their implementation processes **outlined**.
- Institutions, capacities and networks required to implement the vaccination strategies **identified**.

A total of 27 participants attended the workshop, drawn from the animal and human health sectors in Kenya, Uganda and Tanzania; the Food and Agriculture Organization of the United Nations; the Zoonotic Disease Unit, Kenya; Wellcome Trust, Kilifi; Washington State University, Kenya program and ILRI among other institutions. Iain Wright, ILRI's Deputy Director General – Research, gave the welcome remarks while Obadiah Njagi, Chief Veterinary Officer at the Directorate of Veterinary Services, Kenya delivered the opening remarks.

Workshop presentations

Three sets of presentations were given on the first day. The first set of presentations gave an overview of the project and research activities to investigate immunity dynamics in vaccinated animals, gender and RVF vaccination, cost–benefit analyses of alternative vaccination strategies and development of an online platform for administering the RVF decision support framework. The second set of presentations reviewed the RVF risk status and levels of preparedness in Kenya, Uganda and Tanzania, while the third set covered research on development and validation of new RVF vaccines.

Design of RVF vaccination framework and its implementation process

The workshop identified the need for a regional RVF vaccination framework realising that:

- RVF is a transboundary animal disease that can easily spread between countries and its epidemics evolve rapidly within a short time.

- All the East African countries have favourable environments for the disease and often get affected at the same time.
- RVF outbreaks in one country have severe consequences on trade and public health in the entire region and beyond.
- There are opportunities to vaccinate more livestock if vaccination is done at the regional level.
- The existence of similar production systems across the region makes it possible to disseminate messages to all stakeholders.
- There are opportunities to share local facilities and capacities such as research facilities, vaccine production laboratories, standards and guidelines.
- A regional approach would make it more feasible to stockpile vaccines and develop a vaccine bank.
- This would facilitate the establishment of cross-regional collaborations to prevent the recurrence of outbreaks and boost regional herd immunity.
- This would provide incentives for the development of a regional risk map for RVF to identify areas of high, medium and low risk.
- A regional approach would strengthen the capacity of stakeholders and veterinary services to prevent and control RVF and other priority transboundary animal diseases in the region.

RVF vaccination strategies in livestock

The following strategies were identified for consideration in formulating an effective RVF vaccination framework in East Africa:

- **Routine vaccination in high-risk areas:** This should be based on an RVF risk map. However, Uganda, unlike the other countries, has not developed an RVF risk map. A harmonized risk map for the region will be required to design this strategy. Initial vaccinations should target animals of all ages, after which animals not previously vaccinated should be targeted. This, therefore, requires an efficient system of animal identification.
- **Vaccination ahead of predicted outbreak:** This is a common strategy used in many countries but issues that need to be considered to make it more effective include procurement and deployment of vaccines and timing of vaccination based on early warning or climate-based predictions. However, the sensitivity and accuracy of climate-based predictions in the region is low. It is important to identify the required resources and determine how to mobilize them at short notice.
- **Intermittent multi-year vaccination:** This could be done once every three years in high-risk areas, given that immunity in vaccinated or naturally infected herds declines with time due to population turnover. Vaccination can also be targeted at yearlings to maintain about 40% herd immunity and minimize costs.

Key assumptions made while determining the alternative RVF vaccination strategies specified above are:

- Natural infection provides immunity.
- Immunity is life-long but because of animal population dynamics, it is possible that after three years, herd immunity reduces substantially especially for sheep and goats.
- Only a small proportion of cattle will be naïve three years after 100% vaccination coverage in cattle.
- Sheep are the most susceptible and pose great risk during epidemics by amplifying transmission of the RVF virus.
- Cattle move more often and farther away compared to sheep and goats.
- There is need to combine vaccination with livestock identification.

Enabling environment, institutional arrangements and requisite capacities

The workshop also reviewed institutions, policies and networks that would be required to successfully implement the proposed RVF vaccination framework in East Africa.

- **At the Intergovernmental Authority on Development (IGAD) level:** IGAD supports the control of trade-sensitive diseases in the region, considers RVF to be a priority animal disease and supports regional animal health networks. There is, however, a need for a sub-network for RVF formed alongside existing networks, promotion of a regional One Health approach and establishment of a strategy to control transboundary animal diseases.

- **At the East African Community (EAC) level:** The EAC recognizes RVF as a priority disease. Policies at EAC level exist but their implementation needs to be strengthened. Disease control coordination instruments are also in place. These instruments deal with transboundary animal diseases and zoonoses. There is a need to establish a zoonotic disease/One Health office and sub-network for RVF.
- **Requisite policies and legal frameworks:** There is a need to establish appropriate policies to guide the use of vaccines across borders, disease reporting and notification, and standardization. In addition, there is a need for appropriate legal frameworks for disease control and vaccination in each country, a preparedness and response plan and a memorandum of understanding among member countries. There is a need for harmonized disease control policies, legal frameworks and strategies in the East Africa region, based on a review of member countries' existing policies and legal frameworks relevant to RVF and other transboundary animal diseases.
- **Policy and legal issues that need to be addressed:** The existence of an Animal Disease Act is a useful overarching document for each country; harmonized policies for registration of vaccines such as Smithburn® and Clone 13 that are already available; a policy for the use of drones to deliver vaccines, taking into consideration cost-effectiveness, cold chain and availability of technical staff to implement the vaccination after delivery; a policy to address animal identification and traceability; formulation and enforcement of relevant laws pertaining to One Health; and policy and legal frameworks related to animal movement, and their implications.
- **Other issues that need to be addressed to establish an enabling environment** include shortage of veterinary services in pastoralist communities; records of where vaccination has already been undertaken (because some countries do not have disease control policies); identification of regions at risk and development of a regional risk map; and contingency plans for RVF control and enhanced funding within countries.

Regarding the support needed to implement an efficient RVF vaccination framework in East Africa, suggestions were made on the incentives needed to promote participation by the public and private sectors, the required institutions and institutional arrangements, the key stakeholders and their requisite capacity needs.

Introduction

Rift Valley fever (RVF) is an important disease threat to animal and human health in most countries in sub-Saharan Africa. It is associated with major debilitating epidemics that occur every 5 to 15 years following periods of above-normal and persistent rainfall. Endemic RVF virus transmissions have also been observed in riverine or irrigated areas and forested habitats. Its geographical range has slowly expanded from sub-Saharan Africa to the Arabian Peninsula, Madagascar and Mayotte, and recent risk analyses suggest that there is potential for the disease to spread to temperate regions. In East Africa, Kenya and Tanzania often experience a much higher RVF burden but recent cases in Uganda (March 2016) indicate that the country is equally susceptible and vulnerable. About 50 million people live in the high-risk areas in the East Africa region yet its capacity to implement effective RVF prevention and control is low.

Existing options to control RVF in livestock include vaccines, market closure, quarantine and vector control. Progress has been made with the development of new RVF vaccines but there is lack of knowledge on how these should be used at community level. In East Africa, vaccines are usually administered as part of emergency response measures following warnings of heightened disease risk. These emergency vaccination campaigns often fall short of achieving critical levels of coverage that are required to establish protective immunity partly because (i) rainfall-driven risk of RVF evolves rapidly and, therefore, there is usually not enough time to plan and execute vaccination campaigns and (ii) RVF-endemic areas get inundated during these periods, limiting their accessibility and hence the distribution of vaccines and other humanitarian interventions. Other challenges affecting control of RVF include long inter-epidemic periods, inadequate funding, limited shelf-life of the existing vaccines and low uptake of vaccines by livestock producers and other value chain actors.

To address some of these challenges, the International Livestock Research Institute (ILRI) is implementing a project titled *Developing vaccination strategies for Rift Valley fever in East Africa* to support the development of a vaccination framework for RVF. The project is funded by the United States Agency for International Development (USAID)'s Office of U.S. Foreign Disaster Assistance. The objectives of the project are to:

- develop more effective RVF vaccination strategies;
- assess decay rates of RVF-neutralizing antibodies in vaccinated livestock;
- determine socio-economic and other factors that affect uptake of RVF vaccines; and
- build capacity among selected livestock value chain actors, including producers and traders.

The project convened a two-day workshop in Naivasha, Kenya on 4–5 October 2017 to introduce its activities to various stakeholders and design RVF vaccination strategies. The strategies identified were analysed further to identify the optimal option.

Workshop purpose and expected outputs

The purpose of the workshop was to formulate an appropriate regional RVF vaccination framework and identify the institutions, policies and capacities needed to implement the framework. The expected outputs of the workshop were:

- Project stakeholders **sensitized** on the RVF risk status in the region and country-level preparedness **reviewed**.
- RVF vaccination strategies **designed** and their implementation processes **outlined**.
- Institutions, capacities and networks required to implement an effective and efficient regional RVF vaccination framework **identified**.

The workshop also provided an excellent opportunity to establish networks among the stakeholders and projects undertaking RVF-related activities in the region. A total of 27 participants were in attendance, drawn from the animal and human health sectors in Kenya, Uganda and Tanzania; the Food and Agriculture Organization of the United Nations (FAO); the Zoonotic Disease Unit, Kenya; Wellcome Trust, Kilifi; Washington State University, Kenya Program and ILRI. The list of participants is in Annex 1.

Workshop approach

The workshop was designed as a hands-on activity with a logical combination of plenary presentations and discussions, group discussions and feedback sessions. Each group discussion had predetermined terms of reference and the groups presented their reports in plenary feedback sessions. This participatory process facilitated consensus building and agreement on the issues under discussion. Antony M. Kilewe of Topridas Consultancy Services facilitated the workshop, assisted by Violet O. Kirigua. The workshop deliberations were guided by the program shown in Annex 2.

Welcome remarks

Antony M. Kilewe, Topridas Consultancy Services

The facilitator began by leading the participants on self-introduction before inviting Bernard Bett from ILRI to give his introductory remarks. Dr Bett welcomed the participants and thanked them for making time to attend the workshop to discuss the RVF project being led by ILRI. He then outlined the workshop's purpose and expected outputs, after which he delivered the welcome remarks by Iain Wright, ILRI's Deputy Director General–Research, who had sent apologies for not being able to attend the workshop.

Iain Wright, Deputy Director General–Research, ILRI

In highlighting the objectives of the workshop, he noted that the participants were drawn from all the countries in East Africa targeted by the project. ILRI's previous projects on RVF, such as those that have developed RVF risk maps and decision support frameworks, have been implemented in the entire East Africa region, given that RVF-endemic sites traverse international borders. He noted that the participants represented a range of disciplines required to develop sustainable One Health programs and institutions to manage and control zoonotic diseases in the region. He noted this was a very important workshop aimed at addressing key challenges associated with control of RVF in the region. He thanked all for attending the workshop and said he looked forward to receiving the report of the proceedings.

Opening remarks

Obadiah Njagi, Chief Veterinary Officer, Directorate of Veterinary Services (DVS), Kenya

He welcomed the workshop participants to Naivasha, noting that RVF was not a new disease, having been reported in the Rift Valley. It was thus appropriate that discussions on RVF were being held in Naivasha, which is on the floor of the Rift Valley. He said Kenya has experienced RVF outbreaks since the 1990s during which time he worked in the laboratory handling infected animals and even once got infected with RVF. The 2006–07 outbreak affected Kenya, Uganda and Tanzania. Outbreaks can initially be explosive and are usually associated with unusual weather patterns and the dynamic environment in which livestock-keepers raise their animals.

During the 2006–07 outbreak, two main regions in Kenya (Western and Nyanza) were not affected, the reasons for which are not yet understood; research on this will improve our understanding of the mitigating factors. In Kenya, the 2006–07 outbreak resulted in 700 human cases and 158 deaths and the economic cost to the country was 2.1 billion Kenya shillings (KES). This calls for adequate planning and preparedness to manage outbreaks and requires commitment from all relevant institutions. The DVS and the Ministry of Health, through the Zoonotic Disease Unit's technical working group, set out to meet international health regulation obligations of 2005 to protect local communities from the adverse effects of disease outbreaks. In 2010, the group developed the country's preparedness and contingency plan and adopted the One Health approach in the management of RVF. The implementation of the plan has improved the efficiency and effectiveness of RVF management.

Vaccination has been the main intervention in response to RVF outbreaks. The main vaccine that has been successfully used is the Smithburn[®] vaccine, despite its shortcomings. Other vaccines such as Clone 13 are still under development. Vaccination is usually done during periods of heavy rainfall but access to animals is normally hampered by poor road conditions and exacerbated by limited quantities of the vaccines. Kenya has had to call on development partners for assistance, but the desired coverage has not been attained. The DVS is glad to be associated with the project and is committed to supporting its implementation which will provide useful insights in the management of RVF. Dr Njagi thanked the development partners that had assisted in the management of RVF in the past and the participants for finding time to attend the workshop and wished them fruitful deliberations. He then declared the workshop open.

Project strategic focus and implementation arrangements

This session featured presentations on the project activities and implementation arrangements followed by plenary discussions. All the presentations from the session can be accessed from the following link: <https://www.dropbox.com/sh/wkg3wfrgmdiy2tq/AABkzq68x-OzGoHYEE7xmhyua?dl=0>.

Overview of the project

Bernard Bett

The project is two-year activity that was expected to start in February 2017. However, due to the election process in Kenya, there was a delay in implementation and the project only begun in October. The aim of the project is to determine how RVF vaccines can be used more effectively.

In East Africa, RVF outbreaks often occur following periods of heavy and persistent rainfall lasting 2–3 months. It is often difficult to plan effectively for such events, given that the risk evolves rapidly over a short time. Published research suggests that livestock vaccination is a major intervention that can be used for both preventive and control purposes. However, there are no guidelines on how to use these vaccines at the community level. Given that vaccination provides long-term immunity, it might be practical to vaccinate animals when they are still young to build a solid herd immunity over time as is done for East Coast fever. However, for RVF, there is a huge economic implication of vaccinating livestock over the inter-epidemic period when there is no risk. These are some of the issues the project aims to analyse.

Humans often act as sentinels for RVF, given that surveillance systems for the disease are generally unreliable. In this case, official responses are often implemented when human cases have been reported in hospitals. The lack of response during peace-time periods is partly due to lack of data that can be used to quantify the economic benefits of routine vaccination. Although major RVF vaccination campaigns are often implemented as a publicly-funded service, private ranches in endemic areas are slowly getting engaged through their own vaccination campaigns. However, willingness to pay and acceptable levels of vaccination have not been assessed and it is not clear whether such efforts can lead to the required vaccination coverage. There are also no structures and guidelines on how this should be undertaken to avoid patchy distribution of the vaccine. The project objectives that aim at addressing some of these issues include:

- Using mathematical modelling to identify the optimal vaccination strategy for the region.
- Refining the decision support framework to guide RVF vaccination.
- Studying immunity dynamics in livestock in endemic areas to understand how livestock offtake affects the longevity of herd immunity.
- Building capacity in livestock identification and vaccination at the community level.
- Carrying out studies on gender and socio-economics to identify factors that affect uptake of vaccination.

Immune response studies (field and laboratory)

Nicholas Svitek

This presentation outlined the objectives of the first study on immunity dynamics of RVF in vaccinated animals. The study will assess the longevity of RVF immunity in vaccinated animals based on the levels of neutralizing RVF virus antibodies in circulation. It will use a longitudinal design involving cattle, sheep and goats vaccinated with the Smithburn® vaccine. The laboratory component will investigate the decay rates of neutralizing immunoglobulin G (IgG) antibodies using enzyme-linked immunosorbent assay and virus neutralization tests.

Gender and RVF vaccination

Salome Bukachi

This presentation covered gender and socio-economic factors that influence the use of RVF vaccines in livestock. Very few studies have been carried out to identify socio-economic factors that affect the delivery of livestock vaccines. Livestock production is often a shared household responsibility, with men more focused on disease management and women engaged in care of sick animals. Gender and socio-economic differentials are based on

access to and control and management of livestock products. In many areas, the government implements RVF vaccination campaigns with minimal involvement of livestock producers who play a more critical role in bringing their animals for vaccination.

The specific objectives of the study were to:

- assess how household decision-making patterns affect access to, control and use of, and responsibility for animal health interventions including RVF vaccines;
- examine how information on vaccination is disseminated and how motivation for engagement in vaccination is achieved, by gender and other socio-economic characteristics;
- establish perceptions on preventive versus curative services among men and women; and
- assess how vaccine delivery systems affect community-level uptake of RVF vaccines.

It was suggested that the study sites be grouped into two: RVF-endemic sites with frequent vaccination (Baringo, Kenya) and RVF-endemic sites with no history of vaccination (Kabale, Uganda). It will be a qualitative study that will include 20 focus group discussions, half of which will be for men only and the other half for women only. Each group will consist of 8–12 participants. Key informant interviews will be conducted with veterinary and medical officials and prominent community members to triangulate information. The themes to be explored include key livelihood activities in the village, livestock species kept, livestock diseases and their impacts, investments in disease control and decision-making at the household level, livestock vaccination campaigns on RVF, proportion of animals covered in the recent campaigns (proportional piling), factors that affect uptake, and household decision-making on RVF control/vaccination.

Application of cost-benefit analysis to assess the economic viability of transboundary animal disease control strategies

Francis Wanyoike

The economic feasibility of a livestock disease control strategy is a major consideration for a public institution that must justify the use of public resources, a funding agency that seeks to support a disease control program or a private company/individual farmer faced with a decision on whether to invest in a disease control strategy or to comply with government regulations. Cost-benefit analysis is one of the methods used to estimate the economic feasibility of an investment when both the benefits (positive economic impacts) and costs (negative economic impacts) are estimated in monetary terms. An economically viable initiative is one in which the benefits are at least equal to or greater than the costs.

Costs and benefits of transboundary animal disease prevention and control interventions were classified as those within or beyond the livestock sector. Benefits within the sector include increased asset and output value, reduced prevention and treatment costs and reduced cost of outbreak control. Costs within the sector are related to prevention and preparedness, outbreak control and changes to management or production systems. Benefits beyond the livestock sector include human lives saved or quality-life years increased and reduced cost of public health treatment. Costs beyond the livestock sector include public health investments, higher food prices for consumers and costs to tourism and wildlife. The most obvious benefits from controlling a transboundary animal disease result from reduced disease incidence in a system, allowing livestock owners to consume and/or sell more in new markets. It was suggested that this framework be used to evaluate the costs and benefits of the alternative RVF vaccination strategies proposed in the workshop.

RVF decision support framework

Absolomon Kihara

This presentation provided an insight into ongoing work on the development of an online portal to administer the RVF decision support framework. This will enable dynamically generated real-time RVF risk maps that are linked to the decision support framework showing RVF risk estimate at region, country, county or division levels for localized decision-making. The system will use rainfall and flood dynamics to estimate RVF risk over time. The tool will be accessible from a public website and preferably hosted on a government website. Significant progress has been made to improve the tool. The next steps include developing a program to automatically fetch rainfall forecasts, refining the RVF model, dynamically linking risk to the decision support framework and exploring the possibility of linking the risk maps for cost-benefit analysis.

Plenary discussion of the presentations

Question: What is the minimal time of protection following RVF vaccination?

Answer: Data from previous studies show that this can last up to a year, but other studies suggest lifetime immunity.

Q: Baringo may not be representative of high risk in terms of animal husbandry. Could the project widen the scope to include Tana River, highland areas of Murang'a and high-rainfall areas of the Rift Valley to accommodate the varied agro-ecological zones as well as different animals?

A: Initially, the project targeted Baringo, Isiolo and Garissa but due to logistical aspects some sites were dropped. However, this is still under discussion and will be concluded.

Q: On cost-benefit analysis, I did not see much on the effects of abortions on production (reduced milk production, weight gain etc.).

A: The presentation on economic analysis was a general presentation but it did state that among the benefits of vaccination would be increased assets and outputs. These imply the products (e.g. milk) that accrue from the increased benefits and are captured by the word 'outputs'.

Q: Regarding the project sites, would it be possible to consider Tanzania because it has been severely infected in the past, for example, in areas around Iringa?

A: Tanzania was initially in the proposal. ILRI could advise on the status.

A: The sites to be incorporated in the project have not been concluded. There is need to develop criteria for selecting the sites and the workshop could probably advise on the selection criteria.

Q: How easy is it to quantify the costs and benefits beyond the livestock sector?

A: Systems modelling tools, such as Policy Analysis Matrix, could be used.

Q: What are the residual effects of the vaccine on consumers, given that it confers long-term immunity to the animals?

A: The immunity developed by the animals is sterile immunity and, therefore, the Smithburn® vaccine is not transferrable to humans.

Q: To help the uptake of vaccines, it has been suggested that it may be necessary to combine the vaccines into multivalent products to make them cost effective. Single vaccines may not be relevant to different communities. However, multivalent vaccines have the potential to increase uptake. Is the project developing recombinant vaccines?

A: This is an important point, particularly for ILRI as it works on vaccines. This is not within the scope of the project. There are tools in social science (e.g. contingent variation) that use hypothetical scenarios to evaluate the uptake of a product yet to reach the market. We plan to use these tools to evaluate the acceptability of such a product although it has not been made available in the market.

A: A recombinant vaccine strategy would have implications on costs and benefits. The hypothesis is that there would be significant benefits and we hope to generate data that could influence demand for such products.

Q: Will the project use sentinel herds? Where will the animals be sourced?

A: The project will use community herds in endemic areas and not sentinel herds. There is a similar project that will be implemented in collaboration with ILRI in Kapiti which will use sentinel herds. It will be possible to compare the findings of these two projects.

Background review of RVF control policies in East Africa and vaccine development

In this session, presentations were made on the status of RVF and the control measures used in Kenya, Uganda and Tanzania. The presentations also covered challenges and opportunities associated with RVF control, and experiences and lessons learnt in the management of RVF in the region. The presentations were followed by plenary discussions. All the presentations made during this session can be accessed from <https://www.dropbox.com/sh/wkg3wfrgmdiy2tq/AABkzq68x-QzGoHYEE7xmhyua?dl=0>

History of RVF in Kenya

Harry Oyas

The first case of RVF was reported in Kenya's Rift Valley in 1912 and subsequent outbreaks have occurred at intervals of 5 to 15 years. The last major outbreak in Kenya occurred in 2006–07 during which 158 people died and the country experienced losses amounting to KES 4 billion. The outbreak impacted heavily on local, regional and international trade in livestock and livestock products.

Kenya has developed an RVF control strategy contained in the country's RVF contingency plan. The objectives of the plan are to (i) serve as a national reference tool for RVF outbreak preparedness and response, (ii) provide information on risk and disease hotspots in the country, (iii) provide information on actions to be taken during the different phases of the outbreak response, (iv) define the coordination structures, including the Ministry of Health, the Ministry of Agriculture, Livestock and Fisheries and other agencies and (v) identify needs and facilitate the mobilization of resources for response.

Regarding RVF surveillance in Kenya, two approaches have been adopted:

- The use of sentinel surveillance in Machakos, Bachuma, Naivasha and Trans Nzoia where flocks of naïve sheep and goats are tested during high-risk periods. The sentinel herd is sampled before the onset of the rains and thereafter every four weeks during the rainy season until the end of the rains.
- Syndromic surveillance conducted during high-risk periods. Livestock owners are recruited to report on syndromes encountered as well as weather conditions. The Kenya Livestock Wildlife Syndromic Surveillance System has been developed as an offshoot.

Control measures adopted include awareness creation, vaccination during alert periods, movement control (quarantine), market closures and vector control. In addition, routine annual vaccination is conducted in high-risk districts. In other instances, vaccination is done ahead of predicted outbreaks and in low-risk areas during localized outbreaks. Animals for export are vaccinated 21 days before export. As a policy, vaccination is not allowed in areas or flocks confirmed to be affected during an RVF outbreak.

RVF situational assessment in Uganda

Dan Tumusiime and Josephine Namayanja

In 2012, the Government of Uganda embarked on preparing guidelines for RVF surveillance. The initial steps involved serosurveys which revealed the presence of RVF in the country. The first RVF outbreak in the country occurred in March 2016 in Kabale District, western Uganda after the Ministry of Health confirmed on 11 March 2016 that two patients had tested positive for RVF. Management of the human cases was good.

Control measures included surveillance and reporting, disease investigation, movement control, awareness creation and regulatory framework and coordination. To enhance coordination, a multi-sector national task force and national and district rapid response teams were reactivated. Members of the national task force include the Ministry of Agriculture, Animal Industry and Fisheries; the Ministry of Health; the Ministry of Water and Environment; the Uganda Wildlife Authority and partners including the World Health Organization (WHO), Centers for Disease Control and Prevention (CDC), FAO and UNICEF. The Animal Diseases Control Act (1964) does not include RVF in the list of diseases to be controlled. The Ministry of Agriculture, Animal Industry

and Fisheries has developed a statutory instrument for RVF that is awaiting approval. However, there is a multi-sector RVF contingency plan in place.

Uganda has intensified passive and active surveillance through outbreak investigations and entomological surveys. Sampling usually starts from the high-risk areas, including abattoirs, households where human cases have been reported and livestock markets. Upon positive identification of RVF, the Director of Animal Resources and the Director General of Health Services hold a joint press briefing.

RVF outbreak in Tanzania

Fausta Masha

Tanzania reported its first outbreak of RVF in livestock in 1930. Thereafter, outbreak waves of varying magnitude and in different locations have been reported, with an average inter-epidemic period of 7.9 years (range 3–17 years). The country's first documented outbreak of RVF in humans was in 1977. Major outbreaks also occurred in 1997–98 during the El Niño floods. The second major outbreak occurred in 2006–07 after the heavy El Niño-associated rains; this epidemic represented the largest ever reported outbreak of RVF in Tanzania: 309 suspected cases, 186 (60%) RVF-positive and 144 deaths (case fatality ratio 47%).

Among the actions taken to contain the disease were active intensification of surveillance, training workshops in all affected regions, health education campaigns and vaccination of livestock. Tanzania also formed a multi-sector RVF task force to oversee the outbreak. Medical and laboratory supplies were distributed to the affected areas and laboratory capacity strengthened. The presentation also outlined the distribution of RVF in Tanzania, strategies for mitigation and lessons learnt in the management of RVF.

Tanzania has developed a national RVF emergency preparedness and response plan which has the following six intervention areas:

- Improving institutional capacity for early detection and reporting
- Improving the implementation, management and coordination of the plan
- Maintaining business continuity during different phases of an epidemic
- Preventing and controlling RVF infections in humans and animals
- Increasing immunity of animals to RVF
- Monitoring and evaluation of the implementation of the plan

FAO's RVF-related activities in the region

Sam Okuthe and Joseph Njuguna

Past interventions include prevention and control in the livestock sector, joint RVF preparedness assessment in Kenya and Tanzania, collaborative international engagement to prevent and mitigate threats from pathogens in targeted East African countries, and rapid qualitative risk assessment and surveillance in Uganda. Current interventions include ongoing capacity building on priority zoonotic diseases and management of influenza A viruses and other high-impact diseases.

A One Health approach and multi-sectoral engagement involved the national and county governments and partners from the animal and public health sectors. FAO was involved in the review, update and dissemination of the RVF contingency plan and decision support framework, and supported the development of Standard Operating Procedures. The outcomes of the joint RVF risk assessment included better preparedness in terms of training and better awareness creation than during the 2006–07 outbreak.

The outcomes of a collaborative project include strengthened capacity of target countries for risk-based disease surveillance; production and dissemination of a disease investigation and laboratory manual; improved diagnostic capacity of central veterinary laboratories in Ethiopia, Kenya, Tanzania and Uganda and enhanced capacity of field veterinarians to prepare for and respond to animal disease emergencies.

National and sub-national veterinary staff have been trained on syndromic surveillance and outbreak investigations to support surveillance for RVF and other priority zoonotic diseases. In Kenya, support has been provided for livestock sentinel surveillance for RVF sentinel herds in Machakos, Naivasha, Bachuma and Japata.

In Ethiopia, there is a risk-based surveillance plan for RVF within the national contingency plan and strengthened surveillance through two systems that include RVF as a reportable disease. In Uganda and Tanzania, RVF surveillance has been strengthened through an Event Mobile Application system with RVF as a priority disease. Other activities include strengthening of laboratory systems; development of biosecurity and biosafety and workforce; training on good emergency management practice; and enhancing preparedness, detection, response and recovery.

RVF control options

Kariuki Njenga

RVF is endemic in eastern Africa and all countries in the region have experienced outbreaks mainly in north Sudan, western and southern Somalia, northern Tanzania, and eastern and southern Kenya. There are five key recommended control options: livestock vaccination, public education, slaughtering ban, livestock quarantine and vector control. The most effective control measures are livestock vaccination, public education and slaughtering ban. Vector control, though recommended, is largely ineffective and most countries shy away from the cost of implementing it.

There are two main vaccines used to control RVF. The most common is the Smithburn® vaccine that is currently licensed in Kenya and Tanzania and produced at the Kenya Veterinary Vaccines Production Institute (KEVEVAPI). The other, which is more recent and licensed in South Africa and Namibia, is the RVF Clone 13. The Smithburn® vaccine has been reported to have some side effects such as abortions and thus many livestock farmers in the ranches tend to avoid using it. Trials carried out in Kapiti and Kiboko have shown that Clone 13 has fewer side effects. Some of the strategies that have been adopted in control of RVF are (i) yearly vaccination, an excellent policy but the cost is prohibitive and achieving coverage is a challenge; (ii) intermittent multi-year vaccination which is done periodically and is more cost effective and (iii) use of a multivalent or combination vaccine consisting of an RVF antigen and an antigen of a vaccine which is likely to be used regularly and is cost effective.

Vaccines are unstable and, therefore, produced in low quantities for immediate use at a specific time. Setting up a regional vaccine bank would make the vaccine available following disease outbreaks. Most experts agree that an effective livestock vaccination program can significantly mitigate or even prevent any RVF outbreak. Unfortunately, no country in the greater Horn of Africa has an RVF livestock vaccination policy, partly because of the long inter-epizootic periods of up to 10 years.

Development of new vaccines

Madeleine Clark and George Warimwe

The presentation was based on the co-development of a human and animal vaccine using the ChAdOx1 RVF vaccine which can be used in all species affected by RVF. RVF is a multi-species virus that affects cattle, sheep, goats, camels and humans. The current research is looking for a vaccine that can target all vulnerable species. The current licensed inactivated and live RVF virus vaccines are only suitable for use in livestock, and there are no licensed vaccines for humans. The project is in the process of conducting a non-inferiority trial in target animals in the field. This will be validated in four animal species for vaccine-induced immune response.

Madeleine also presented the vaccine development plan. The ChAdOx1 vector was selected due to its inherent stable and safe characteristics (It has been used successfully in several animal and human vaccine candidates). Product development has been initiated in collaboration with Oxford University that has an excellent facility for the development of viral vectors. The project has received funding for livestock field trials in sheep, goats, cattle and camels in Kenya and human phase 1 clinical trials in healthy adults in the United Kingdom and Uganda.

Plenary discussion of the presentations

Question: Reference is made to Uganda's presentation and the slide on anti-RVF virus IgG detection results. Was this from the same animals?

Answer: Yes, it was.

Q: Studies have shown that RVF is caused by different strains and epicentres. Do the available vaccines protect against all the strains and animals? Are these variables expected to affect vaccination strategies?

A: Previous work by CDC on gene sequencing showed the differences in RVF virus are at the level of amino acid sequences and not profound to affect the effectiveness of vaccines. We, therefore, believe one vaccine should be able to control all the strains. Any vaccines developed should be able to contain the disease across the region.

Q: Reference is made to the point that vaccination should not be done among infected animals. But if you provide only 100,000 doses in the event of an outbreak, will you vaccinate healthy animals or those already showing signs of infection? We always advise officers that they should try to contain an outbreak. We understand the justification for not vaccinating infected animals but when inadequate doses of vaccines are provided, how can vaccines be distributed effectively on the ground?

A: Based on the presentation from Uganda on flooding and stagnant water, we probably need to reconsider the approach we use for risk mapping. We have been focusing on rainfall intensity and, therefore, might have missed some of the high-risk areas. We need to consider how to capture floods and their duration of persistence. This will probably require better approaches such as topography and surface run-off, but we haven't done that yet.

Q: Studies on Clone 13 have not conclusively stated the duration of immunity in vaccinated animals. For how long does the vaccine provide protection? How long should the interval of vaccinations be, especially for small stock? Waiting for alerts is not the best approach.

A: We did the study for up to one year and animals tested at the end of the period still had protective antibodies. This shows that these animals were immunized over the study period. The animals were, however, not exposed to the virus during the period of the trial.

Design of RVF vaccination strategies and their implementation processes

The design of RVF vaccination strategies and their implementation processes was carried out in three discussion groups. While carrying out their respective assignments, the groups were expected to refer to the plenary presentations and discussions, any other relevant documents as well as their collective knowledge and experience. The following questions guided the group discussions:

- What are the compelling **purpose and objectives** of a regional approach to RVF vaccination in East Africa?
- Given the overall purpose and objectives of a regional approach to RVF vaccination in East Africa, **identify and design** at least three alternative RVF vaccination strategies in livestock. (Some of the issues to consider in the design of vaccination strategies are the timing of vaccination, targeted areas, and species or ages of animals to vaccinate).
- Given the designed RVF vaccination strategies in livestock, outline the **appropriate processes** required for their effective implementation.
- What are the **major elements or aspects** that should be considered in the formulation of an effective and efficient RVF vaccination framework in East Africa?
- What are the anticipated **challenges and opportunities** in the design, adoption and implementation of an effective and efficient RVF vaccination framework in East Africa?

After the deliberations, reports from the three groups were presented and discussed in plenary. Since the three groups responded to the same guiding questions, their reports were then harmonized and summarized into one report that incorporates the plenary feedback outlined below.

Purpose and objectives of a regional approach to RVF vaccination

The following were indicated as the rationale for a regional approach to RVF vaccination in East Africa:

- **Transboundary nature of the disease:** Being a transboundary animal disease, RVF poses significant economic, trade and/or food security challenges in several countries and can easily spread from one country to another and evolve rapidly into major epidemics. Therefore, the control and management of the disease, including exclusion, requires cooperation between neighbouring countries.
- **Common conducive environmental conditions for outbreaks and similar ecosystem:** RVF outbreaks have been associated with periods of widespread and above-normal rainfall over several months. All countries in East Africa can experience these conditions at the same time.
- **Consequences of the outbreak affect trade partners and public health in the region:** RVF leads to trade bans on the infected country, causing significant economic losses. The zoonotic nature of RVF leads to serious public health problems.
- **Greater impact as compared to individual countries:** Greater numbers of livestock would be vaccinated if vaccination were done at regional level.
- **Similar production systems:** The existence of similar production systems across the region makes it possible to pass messages to all stakeholders.
- **Facilitation of sharing of local facilities within the region:** A regional approach would make it possible for countries to share and effectively utilize local laboratories, vaccine laboratories, standards and guidelines, among other facilities.
- **Stockpiling and storage of vaccines:** A regional approach would make it viable to have a vaccine bank in the region. Vaccines stored in one country should not go to waste and should be made available in another country in the event of an outbreak there.
- **Establishment of cross-regional collaborations:** A regional approach will facilitate the establishment of cross-regional collaborations to prevent the recurrence of outbreaks and boost regional herd immunity.
- **Facilitation of the development of one regional risk map:** A regional approach will facilitate the development of one regional risk map for RVF to identify areas of high, medium and low risk. Currently, only Kenya has developed a risk map.

In view of the above considerations, the **overall purpose** of a regional approach to RVF vaccination in East Africa should, therefore, be to:

- facilitate the establishment of cross-regional collaborations to prevent the recurrence of outbreaks and boost regional herd immunity;
- strengthen the capacity of stakeholders and veterinary services to prevent and control RVF and other priority transboundary animal diseases in the region; and
- improve the management, prevention and control of RVF and other priority transboundary animal diseases in the region.

Given the overall purpose, the **objectives** of a regional approach to RVF vaccination in East Africa are to:

- take advantage of economies of scale and enhance impact through sharing of facilities for vaccine production, vaccination, research, laboratories and technical expertise;
- minimize the regional impact of RVF by reinforcing veterinary services in the region;
- harmonize and ensure effective coordination of RVF vaccination activities among countries in the region;
- improve the quality and efficiency of RVF vaccination through a structured and scientific approach;
- sustain RVF control measures to ensure accessibility to external livestock and livestock product markets; and
- improve the overall health of livestock in the region by reducing the impact of RVF and other priority animal diseases.

RVF vaccination strategies in livestock

The following were identified as some of the general vaccination issues to consider:

- Period of immunity in animals after vaccination, assuming lifelong protection: the lifespan of cattle is 4–5 years, sheep and goats 1–2 years and camels 15–25 years.
- The main variant is at herd level; newborns and new recruits will be susceptible.
- The cost of vaccine delivery is higher than that of the vaccine itself. For example, the Smithburn® vaccine costs KES 12 per dose.
- Deliver the vaccine when it is logistically convenient.
- Identification of animals is an issue to consider.
- During peace time, vaccine stocks should be available.
- There is need to identify a regional coordination body, funded by all countries involved, to drive RVF activities.

The following alternative RVF vaccination strategies in livestock were identified for consideration in the formulation of an effective and efficient RVF vaccination framework in East Africa (see summary in Table 1):

- **Routine vaccination in high-risk areas (yearly):** This should be based on an RVF risk map. However, only Kenya and Tanzania have risk maps; the other countries need to develop theirs. Routine vaccination should target all animals of all ages (without maternal antibodies). Subsequent vaccination should target animals that were not vaccinated (yearlings); consider animal identification.
- **Vaccination ahead of a predicted outbreak (during alert/emergency):** Issues to consider include deployment, procurement of vaccines and timing between climate predictions. However, the sensitivity and accuracy of climate predictions in the region are low. It is important to know where resources are and how to mobilize them at short notice.
- **Intermittent multi-year vaccination:** This should be carried out once every three years in high-risk areas because immunity is approximately three years. Only yearlings should be vaccinated and a herd immunity of 40% maintained because vaccination is a very costly exercise.

Table 1: Summary of the vaccination strategies

Time	Vaccination strategy			Assumptions
	Routine vaccination (yearly)	Intermittent multi-year vaccination	Vaccination ahead of predicted outbreak (during alert/emergency)	
Peace time	<p>Timing During the wet season when animals are in good condition. During the dry season, animals are usually scattered and have poor body condition, raising questions about their response to vaccination. Uptake studies are, therefore, needed in different seasons. Timing is also affected by season and production system.</p> <p>Target areas Target high-risk areas and consider vulnerability. Within high-risk areas, there are also more vulnerable areas. Areas with constant exposure have protective cover. Consider the gender and socio-cultural and economic dynamics of target communities.</p> <p>Target species Cattle, sheep, goats and camels Cattle have higher seropositivity while small ruminants have high mortality rate. Identify vaccinated animals to avoid repeats and unnecessary costs.</p> <p>Age of animals to vaccinate Target animals of a specific age (6–18 months for cattle; 6–12 months for sheep and goats). RVF maternal antibodies should guide on age. Maternal immunity lasts up to the first six months of life.</p>	<p>Timing Every three years but interrupted if there is an alert. Consider turnover rate which is faster in small animals.</p> <p>Target areas High-risk areas Vaccinate in medium-risk areas only if there is a confirmed outbreak.</p> <p>Species Cattle and camels but spaced every three years. Small ruminants can be vaccinated annually because of high turnover rate. There is a challenge of separating the species.</p>	<p>Timing During alert or ahead of predicted outbreak.</p> <p>Targeted areas Localized vaccination. Depending on production systems, determine how far to go from the index case. Delineate the area and carry out rapid assessment to establish the extent of risk.</p> <p>Species All animals at risk All remaining cattle, sheep and goats</p>	<p>Natural infection provides immunity. Only a small proportion of cattle will be naïve three years after 100% vaccination coverage. After three years, all sheep will be naïve. Sheep are the most susceptible and pose great risk to the public. Cattle move more often and farther than sheep and goats. Immunity is lifelong. Need to couple vaccination with livestock identification. Population turnover does not affect herd immunity.</p>
Alert (expect heavy rains, early warning signal)	<p>Vaccination moved to medium-risk areas with the assumption that the high-risk areas are well covered. Carry out a risk assessment in high-risk areas while covering medium-risk areas. Consider all animals.</p>	No vaccination	<p>Emergency vaccination Delineate the area and vaccinate</p>	
Outbreak	No vaccination	No vaccination	<p>Vaccinate uninfected animals that have potential of getting infected Avoid in areas of outbreak Cover all species.</p>	

Aspects to consider in the process of implementation of a sustainable RVF vaccination framework

- Setting up of a regional coordination body to drive the implementation of the RVF vaccination framework.
- East African Community (EAC) ministries, in close collaboration with the relevant livestock and human health ministries, could be lobbied to source for funding for the coordination body and ensure the purpose and objectives of the regional approach to the control of RVF are achieved.
- Strengthening of country and regional weather forecasts, climate studies and information sharing.
- Lobbying and advocacy for the formulation of appropriate policies and legal frameworks to support the implementation and sustainability of the RVF vaccination framework.
- Lobbying and advocacy for registration of at least one RVF vaccine in each of the countries at risk.
- Advocacy and sensitization for buy-in from all livestock value chain actors, including policymakers, using communication strategies that take into consideration gender and socio-cultural and economic factors.
- Assessment and development of capacities at all levels.
- Supporting and facilitating the development of appropriate vaccination plans and effective monitoring and evaluation systems.
- Assessment of the available infrastructure and establishment of appropriate sharing mechanisms.
- Establishment of appropriate mechanisms to ensure sustainability, including reducing costs, exploring the possibility of recombinant vaccines, sharing the cost of vaccine delivery between the government and producers, and public-private partnerships.

Aspects to consider in the formulation of an effective and efficient regional RVF vaccination framework

- Coordination within countries (including the relevant sectors such as finance, education, security and disaster preparedness) and between countries.
- Vaccine availability, sourcing, delivery and affordability, including the possibility of establishing a regional vaccine bank.
- Targeted research to understand the disease epidemiology and to develop appropriate vaccines, including multivalent or combination vaccines.
- Information gathering, dissemination and sharing to inform decision-making processes.
- Consideration of risks in different regions and development of regional risk maps.
- Existence of different policies and legal frameworks in each of the countries and consideration of possible harmonization.
- Socio-economic and gender considerations and understanding of the impact of RVF within and across countries.
- Ensuring political goodwill to avoid conflict and political instability.
- Publicity and awareness creation.
- Capacities of the national and regional veterinary services in terms of financial and human resources and infrastructural facilities.
- Individual and joint country mobilization of resources to implement the RVF vaccination framework.
- In-country and regional monitoring, evaluation and sharing of lessons and experiences.

Challenges and opportunities in the design, adoption and implementation of an effective and efficient regional RVF vaccination framework

Challenges

- Inadequate financial and human resources due to competing priorities.
- Inadequate stocks of RVF vaccine, side effects of the vaccine and low uptake, which call for the development of a multivalent vaccine.
- Limited lead time to prepare and mobilize resources after an alert is issued.
- Insufficient data to support modelling of, for example, protection level and minimum number of animals to vaccinate to ensure herd immunity.

- Inadequate core infrastructure such as storage facilities, equipment, roads, telephone network and electricity, and insecurity in high-risk areas.
- Poor livestock identification and traceability systems and lack of a 'Differentiating Infected from Vaccinated Animals' strategy.
- Overlooking of the gender, socio-cultural and economic dynamics of communities in major decision-making.
- Weak animal health services sector and inaccurate prediction of outbreaks.
- Weak inter-government collaboration and cross-border monitoring of animal movement and vaccine uptake.
- Low sensitivity and accuracy of climate predictions in the region.

Opportunities

- Availability of multi-disciplinary expertise to develop a combination vaccine and other novel, safer vaccines.
- Existence of veterinary systems, an animal health desk at the EAC and availability of technical and support experts in governments.
- Possibility to carry out RVF vaccination during routine vaccination for other diseases.
- Existence of regional health networks such as the East African Public Health Network (human disease surveillance) and the Veterinary Epidemiology Network, including proximity to the Pan-African Veterinary Vaccine Centre (PANVAC) and Africa CDC.
- Existence of political goodwill and regional economic communities such as the EAC, the Intergovernmental Authority on Development (IGAD) and the Common Market for Eastern and Southern Africa.
- Presence of and close liaison with international technical organizations and institutes such as the African Union–Interafrican Bureau for Animal Resources (AU-IBAR), CDC, FAO, the World Organisation for Animal Health (OIE) and WHO.
- Existence of established institutions of research and higher learning.
- Established reference laboratories such as the Kenya Medical Research Institute (KEMRI) and the Uganda Virus Research Institute.
- Recognition of RVF as a priority zoonotic disease in the region and availability of vaccines, including Clone 13.
- Possibility of adapting the contingency plans available in some countries for use in other countries that are yet to develop and implement theirs.

Plenary discussion of the group reports

Comments

- What is the opportunity for delivery of vaccines using mobile phones, particularly in remote areas? Some scientists are interested in using drones for delivery of vaccines and these are new opportunities. Community animal health services were used successfully in the management of rinderpest, showing how veterinary services can be effective particularly over large areas. There is a need to scan the innovations around animal health. The current global push to eradicate peste des petits ruminants (sheep and goat plague) is receiving a lot of funding and could be an opportunity for more funding for RVF prevention and control.
- Interconnectivity of livestock markets is important. For instance, if there is an outbreak in Tanzania, would Kenya continue to export its livestock? This is a compelling reason to have a regional RVF framework or strategy, especially because of the porous borders. It would be in the common interest of the countries to address the disease jointly.
- Intermittent vaccination can be carried out every three years for cattle and camels. A recombinant vaccine could increase uptake of the vaccines although it may not fully solve the problem of low uptake.
- There is need for clear objectives to enable us to move forward with defined activities.
- The strategy of intermittent vaccination requires discussion to identify suitable options for implementation.
- Integration of the risk map with infection phases is good as it recognizes the need to conserve resources without compromising on effectiveness.

- Camels as target species in the vaccination strategies were only mentioned by one group. Probably this is because no data currently exists on vaccination of camels. It is important that they are factored in, although no suggestions were made on whether this should be adopted.
- Gender-related challenges need to be mapped out to identify entry points for follow up as well as incentives and effects.

Question: How practical is animal identification, considering that outbreaks happen in remote regions?

Answer: The suggestion is that simple approaches be used, for example, notching as is done for rinderpest. However, the challenge is whether communities will accept to have their animals notched as this may affect the value of the animals.

Enabling environment, institutional arrangements and requisite capacities

Discussions on the establishment of an enabling environment, institutional arrangements and requisite capacities for the implementation of a regional RVF vaccination framework were carried out in the same groups used to discuss the design of RVF vaccination strategies. The following questions guided the group discussions:

- What are the **policies and legal frameworks** needed to establish an enabling environment for implementing an effective and efficient RVF vaccination framework in East Africa?
- What **incentives** are needed to promote participation by the public and private sectors in the implementation of an effective and efficient RVF vaccination framework in East Africa?
- What **institutions and institutional arrangements** are needed to implement an effective and efficient RVF vaccination framework in East Africa?
- What are the key stakeholder categories and their **requisite capacity needs** for implementing an effective and efficient RVF vaccination framework in East Africa?

After the deliberations, reports from the three groups were presented and discussed in plenary. Since the three groups responded to the same guiding questions, their reports were then harmonized and summarized into one report that incorporates the plenary feedback as outlined below.

Establishment of an enabling environment

The following were identified as the policy and legal frameworks needed to establish an enabling environment for implementing an effective RVF vaccination framework in East Africa:

- **At the IGAD level:** IGAD supports the control of trade-sensitive diseases in the region, recognizes RVF as a priority animal disease and supports regional animal health networks such as the Eastern Africa Regional Laboratory Network and the Eastern Africa Regional Epidemiology Network. IGAD, however, needs to set up a sub-network for RVF alongside existing networks, promote a regional One Health approach and put in place a strategy for control of transboundary animal diseases.
- **At the EAC level:** EAC recognizes RVF as a priority disease. Policies at EAC level exist but their implementation needs to be strengthened. Disease control coordination instruments are also in place; these instruments refer to transboundary animal diseases, zoonoses and a contingency plan. There is, however, need to implement the existing policies, establish a regional zoonotic disease/One Health office and establish a sub-network for RVF.
- **Required policies and legal frameworks:** There is a need to establish appropriate policies to guide the use of vaccines across borders, disease reporting and notification, and standardization. In addition, there is a need for appropriate legal frameworks for disease control and vaccination in each country, a preparedness and response plan and a memorandum of understanding among member countries. Currently, there are memoranda of understanding for transboundary animal diseases. There is a need to harmonize disease control policies, legal frameworks and strategies in the region; initially, this will require a review of existing policies and legal frameworks in the member countries.
- **Policy and legislative issues that need to be addressed:**
 - The existence of an Animal Disease Act is a useful overarching document for each country
 - A harmonized policy for registration of vaccines such as Smithburn[®] and Clone 13 that are already available
 - A policy for the use of drones to deliver vaccines during flooding; this should consider cost-effectiveness, cold chain storage and availability of technical staff to administer the vaccine
 - A policy to address animal identification and traceability
 - Formulation and enforcement of relevant laws pertaining to One Health
 - Policy/legal framework on animal movement, and its implications
- **Other issues that need to be addressed:**
 - Shortage of veterinary services in pastoralist communities
 - Records of previous vaccination, considering the lack of a disease control policy in some countries
 - Identification of regions at risk and development of a regional risk map

- Contingency plans for RVF control
- Enhanced funding within countries

Incentives to promote public and private sector participation

RVF control is more of a public than a private good. Benefits are realized when livelihoods are improved through better markets for livestock, leading to better incomes. The following were identified as the incentives needed to promote public and private sector participation in the implementation of an effective and efficient RVF vaccination framework in East Africa:

- Offering tax reliefs for companies such as beef exporters that contribute to vaccination
- Compensating farmers for losses accruing from the use of vaccines
- Providing subsidies on vaccines to lower the costs borne by farmers
- Contractual collaborations to address the shortage of professionals
- Mobilization and use of centralized resources
- Involving farmers, local communities and farmer associations
- Sensitization and training of local groups to create awareness among communities
- Understanding the local communities and addressing their knowledge and information needs
- Combining vaccination and free health check-ups for livestock and complimentary treatment during vaccinations
- Contracting private-sector practitioners with the requisite expertise and training to diagnose, treat and report back to the government
- Coordinated joint regional vaccination campaigns through RVF sub-networks
- Establishment of disease-free zones
- Facilitated market access (local, cross-country and regional) for vaccinated livestock by regional economic communities, governments and partners
- Strengthening of public education and extension services

Institutions and institutional arrangements

The following were identified as the **institutions** that have a role to play in the implementation of an effective and efficient RVF vaccination framework in East Africa:

- Ministries of livestock
- Departments of veterinary services
- Vaccine production institutions
- Diagnostic institutions
- Ministries of health
- Research institutions
- Private animal health service providers
- Livestock producers
- Regional economic communities
- Livestock producer associations
- Regional and international organizations such as FAO, OIE, WHO and AU-IBAR
- Livestock marketing associations
- Devolved governance units (national and local administration)

The following were identified as the required **institutional arrangements**:

- Establishment of a coordination committee: identify the strengths of each institution and linkages among them; identify what the institutions do and group those with similar activities
- Cross-institutional arrangements linking research, diagnostics and dissemination personnel, including training of field personnel and financial allocation to manage the cross-institutional arrangements
- Zoonotic Disease Unit technical working group
- International training organizations to provide standardized training and capacity building
- East Africa RVF committee; national RVF committees within each country; working groups at county levels and local communities
- East Africa RVF committee: reference laboratory (livestock), KEMRI laboratory for viral haemorrhagic fever (humans)

- Suggested membership of the national RVF committees in Kenya, Tanzania and Uganda: ministries of livestock, FAO, WHO, OIE, research institutions, meteorological departments, diagnostic laboratories, representatives from county governments, and PANVAC

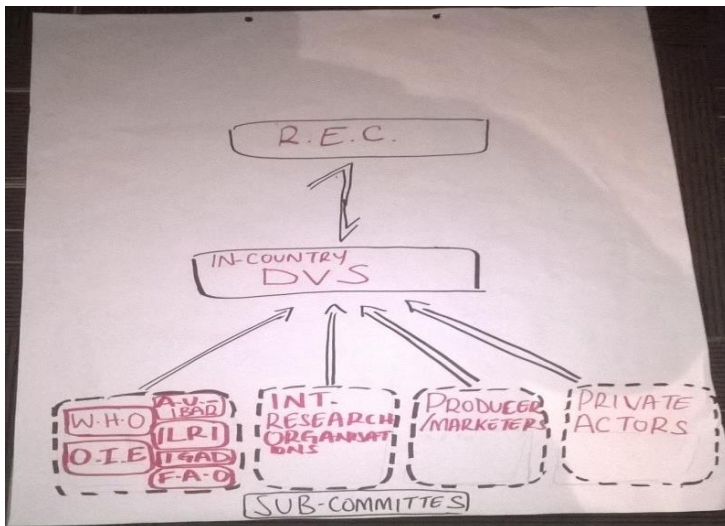
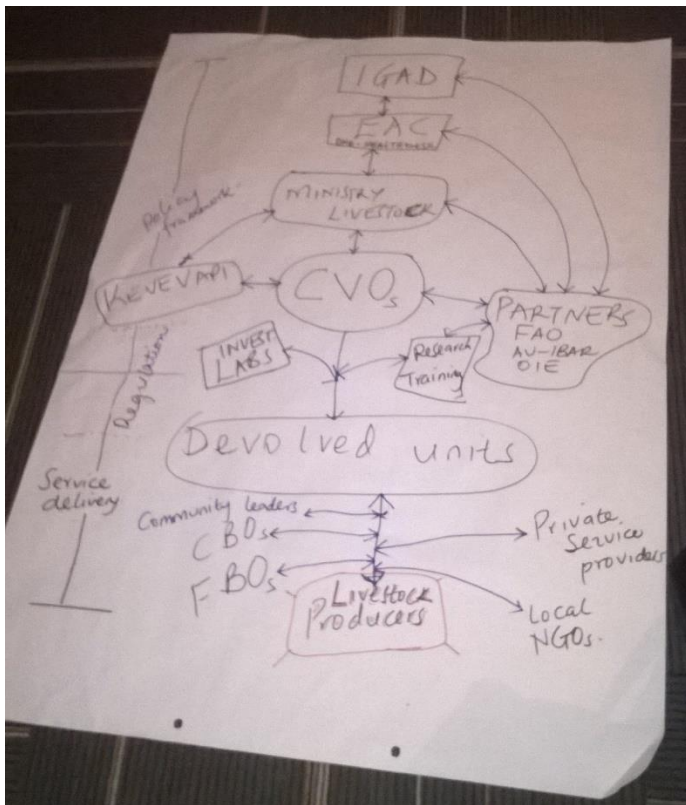
Key stakeholder categories and their capacity requirements

Table 2 summarises the key stakeholder categories and their requisite capacity needs for implementing an effective and efficient RVF vaccination framework in East Africa.

Table 2: Key stakeholder categories and their capacity requirements

Key stakeholder category	Capacity requirements
Relevant ministries	Personnel, equipment, vehicles, cold chain Information and data collection, analysis and sharing Formulation and enforcement of policy and legal framework
State and county veterinary departments	Human and financial resources Communication and advocacy Infrastructure and facilities Administration and other logistical support to the department
Provincial administration	Awareness creation Human and financial resources Ground logistics Security
Research institutions	Expertise in technology and innovation development Research infrastructure and other facilities Human and financial resources Technical expertise
Extension divisions	Expertise in technology and innovation dissemination Human and financial resources Communication and advocacy Capacity building and training
Training and research institutions	Expertise in technology development Research and training infrastructure and facilities Specialized training
Vaccine manufacturers	Technical expertise Human and financial resources Expansion of production units Investment in new technologies Stockpiling of vaccines Production of vaccines at short notice
Livestock producer and marketing associations	Awareness creation Knowledge on disease recognition and reporting Market requirements
Private animal health service providers	Knowledge on disease recognition Vaccination infrastructure and facilities (cold chain, equipment) Registration by professional bodies
Meteorological departments	Human and financial resources and facilities to undertake regular and accurate weather and climate predictions Communication of regular and accurate information on changes in weather and climate
Technical organizations (WHO, FAO, OIE, Africa CDC and AU-IBAR)	Expertise to develop the policy framework Improved linkages among themselves and with countries Technical expertise
Regional economic communities	Formulation of a regional policy and legal framework Expertise to develop the policy framework Coordination, monitoring and evaluation
Development partners	Policy orientation Technical expertise
Media	Communications and information sharing Writing of targeted communication briefs

Figure 1: Proposed organizational structures.



Workshop closing remarks and evaluation

Closing remarks

Antony M. Kilewe, Topridas Consultancy Services

He said that he had enjoyed facilitating the workshop and hoped that it had delivered on the expected outputs and that the facilitators' performance met both the participants' and the organizers' expectations. He thanked the ILRI management for the opportunity to facilitate the workshop; Bernard Bett for his valuable guidance, advice and encouragement in preparing and conducting the workshop; the participants for their dedication and commitment which made the facilitation task easy and enjoyable; Sarah Ndung'u of ILRI and the rest of the organizing team for the excellent handling of the logistics before and during the workshop; and the management of Lake Naivasha Country Club for providing excellent facilities and services. He concluded his remarks by wishing everybody a safe journey to their respective destinations and said he looked forward to continued cooperation and collaboration in similar future activities. He then invited Bernard Bett to proceed with the remaining part of the workshop closing protocol.

Bernard Bett, ILRI

He thanked the participants for their dedication and commitment during the workshop. He also thanked Dr Murithi, a private citizen, who found time to attend the workshop. He said the workshop report would be shared and the presentations made available via an online link. He was grateful for the good discussions on economic analysis that provided insights into viable options and said that follow-up discussions would be held on the ideas generated during the workshop and individual countries would be consulted to identify activities that can be undertaken. He also thanked the Director of Veterinary Services for finding time to join the workshop for the closing session. He then invited Rosemary Sang, Samuel Amwayi and Harry Oyas to make some remarks about the workshop and requested Harry Oyas to conclude his remarks by inviting the Director of Veterinary Services to make the final closing remarks.

Rosemary Sang, KEMRI

She thanked Bernard Bett and the ILRI management for the invitation to the workshop and said that it was a good learning opportunity and she had learnt a lot. She said that despite the efforts being made in control of RVF, the issue of vector control seems to be neglected and hoped that it would be given greater emphasis in future. She concluded by thanking all participants and said she hoped they would meet again.

Samuel Amwayi, Ministry of Health

He thanked all for sparing time to attend the workshop. He said he was the only representative from the Ministry of Health and was impressed with the efforts that the DVS had put into this initiative. He recalled the One Health initiative after the 2007 RVF outbreak where there was impressive input from the ministry. This effort, he said, had waned over the years and there is a need to revive it so that the ministry can benefit from such exchanges of information. He said sharing of information is critical among partners as it enhances understanding of the problem and enables parties to prepare to mitigate appropriately. Such initiatives are beneficial because, at the end of the day, it is to the advantage of the human population. He assured the participants of the ministry's support, thanked them and wished them a safe journey.

Harry Oyas, DVS

He thanked all and said he was pleased with the achievements of the workshop, having participated in the initiative and as part of the DVS. He said his presentation covered the strategies Kenya had adopted and which the government has been implementing for a long time. This workshop had, however, presented a more scientific approach to vaccination that is workable and agreeable to the three countries. He assured ILRI of the support of the DVS in the implementation of the project. He then invited the Director of Veterinary Services, Obadiah Njagi, to give the final workshop closing remarks.

Obadiah Njagi, DVS

He thanked the participants for their commitment to the workshop and said he was grateful to be back to make the closing remarks. He said the DVS was keen to work on this initiative among others and assured the project of

the directorate's support in the implementation. He said the directorate could no longer take for granted the support and goodwill of donors and, therefore, must ensure that initiatives are actualized. Development partners are making available resources to complement what the government provides and there is need to take advantage of this support and ensure initiatives are coordinated.

He said he was aware of several initiatives dealing with RVF whose impact is yet to be felt and that the ministry is streamlining their implementation to avoid overlaps and duplication of activities. He said this was a good initiative and hoped the next step would include discussions with the county governments because they are the implementers at the grassroots. He said the DVS has developed a platform that has been successful so far and this initiative can take advantage of it. He thanked all for finding time to participate and encouraged them to visit some of the nearby tourist sites. He concluded by wishing all a safe journey home and then declared the workshop officially closed.

Evaluation

The participants (in group formation) were requested to take a few minutes to evaluate the workshop by completing a simple evaluation form that required the participants to rate the workshop in general, attainment of the workshop purpose, attainment of the expected workshop outputs, workshop facilitation and the main features of the workshop on a scale of very good, good, average and poor. The feedback provided by the participants will be used to improve the planning, organization and management of future workshops. A total of three groups completed and returned the evaluation forms. The analysis of the responses indicated that the workshop was quite successful with an overall rating of 45% very good and 55% good.

The most mentioned aspects of the workshop that the participants thought went well were as follows:

- Very good adherence to the workshop agenda
- Successful collection of the required information
- Good group discussion sessions with clear terms of reference
- Very good workshop facilitation and good time management
- A good mix of the workshop participants and presentations
- Good pre-workshop preparations and communication

The most mentioned aspects that the participants thought needed improvement were as follows:

- Facilities in the conference hall, particularly the flickering light in the hall
- Some participants coming late and leaving before the end of the workshop

Annex 1: Workshop participants

Name	Email	Designation/Organization
Absolomon Kihara	wangoru.kihara@badili.co.ke	Director, Badili Innovations
Antony M. Kilewe	kilewe@topridasconsultancy.co.ke	Consultant, Topridas Consultancy Services
Bernard Bett	b.bett@cgiar.org	Scientist, ILRI
Catherine Karungo	drcatherinekarungo@gmail.com	Graduate assistant, Moi University
Dan Tumusiime	drdantumusiime@gmail.com	Senior veterinary officer
Delia Grace	d.grace@cgiar.org	Scientist, ILRI
Fausta Mosha	fausta_mosha@yahoo.com	Laboratory consultant
Francis Wanyoike	f.wanyoike@cgiar.org	Research associate, ILRI
George Njogu	njoroge2003@yahoo.com	Veterinary epidemiologist
George Warimwe	gwarimwe@kemri-wellcome.org	Immunologist, KEMRI Wellcome Trust Research Program
Harry Oyas	harryoyas@yahoo.com	Deputy director, DVS, Kenya
Jones Mutua	drmutuajones@gmail.com	Senior production officer, KEVEVAPI
Joseph Njuguna	joseph.njuguna@fao.org	National livestock officer, FAO
Josephine Namayanja	namayanjajosephine@gmail.com	Veterinary epidemiologist
John Gachohi	john.gachohi@wsu.edu	Postdoctoral fellow, Washington State University
Johanna Lindahl	j.lindahl@cgiar.org	Scientist, ILRI
Kariuki Njenga	knjenga@vetmed.wsu	Director, Washington State University
Madeleine Clark	madeleine.clark@pirbright.ac.uk	Epidemiologist
Mathew Kungu	muturimathew@gmail.com	Veterinary epidemiologist
Nicholas Svitek	n.svitek@cgiar.org	Scientist, ILRI
Nicoline de Han	n.dehaan@cgiar.org	Scientist, ILRI
Obadiah Njagi	jesse.mwere@gmail.com	Director, DVS, Kenya
Rees Mbabu	murithi.mbabu@gmail.com	Animal health expert
Rosemary Sang	Rosemary.sang@vsmru-k.org	KEMRI
Salome Bukachi	sallybukachi@yahoo.com	University of Nairobi
Sam Okuthe	sam.okuthe@fao.org	Epidemiologist, FAO
Samuel Amwayi	samwayi2016@gmail.com	Ministry of Health
Violet O. Kirigua	violetkirigua@yahoo.com	Associate consultant, Topridas Consultancy Services

Annex 2: Workshop program

Wednesday 4 October 2017

Time	Activity	Responsible
08:00–08:30	Registration and review of documents	ILRI/facilitators
SESSION 1	Workshop opening and scene setting	
08:30–08:40	Introductions and workshop approach	Facilitators
08:40–08:50	Workshop purpose and expected outputs	Bernard Bett
08:50–09:00	Welcome remarks	Iain Wright
09:00–09:30	Workshop opening remarks	Chief Veterinary Officer, Kenya
SESSION 2	Project strategic focus and implementation arrangements	
09:30–09:40	Overview of the project	Bernard Bett
09:40–09:55	Immune response studies (field and laboratory)	Nicholas Svitek
09:55–10:10	Gender and RVF vaccination	Salome Bukachi
10:10–10:25	Decision support framework electronic platform	Absolomon Kihara
10:25–10:50	Plenary discussion on the presentations	Facilitators
10:50–11:20	HEALTH BREAK AND GROUP PHOTOGRAPH	
SESSION 3	Background review of RVF control policies in East Africa	
11:20–11:35	RVF report: Kenya	Harry Oyas
11:35–11:50	RVF report: Uganda	Dan Tumusiime
11:50–12:05	RVF report: Tanzania	Fausta Mosha
12:05–12:20	FAO's RVF-related activities in the region	Folorunso Fasina
SESSION 4	RVF vaccine development	
12:20–12:35	Validation of Clone 13 RVF vaccine in Kenya	Kariuki Njenga
12:35–12:50	Development of new vaccines	George Warimwe
12:50–13:30	Plenary discussion	Facilitators
13:30–14:30	LUNCH	
SESSION 5	Design of RVF vaccination strategies and their implementation processes	
14:30–14:40	Discussion group formation, terms of reference and task assignment	Kariuki Njenga
14:40–16:00	Group-based discussions as per the terms of reference	Group chairpersons; facilitators
16:00–16:30	HEALTH BREAK	
16:30–17:30	Group-based discussions as per the terms of reference (continued)	Group chairpersons; facilitators
17:30	Review of Session 5	Facilitators

Thursday 5 October 2017

SESSION 5	Design of RVF vaccination strategies and their implementation processes (continued)	
08:30–08:40	Recap on day one and emerging issues	Facilitators
08:40–10:00	Plenary presentation, discussion and consensus building on group reports	Group rapporteurs; facilitators
10:00–10:30	HEALTH BREAK	
SESSION 6	RVF vaccination framework enabling environment, institutional arrangements, requisite capacities	
10:30–10:40	Discussion group formation, terms of reference and task assignment	Bernard Bett
10:40–12:30	Group-based discussions as per the terms of reference	Group rapporteurs; facilitators
12:30–14:00	LUNCH	
14:00–15:00	Plenary presentation, discussion and consensus building on group reports	Group rapporteurs; facilitators
SESSION 7	Way forward, workshop evaluation and closing remarks	
15:00–15:20	Way forward	ILRI/facilitators
15:20–16:00	Closing remarks and evaluation	DVS; Delia Grace; Josephine Namayanja
16:00–16:30	HEALTH BREAK	
	End of workshop and departure	