PPR GLOBAL RESEARCH AND EXPERTISE NETWORK (PPR-GREN):

Second Meeting

Nairobi, Kenya, 13-15 November 2019

PPR GREN II Communique

Contents

Background

Noting the dramatic spread of peste des petits ruminants (PPR) in Africa, the Middle East and Asia, and considering the high negative impact of that disease on the livelihoods of poor farmers, the Food and Agriculture Organization of the United Nations (FAO) and the World Organisation for Animal Health (OIE) developed in 2015 a strategy for the control and eradication of the disease worldwide (PPR-GCES). That strategy was developed by taking lessons from the successful global eradication of rinderpest (GREP): (i) through the GREP Secretariat based in FAO-ROME, international coordination of programmes run at national and regional levels, (ii) in Africa, creating an advisory committee to provide advice to the African Union Inter African Bureau for Animal Resources (AU-IBAR) that were implementing the rinderpest eradication projects at the continental level, and (iii) building rinderpest diagnostic capacities in countries by providing support to their national veterinary diagnostic laboratories. This support was provided by the FAO and IAEA Joint Division based in Vienna (Austria) and in close collaboration with the rinderpest reference laboratories that were conducting research on rinderpest, the Pirbright Laboratory of the United Kingdom Institute for Animal Health (UK), and the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (Cirad) in France. Continuous innovation was part of the success of GREP: innovation in diagnostics, innovation in vaccine and vaccine delivery, and innovation in the vaccination strategy. To take into consideration the need of innovation for also the PPR global eradication, and to support the FAO – OIE PPR Secretariat and the PPR Advisory Committee it has been foreseen in the PPR-GCES the establishment of the PPR Global Research and Expertise Network (PPR-GREN) with the objective to build strong partnerships between researchers and, thereby, fostering the improvement/development and transfer of new tools to appropriate users to support the implementation of PPR eradication programme (PPR GEP) for achieving the objective of PPR virus elimination globally by 2030.

PPR-GREN was launched at its first meeting organised by FAO and OIE in Vienna in collaboration with Joint FAO/IAEA Division. At the launch, members of the PPR-GREN Bureau were elected: chair Adama Diallo (Cirad) as the chair of bureau, Amanda Fine (WCS), Barbara Wieland (ILRI), Jeremy Salt (GALVMed), and Hamid Varshovi (Razi vaccine and

serum research institute). During that meeting, participants agreed on four thematic areas for PPR-GREN work:

- PPR Epidemiology including socio-economic factors and the livestock-wildlife interface,
- PPR diagnostics,
- PPR vaccine and delivery,
- Outreach, advocacy and communication in order to facilitate awareness raising, resource mobilization, and both local and national participation in PPR eradication programme (s).

In collaboration with the AU-IBAR and ILRI, the FAO and OIE have organised the 2nd PPR-GREN meeting in Nairobi, Kenya, from 13th to 15th of November 2019, with the GREN Bureau overseeing planning and implementation. The second PPR-GREN meeting aimed to foster discussions around "*PPR epidemiology including socio-economic factors and the domestic /-wildlife interface*", one of the four PPR research thematic areas that was identified during the first meeting. Indeed PPR-GCES has been designed to target only sheep and goats, the only animal species that are believed to be responsible for the spread and the maintenance of PPRV infection in the field. Infections of other animal species, i.e. cattle, buffaloes, camels and wildlife, are thought to be the result of spillover of sheep and goat infection. In that case, and for any reason, including socio-economic reasons, failure to eliminate the virus from sheep and goat populations means a risk of continuous spill-over infection of animal species other than sheep and goats, with implications for the survival of susceptible endangered wildlife species with serious negative impacts on biodiversity.

Meeting Programme

The meeting was attended by about 115 participants. It was officially opened by:

- Mr Harry Kimtai, Principal Secretary, Ministry of Agriculture, Livestock and Fisheries, Republic of Kenya
- Mr Dieter Schillinger, ILRI Deputy Director General for Biosciences
- Mr Berhe Tekola, Director of Animal Production and Health Division, FAO

- Mr Samuel Wakhusama, Sub-regional representative of the OIE for East Africa and the Horn of Africa
- Mr Henry Wamwayi, AU-IBAR Representative

At the opening ceremony, Mr Adama Diallo, Chair of the PPR-GREN, presented the objective of the meeting: to discuss and identify research topics to help fill gaps identified in the understanding of the epidemiology of PPR (outcome of infection of animal species other than sheep and goats and their potential involvement in the epidemiology of PPR) and in the PPR socio economic impacts on human livelihoods.

Participants were provided with keynote presentations in 4 sessions:

- **Session I (Overview on the PPR GEP)**: Update on the PPR GEP implementation by the PPR Secretariat, and a report on Kenya PPR control/eradication activities by the Kenya Directorate of Veterinary Services (KDVS). After having recalled the PPR GCES and the 5 year-eradication programme (PPR GEP 2017 – 2021), the PPR Secretariat highlighted some key activities and results obtained since the first PPR GREN meeting, held in April 2018 in Vienna, Austria: Regional Strategies developed in 8 out of the 9 PPR regions, National PPR Eradication Strategy developed in 68 countries, organisation of technical PPR vaccine producers meeting, meeting on PPR in wildlife, PPR Global Conference in Brussels in September 2018 for resources mobilization, and Lake Chad Epizone meeting taking place in December 2019. At the conclusion, the PPR Secretariat conveyed the following main messages: (i) strong international consensus for PPR eradication by 2030 as a contribution to achieve the UN SDGs, (ii) FAO/OIE are committed in this regard, (iii) better coordination of countries' PPR eradication activities and more vaccination based on epidemiology (need to review the PMAT[1] to help), (iv) still a funding gap in the PPR GEP, so resource mobilization and communication are essential for advocacy with donors and development partners, in order to keep the momentum and move forward, (v) Coordination at the global level is also essential, especially with the scientific community through the PPR GREN to deal with emerging issues (e.g. Wildlife). The representative of the KDVS, after having stressed the high negative impact of PPR in the economy of the country, in particular the 2006-2008 outbreaks which resulted in the death of 1.2 million small ruminants with an estimated value of USD 23.6 million and

[1] PPR Management and Assessment Tool

a drop in milk production of 2.1 million litres, went through all activities being conducted now in the country, Kenya being currently in the control phase (stage 2) of the PPR eradication programme with the objective of declaring free from PPR infection by the year 2027.

- **Session II (Update on OIE and FAO PPR Reference Laboratories Activities):** activities report of CAHEC (China), Cirad (France), Pirbright Institute (UK), Joint FAO/IAEA Division (OIE collaborative Centre, Austria). They are all working in different aspects of PPR research but improving/developing PPR diagnostic tests seems to be the common topic for all.

- **Session III (PPR in the Rinderpest Free World)**: Studies on sub-clinical PPR infection in cattle (Mr Arnab Sen), PPR Experimental and surveillance results in camel (Abdlemalik Khalafalla), Experimental and surveillance results in pig (Eeva Tuppurainen), Report on the meeting "*Controlling PPR at the Livestock/Wildlife Interface*" held at FAO Headquarters in Rome, March 2019 (Amanda Fine), Wildlife PPR - the evidence (Richard Kock), Development of Guidelines for the Control and Prevention of PPR in Wildlife Populations (Jonathan Sleeman). If cattle seem to be dead-end for PPRV, there are serious concerns about the potential impacts of PPRV infection in camels, suids and wildlife. In particular the high risk constituted by PPR was highlighted for some endangered wildlife species in Asia and the potential impacts on wildlife conservation in general. **Session IV: PPR Socio-Economic Impacts Global**- Case studies examining role of gender in PPR control from Asia and Africa (Nicoline De Haan). The speaker highlighted the need to provide data and case studies to governments to change the top-down narrative on vaccination campaign and showed that bottom-up approaches (community-based approaches) can improve vaccination campaigns, with better targeted strategies.

The keynote talks sessions were followed by a session, **the Session V**, during which scientists presented selected research activities updates. In that Session, Ms Paula Menzies, former Chair of the PPR-GEP Advisory Committee, also presented main recommendations adopted at the 3rd PPR Advisory Committee meeting held in Nairobi in July 2019, and that were addressed to the Joint FAO/OIE PPR Secretariat, meeting hosted by the AU-IBAR. Some of the participants presented their data in the poster session, the **Session VI**. These

two sessions covered a wide range of topics on PPR and allowed members of the network to share their recent research highlights or other insights relevant to advance with PPR control and eradication.

Abstracts of all presentations (keynotes, mini talks and posters) are provided in Annexe I and copies of the presentations are available at the following link:

https://www.dropbox.com/sh/2v3hifgc180q36c/AABoLNXSxkHNNxT0jcJzz1i1a?dl=0

Following all presentations, the meeting participants were broken into 3 working groups: (i) Atypical Domesticated PPRV Hosts group, (ii) Wildlife group, (iii) PPR Vaccination Programme group and (iv) Socio-economics working group. Objectives assigned to those working groups were to come up with research themes which results might be beneficial for PPR-GCES in redesigning, if needed, the PPR Eradication Strategy.

Outcomes of the Meeting

Working Group recommendations

General recommendations. Participants at the international conference organized on PPR in Abidjan adopted the Strategy developed by the FAO and the OIE for the Global Control and Eradication of PPR by the year 2030. Considering that the Strategy is based mainly on sheep and goat vaccination, participants at the GREN II meeting made the following recommendations in view of ensuring in a timely manner the successful eradication of PPR:

– Update the PPR Global Control and Eradication Strategy to take into account emerging issues including geographical spill-overs, biodiversity impact, atypical species and socio-economic concerns,

- Develop and disseminate clear guidelines for the surveillance, primary interventions and control that can be tailored to country settings where atypical host species mix with domestic small ruminants,

- Establish risk mapping to better inform vaccination plans,

- Develop national strategy plans for PPR eradication in cooperation with countries in the same region and with the support of PPR Secretariat,

- When developing the national plans, to seek for sustained strong political commitment and involvement of the whole community (from smallholders to national governments/regions at all levels),
- Work toward harmonization of control efforts across all neighbouring countries (regional/epizone approach adopted and strengthened in the disease eradication activities planning),
- Use post vaccination evaluation results as indicators instead of focusing only on vaccination,
- Implement annual assessment of national PPR control and eradication activities to determine progression and impact (PMAT).

Recommendations on Research topics identified by the working groups. Currently, tools are available for the control and eradication of PPR. However, to facilitate, speed up implementation of planned activities, and fill in gaps there are needs of research on PPR with expected outputs that might help in updating/refining the programme. Based on presentations and discussions during this GREN meeting, participants identified the following research topics for the near future:

- Evaluation of current PPR diagnostic tests for their suitability to be used in PPR investigation in non-typical animal hosts, and if needed, development of new tests that are fit for purpose,
- Understanding the epidemiology of the disease, including the potential role of wildlife and other animal species (including non-typical species in surveillance) to inform sheep and goat vaccination plans (PPRV transmission studies using virulent PPRV strains in sheep and goats and also non-typical species),
- Specifically, study on the role of wildlife and wildlife/livestock interface in the epidemiology of PPR in different regions in order to address knowledge gaps,
- Study on the PPR socio-economic impact including wildlife aspects,
- Need for bio-bank(s) of wildlife sera and molecular studies on wildlife samples,
- Impact and cost of PPR at different levels (value chain approach),
- Development of disease mathematical model to help informing vaccination strategies,
- Impact of different diluents on vaccine efficacy,
- Perceptions of the value of vaccination & impact on acceptance,
- Develop differential diagnostics for post-vaccination monitoring/reassurance,

- Cost-benefit analysis of vaccination for increasing uptake.

Organisation of PPR GREN into thematic Group

The GREN structure adopted at the first GREN meeting includes a bureau thematic expertise groups: the role of these groups is to improve vaccines, diagnostic tools, and epidemiologic methods, and to bring up other PPR relevant topics for the efficient control and eradication of the disease.

Unfortunately, the thematic groups that were suggested last year have not been established. At this second GREN meeting, the thematic areas were revisited, and a tentative agreement was made to establish four working thematic groups with respective focal points until next GREN meeting:

- Atypical hosts (understand roles and connections): Catherine Herzog and Abdelmalik Khalafalla
- Wildlife (reduce risks of PPR for and from wildlife): Camilla Benfield
- Socio-economics (understand impact of PPR on different people, generate evidence to inform policy): Pacem Kotchofa and Nicoline de Haan
- Vaccination Strategy (vaccines, epidemiology, modeling and human behavior/social science aspects): Bryony Jones, Mohd Saddam Bintarif and Nimmo Gicheru

The objectives of the groups are to: (i) update GREN & GF-TADs on research outputs in their respective expertise areas, (ii) advise on research priorities. It is expected and encouraged that groups will communicate between each other. Participants are requested to register on-line in their selected group (s) within which they would like to work.

The joint FAO/OIE PPR Secretariat will submit this suggestion to both FAO and OIE managements for approval.

PPR-GREN E-discussion Platform

During the first GREN meeting participants requested the creation of a platform for E-discussion between GREN members. This request was reminded in GREN II meeting. Now

PPR Secretariat has made available at the FAO Web site: https://listserv.fao.org/scripts/wa-fao.exe?A0=PPR-GEP-GREN-L

3rd PPR-GREN Meeting

The next meeting will take place in the last week of October 2020 in Qingdao, China, to be organized by FAO and OIE in Collaboration with the China Animal Health and Epidemiology Center in collaboration with the GREN Bureau.

Participants agreed to organize the next GREN meeting, GREN III, in China. The China Animal Health and Epidemiology Centre in Qingdao has kindly accepted to host that meeting in the last week of October 2020.

Closing Ceremony

At the closing ceremony, Mr Henry Wamwayi, AU-IBAR Representative, Mr Samuel Wakhusama, Sub-regional representative of the OIE for East Africa and the Horn of Africa and Mr Berhe Tekola, the Director of Animal Production and Health Division, FAO, Mr Mark Rweyemamu, the in-coming Chair of the PPR Advisory Committee, gave addresses to thank all participants. They all noted that the GREN II meeting was a success in terms of number and diversity of participants, and the high quality of the presentations and discussions.

Mr Adama Diallo, the Chair of the PPR GREN Bureau, on behalf of the PPR GREN Bureau Members, thanked the participants, many of them being self-supported, for their contributions to the meeting, the AU-IBAR, ILRI, FAO and OIE for their strong support in the organization of this successful event. He highlighted the excellent work done by the meeting organization committee during the past 3 months, the good collaboration between the PPR GREN Bureau and the Joint FAO/OIE PPR Secretariat during the preparation and the conduct of the meeting.

The PPR-GREN Bureau and the Joint FAO/OIE PPR Secretariat acknowledge and thank all donors and the generous support provided to FAO, OIE, AU-IBAR and ILRI that allowed the organization of this successful meeting.

Acknowledgments

Special thanks go to the following donors for supporting meeting logistics and attendance of participants: IFAD/European Commission for their support through the ECO-PPR project, European Commission, CGIAR Research Program on Livestock, AU-IBAR through funding provided by the Member States of the African Union to support implementation of the Pan-African PPR Control and Eradication Programme and all other donors and institutions that facilitated attendance of participants

Annexe I: Agenda

GF-TADs
GLOBAL FRAMEWORK FOR THE PROGRESSIVE CONTROL OF TRANSBOUNDARY ANIMAL DISEASES

Food and Agriculture Organization of the United Nations

OIE WORLD ORGANISATION FOR ANIMAL HEALTH

AFRICAN UNION
INTERAFRICAN BUREAU FOR ANIMAL RESOURCES

ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

CGIAR

PPR GLOBAL RESEARCH AND EXPERTISE NETWORK (PPR-GREN)
SECOND MEETING, NAIROBI (KENYA), 13 – 15 NOVEMBER 2019

AGENDA

Day 1 – 13 November 2019		
Time	***Topic***	***Speaker***
08.00 – 09.00	Registration	
09.00 – 09.30	- Welcome address of the Director of AU IBAR - ILRI remark - OIE remarks - FAO remarks - Objectives of the meeting - Official opening, Ministry of Agriculture, Livestock and Fisheries, Republic of Kenya	- **Mr Henry Wamwayi**, AU-IBAR Representative - **Mr Dieter Schillinger**, ILRI Deputy Director General for Biosciences, - **Mr Samuel Wakhusama**, Regional Representative of the OIE Representation for East Africa and the Horn of Africa, - **Mr Berhe Tekola,** Director of Animal Production and Health Division, FAO, - **Mr Diallo Adama**, PPR GREN Chair Secretary for -**Mr Harry Kimtai,** Principal Secretary, Ministry of Agriculture, Livestock and Fisheries, Republic of Kenya
Session 1: overview on the PPR GEP		
09.30 – 10.00	Update on the PPR GEP implementation	PPR Secretariat
10.00-10.15	A country report on a PPR control/Eradication Activities	Kenya
10.15-10.30	Discussions	All participants
10.30 – 11.00	*Coffee break*	
Session 2: Update on OIE and FAO PPR Reference Laboratories Activities		
11.00-11.15	CAHEC activities on PPR	CAHEC

11.15 – 11.30	CIRAD Activities on PPR	CIRAD
11.30 – 11.45	The Pirbright Institute Activities on PPR	The Pirbright Institute
11.45-12.00	Joint FAO/IAEA Animal Production and Health Laboratory (APHL) activities on PPR	APHL (OIE Collaborating Centre)
12.00-12.30	Discussions	All participants
12.30 – 13.30	Lunch break	
Session 3: PPR in the Rinderpest Free World		
13.30 – 14.00	PPRV: Studies on Sub clinical PPR infection in cattle	Arnab Sen
14.00 – 14.30	PPRV: Experimental and surveillance results in camel	Abdlemalik Khalafalla
14.30 – 15.00	PPRV: Experimental and surveillance results in pig	Eeva Tuppurainen
15.00 – 15.30	PPR in wildlife – what does it mean? Report on the meeting "Controlling PPR at the Livestock/Wildlife Interface" held at FAO Headquarters in Rome, March 2019	Amanda Fine
15.30 – 16.00	Wildlife PPR - the evidence	Richard Kock
16.00 – 16.30	Coffee break	
16.30 – 17.00	Development of Guidelines for the Control and Prevention of PPR in Wildlife Populations	Jonathan Sleeman
17.00 – 18.00	Discussion	All participants
18.00	End Day 1	
19.00	FAO-OIE Welcome Reception – PrideInn Rhapta Road	All participants
	Day 2 – 14 November 2019	
	Section 4: PPR Socio-Economics Impacts	
09.00 – 09.30	PPR Socio-Economic Impacts Global- Case studies examining role of gender in PPR control from Asia and Africa	Nicoline De Haan
09.30 – 10.00	Discussions	All participants
Session 5: Selected research		
10.00-11.00	Research status	5 min for each update
11.00-11.30	Coffee break	
11.30-12.00	Research status	5 min for each update
12.00-13.00	Discussions	All participants
13.00 – 14.00	Lunch break	
14.00-15.30	**Session 6: Posters Session ("Gallery Walk" and "Flash Talk")**	
	Session 7: Working Group Session	
15.30 - 16.00	<u>Constitution of Working Groups</u>: - Group 1 (PPR in Cattle, buffaloes: importance for GEP, surveillance and research needs) - Group 2 (PPR in camels and pigs: importance for GEP, surveillance and research needs) - Group 3 (PPR in Wildlife. Importance for the PPR GEP) - Group 4 (PPR socio-economic aspects: understanding and addressing challenges with PPR GEP roll out at the national level) - Group 5: vaccination (how to proceed to ensure the effectiveness of PPR control and eradication?)	All Participants

16.00 – 16.30	Coffee break	
16.30 – 18.00	Working Groups	WGs
18.00	End of Day 2	
Day 3 – 15 November 2019		
	Session 7: Conclusion & Recommendations	
09.00-11.00	Reports from Working Groups	WG rapporteurs (30 min for each group)
11.00 – 11.30	Coffee break	
11.30 – 13.00	General Discussions	All participants
13.00-14.00	Lunch	
14.00-15.00	Organisation of GREN into thematic working Groups	All participants
15.30-16.00	GREN 2020 Meeting: theme and provisional date	All participants
16.00-16.30	Recommendations and closing ceremony	AU-IBAR/ILRI/OIE/FAO/PPR Secretariat/ GREN Bureau
16.30-17.00	Coffee break and end of the Meeting	

Annexe II: Abstracts

Keynotes Presentations

Title: PPR activities in the Joint FAO/IAEA Animal Production and Health Subprogram

Presenter: Giovanni Cattoli

Abstract: The Animal Production and Health Subprogram (APHS) of the Joint FAO/IAEA Division and its laboratory (APHL) in Seibersdorf, Austria assist Member State national veterinary laboratories to improve and strengthen their capacity for the early and accurate detection of PPR virus and related small ruminant diseases. Through a large network of scientific institutions and laboratories, APHS also encourages applied research on PPR disease diagnosis, prevention and control. In African and Asian countries that are at-risk or endemic for PPR, access to diagnostic and research activities is facilitated by the network of national veterinary laboratories supported and coordinated by the Joint Division (the VETLAB Network project). Trainings and expert missions are regularly organized by the network and APHS, aiming at building, maintaining and harmonizing PPR diagnostic capacity. In this context, an international interlaboratory comparison for PPR serological and molecular diagnosis is regularly organized by APHL. It involves more than 30 laboratories every year. Validation and transfer of novel serological and PCR-based assays is one of the PPR core activities of APHL. Collaborating jointly with partner laboratories, APHL has recently validated and published a sensitive multiplex real time PCR for four of the main pathogens causing respiratory disease in small ruminants. Such a test can cost-effectively enable syndromic surveillance and PPR differential laboratory diagnosis. A novel multiplex serological assay is currently under development, and a luciferase immune precipitation assay for PPR antibody detection has been validated for livestock. Its application on sera collected in wild ruminants will be investigated soon.

Title : CIRAD activities on PPR

Présenter : Arnaud Bataille, CIRAD, UMR ASTRE, Montpellier, France

Abstract: Research activities of CIRAD (Montpellier, France) on PPR encompass multiple priority areas listed during the inaugural PPR GREN meeting. CIRAD collaborates on RVC and WCS-lead projects dealing with PPR transmission at the wildlife/livestock interface in East Africa and Mongolia, respectively, including work on virus detection and risk analyses. CIRAD efforts now also concentrate on integrated approaches to develop locally adapted PPR surveillance and control strategies, with a strong focus on participatory approaches for epidemiology and socio-economy research, and on awareness issues. CIRAD will collaborate closely with ILRI on proposing common methodologies on these themes. The OIE/FAO and EU reference laboratory also continues its work on the molecular epidemiology of PPRV, with a special focus on West Africa. Phylogenetic analyses based on full genome PPRV sequences are underway. The laboratory's work in 2020 will also concentrate on understanding risks of cross-reactivity with cELISA kit and will propose new reference material to homogenized practices in lab network and companies. CIRAD activities include also vaccine research. Deep sequencing study of the Nigeria 75/1 vaccine strain and of associated attenuation passages provided some new understanding of the evolution of attenuation and risk of reversal in PPRV vaccine. New DIVA and recombinant vaccines are under tests. CIRAD epidemiologists propose new modelling methods to evaluate vaccination strategies. CIRAD is keen to support synergies between projects of the PPR GREN community. Importantly, the CIRAD team flag confusion in the scientific community on the modifications of PPRV taxonomic name.

Title: Studies on Sub clinical PPR infection in cattle

Presenter: Arnab Sen

Abstract: The preliminary study was undertaken to investigate the possible involvement of cattle in the epidemiology of peste des petits ruminants (PPR) as subclinical carriers. Cattle were exposed experimentally to PPR virus (PPRV) infection or placed in contact with PPR infected goats. Clinical samples including heparinized/EDTA blood, plasma, peripheral blood monocyte cells (PBMCs) and clotted blood (for serum) were collected periodically from21 days post infection (dpi) to 397 dpi (21, 45, 50, 57, 65, 95, 111, 119, 148, 190, 203 and 397 dpi) and

tested for PPRV antigen, nucleic acid and antibody. Exposed cattle seroconverted and maintained PPRV specific haemagglutinin antibodies and detectable PPRV antigen/nucleic acid in blood, plasma and PBMCs from 21 to 397 dpi. PPRV was recovered from blood and PBMC collected from experimental animals at 21 dpi, initially in B95a cells and then adapted to Vero cells. The study indicated that PPRV can infect cattle subclinically and PPRV antigen/ nucleic acid persist in cattle for at least 397 days.

Title: Peste des petits ruminants in camels (camelus dromedaries)

Presenter: Abdlemalik Khalafalla, Abu Dhabi Agriculture and Food safety Authority, UAE

Abstract: Peste des petits ruminants (PPR) is an important disease that recently emerged as a significant threat to the productivity of small ruminants in Africa and Asia. Over the last decades, the host range has expanded, which could carry a potential challenge to the proposed international campaign to eradicate the disease. Although PPR is regarded as primarily a disease of domestic small ruminants, the disease has been reported in several other species including dromedary camels. Clinical PPRV infection has been documented in dromedary camels and the disease has been reported in camels in Ethiopia in 1995/6, Sudan in 2004, Iran in 2013 and Kenya in 2016 with clinical manifestations affirmed by lab findings. However, experimental infection of dromedary camels with the virus failed to reproduce the disease. In this presentation, an overview of the PPRV infection in camels based on published reports will be given. The possible role these animals may play in the epidemiology of the disease in endemic zones will be discussed as well as the need to involve camel populations in the epidemiological surveys of PPR.

Title: PPRV: experimental and surveillance results in pig

Presenter: Schulz C.1, Fast C., Schlottau K.1, King, R.2, Friedgut, O.3, Tuppurainen E.1, Dietze K.1, Beer M.1 & Hoffmann B.1

1 Friedrich-Loeffler-Institut, Bundesforschungsinstitut für Tiergesundheit, Federal Research Institute for Animal Health, Greifswald, Germany

2 Israel Nature and Parks Authority, Jerusalem, Israel

3Virology Division, Kimron Veterinary Institute, P.O. Box 12, Bet Dagan, 50250 Israel

Abstract: Peste des petits ruminants (PPR) is one of the high-impact transboundary diseases of small ruminants. The aim of this study was to investigate the capability of domestic pigs and wild boar to transmit the PPR virus lineage IV strain (PPRV-LIV) Kurdistan/2011 to naïve pigs and goats and to determine the pathogenesis of PPRV-LIV infection in suids. Four independent contact transmission trials were conducted in the high-containment animal facilities of the Friedrich-Loeffler Institut (FLI). Pigs, wild boar, goats and sheep were intranasally infected with PPRV and then allowed a direct contact with fully susceptible pigs, goats or sheep. Animals were closely monitored for clinical signs and fever. Oronasal, conjunctival and faecal swabs, blood in EDTA, serum and post-mortem (PM) samples were collected. Suitability of different diagnostic methods for the detection of PPRV infection was evaluated. Domestic pigs, wild boar and sheep showed less severe clinical disease than goats. The level of virus excretion in suids was 2-3 log steps lower than in goats and 0.5 to 1 log step lower than in sheep. A complete interspecies transmission cycle was demonstrated between pigs and goats and possibly also intraspecies transmission between pigs. Infected wild boar did not transmit the virus to goats or pigs and surprisingly, no transmission occurred between infected and in-contact sheep. Tonsils, head, lung –associated and mesenteric lymph nodes, as well as small intestinal Peyer's patches were found to be preferable sample materials for PM. The findings of this study indicate that suids can be an unexpected source for PPRV infection, relevant to stringent control programmes. Further studies in different environmental and experimental conditions are required to evaluate the epidemiological role of suids in the field.

Title: PPR in wildlife – what does it mean? Report on the meeting "Controlling PPR at the Livestock/Wildlife Interface" held at FAO Headquarters in Rome, March 2019

Presenter: Amanda Fine

Abstract: There is growing evidence that multiple wildlife species can be infected with peste des petits ruminants virus (PPRV). This has important consequences for the potential maintenance of PPRV in communities of susceptible hosts, the goals of eradication, and the threat that PPRV may pose to the conservation of wildlife populations and resilience of ecosystems. PPR has been targeted by the Food and Agriculture Organization of the United Nations (FAO) and the World Animal Health Organization (OIE) for global eradication by 2030, as a response to the devastating impacts the disease has on rural livelihoods, food security, and local economies. Significant knowledge gaps in the epidemiology of PPRV across the ruminant community (wildlife and domestic), and understanding of the infection in wildlife and other atypical host species groups (e.g. camelidae, suidae, and bovinae) currently hinders our ability to apply necessary integrated disease control and management interventions at the wildlife-livestock interface. This presentation will report on a meeting, "Controlling PPR at the livestock-wildlife interface", held in Rome, Italy, March 27-29, 2019, to review recent advances in our understanding of PPR virus in wildlife, identify knowledge gaps and research priorities, and formulate recommendations to support the integration of wildlife into global PPR eradication efforts. The need for a better understanding of PPR epidemiology at the wildlife-livestock interface was highlighted along with the reminder that PPR eradication and wildlife conservation need not be viewed as competing priorities, but should instead constitute two requisites of healthy socio-ecological systems.

Title: Wildlife PPR - the evidence

Presenter: Richard Kock

Abstract: The role of wildlife in PPR. PPR is emerging globally, a disease not only of small domestic livestock but also of many wildlife species, affected both in captivity and in endangered wild populations in Asia. African free ranging wildlife appear to be resistant to disease. The first confirmed case in African wild populations being in dorcas gazelle in Dinder National Park, Sudan in 2017. The reason for wildlife disease emergence in Asia and now Africa, is not yet clear but might relate to changing environmental pressures and loss of

resilience of populations. Tracking infection is vital to understand epidemiology and when confirming freedom from infection during eradication programmes. The OIE designated serological tests (competition ELISA and virus neutralisation (VN) appear useful in wildlife species, and preliminary findings of estimated true PPR seroprevalence amongst wildlife in a PPR endemic system will be described but the sensitivity and specificity of the test used remains unknown. Neutralisation is cumbersome and costly in time and resources. VN of wildlife sera during the last phases of rinderpest eradication, differentiated antibody provenance in areas where both viruses circulated. There is also a question mark over cross-reaction with other morbilliviruses, e.g. canine distemper. Novel more efficient gold standard tests include, potentially, the use of luminescence and pseudotype assays to improve differentiation of antibody. These older and newer assays are to be validated over the next year, in a collaborative programme between the world reference laboratories and various institutions, using wildlife sera collected from PPR endemic Greater Serengeti Ecosystem.

Title: Development of Guidelines for the Control and Prevention of PPR in Wildlife Populations

Presenter: Jonathan Sleeman

Abstract: Experiences in Asia suggest that wildlife can be adversely affected through the ongoing presence of PPR in livestock with periodic, severe mortality events, and impacts of PPR on wildlife populations and wildlife conservation efforts are greater than previously recognized. Furthermore, eradication efforts in livestock might be hampered by the occurrence of PPR in susceptible wildlife populations acting as a short-term reservoir or vector of PPR virus. Consequently, the PPR Secretariat, OIE Working Group on Wildlife and PPR Global Research and Expertise Network (GREN) formed a joint Working Group to develop guidelines for PPR prevention, outbreak response, and control in wildlife that can be used by countries in the development of their PPR national eradication plans. These guidelines are intended to help countries in the development and implementation of PPR disease eradication programmes that include objectives, policies and strategies adaptable to the full range of national needs that facilitate the integration of the wildlife sector in the national eradication plans. The purpose of the guidelines is to provide a conceptual framework that can be adapted to a particular national and epidemiological context, and these guidelines, while specific to PPR eradication, could be adapted for any disease at the wildlife-human-livestock interface. Components of the

guidelines include programme planning and governance, surveillance for PPR in wildlife, standardization and data management, outbreak investigations in wildlife populations, laboratory diagnostics, risk assessments, prevention and management options in wildlife populations, risk communication, knowledge gaps and research, capacity building and references and resources.

Title: What role can socio-economics play in the Global Strategy of PPR?

Presenter: Nicoline de Haan

Abstract: Understanding the social and economic impacts of Peste des Petits Ruminants (PPR) will be vital for livestock owners across the world and for the global strategy to succeed. As PPR is a widespread, virulent and devastating disease, it has huge economic, food security and livelihood impacts. Because of is highly pathogenic nature, and its negative impact on the poor, PPR needs to be understood better in a social and economic context if we are to be successful in tackling it. Yet the control of a trans-boundary animal diseases such as PPR in (increasingly) endemic settings poses a series of challenges that need to be addressed. For instance, small ruminants are often found in marginalized extensive production systems and/or produced by people with limited access to services, such as women. Yet for these people, small ruminants are often their most important asset. At the national level, small ruminant lobbies often have limited access to political will or resources, reducing the attention PPR gets. Another challenge is the short cycle nature of production, which implies a different cost benefit picture to investments in vaccines and other animal health inputs. It is important for any strategy to engage the small ruminant owners in improving their own systems, through production enhancing interventions, and local delivery mechanisms. The presentation will touch on issues of the role of small ruminants as foundations of food security and livelihoods, the impact of PPR on small ruminant systems and society, and the role of gender in any PPR campaign.

Mini-talk Presentations

Title: Management practices and age cohorts that contribute to increased Peste des petits ruminants seroprevalence in sheep, goats, and cattle in northern Tanzania

Presenter and co-authors: Catherine M Herzog

Abstract: Peste des petits ruminants virus (PPRV) causes a contagious disease of high morbidity and mortality in sheep and goats and has been shown to elicit seroconversion in cattle. PPRV threatens 80% of the global small ruminant population. Using a serosurvey (n = 7,538) from 20 villages in Tanzania, we investigated PPRV age-seroprevalence and household survey data to determine significant risk factors and specific management practices for increased PPRV circulation, to explore spatial variation in the force of infection, and to identify the age cohort(s) responsible for PPRV transmission among sheep, goats, and cattle. We used generalized linear mixed models within a catalytic framework to calculate the force of infection (FOI, per capita infection rate of susceptible hosts) and reproductive numbers using both an age constant and piecewise constant model. We identified specific management risk factors for PPRV seroconversion such as herd size, seasonal camp attendance, animal introductions, and confinement and grazing practices. We found the observed, unadjusted seroprevalence was 21.1% and differed with management practice (agropastoral: 5.8%, pastoral: 30.7%). Seroconversion varied significantly by management system. Pastoral management systems had higher FOI and a wider range of ages with a higher FOI than agropastoral systems. Sheep and goats had a steady FOI across ages, suggesting control efforts should target vaccination by management characteristics (and pastoral systems), rather than age, for optimal effect. There was a significant peak in pastoral cattle ages 2.5-3.5 years. Insights from this investigation will lead to improved targeting of control strategies by region, management, age, and species.

Title: Widespread infection of cattle in the Serengeti ecosystem by peste des petits ruminants virus (PPRV): implications for global eradication

Presenter and co-authors: Brian Willett

Abstract: Over the last decade, the global spread of PPRV has been dramatic; it is now endemic in many areas of Africa, the Middle East, Asia and China, while outbreaks in Turkey and Bulgaria have placed PPRV at the borders of the European Union. PPRV causes a devastating disease in small ruminants, threatening both food security and the health and well-being of many of the poorest livestock-dependent communities in the world. Global PPRV control and eradication programs focus on the mass vaccination of small ruminants. Understanding the role of cattle and other atypical host species in viral spread and persistence will be critical for the design of an effective strategy for the successful eradication of PPRV. In this study, we conducted a comprehensive serological survey of livestock exposure to PPRV across Northern Tanzania. Using a pseudotyped virus-based neutralisation assay (PVNA), PPRV reactivity was detected in 35% of goat sera (range 0-75%), 28% of sheep sera (range 0-62%) and 21% of cattle sera (range 3-35%). Comparison of the PVNA assay with an established cELISA suggested that the ELISA specificity was excellent (>99% for all species), but the sensitivity was 81% for goats, 88% for sheep and only 48% for cattle. Our data indicate widespread PPRV infection of goats, sheep and cattle, with considerable variation between villages. Further, the data suggest that using cELISAs to establish seroprevalence may underestimate the widespread nature of exposure to PPRV and the significance of cattle as a potential reservoir of infection.

Title: OIE Terrestrial Manual Chapter 3.7.9. Peste des petits ruminants - Overview of some proposed amendments and request for comments from PPR-GREN experts.

Presenter and co-authors: Glen Gifford

Abstract: The presentation will briefly highlight some proposed amendments that have been drafted for the vaccine-related sections in the OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals (Terrestrial Manual) Chapter 3.7.9 Peste des petits ruminants. The objective of the presentation will be to bring these proposed amendments to the attention of the PPR-GREN, to solicit experts' input during the comment period, so they can provide input to the OIE through their respective OIE Delegates. The proposed revisions have been prepared by experts from the OIE Reference Laboratories for PPR, under the direction of the OIE

Biological Standards Commission (BSC), which is responsible for managing the drafting and revision of Terrestrial Manual chapters. A copy of the draft revised chapter showing the proposed revisions is currently being circulated to OIE Delegates of the 182 Member Countries for first round review and comments. A copy of the draft text and an explanation of the procedure for providing comments will also be circulated to the PPR-GREN members. Any comments from PPR-GREN experts may be submitted to the OIE via their respective OIE Delegates, who have been asked to return comments to the OIE by 8 January 2020.

The proposed revisions are in the section on "Requirements for Vaccines", as noted below. They include some changes to in-process controls and batch release testing procedures that have been recommended by groups such as the PPR Vaccine Manufacturers Workshop and AU-PANVAC.

2.1 Characteristics of the seed

- Quality criteria (e.g. freedom from extraneous agents)

2.2 Method of manufacture

- Requirements for substrates and media

- In-process controls

- Manufacturing procedure

- Final product batch tests

- Sterility & purity

- Safety

- Potency

2.3 Requirements for authorisation

- Safety requirements

Title: Characterisation of PPR disease in pastoralist small ruminant flocks in Ngorongoro District of Tanzania

Presenter and co-authors: Bryony A. Jones, Mahapatra, M, Chubwa, C, Clarke, B, Batten, C, Hicks, H, Henstock, M, Keyuu, J, Kock, R, Parida, S

Abstract: Peste des petits ruminants (PPR) disease was first confirmed in Tanzania in 2008 in sheep and goats in Ngorongoro District, northern Tanzania, and is now considered to be endemic. This study aimed to characterise PPR disease in pastoralist small ruminant flocks in Ngorongoro District. During June 2015, 33 PPR-like disease reports were investigated in seven wards (out of 22) in the north and south of the district, using semi-structured interviews, clinical examinations, PPR virus rapid antigen detection test (PPRV-RDT), and laboratory analysis (real-time RT-PCR, partial N gene sequencing). Ten flocks in six wards were confirmed to be infected with PPR virus by PPRV-RDT and/or real-time RT-PCR. Co-infection of two flocks with bluetongue virus (BTV) was also confirmed by real-time RT-PCR. Phylogenetic analysis of six partial N gene sequences from four flocks showed them to cluster with recent lineage III Tanzanian viruses, grouping with Ugandan, Kenyan and Ethiopian isolates. There was considerable variation in clinical syndromes between flocks. Flock morbidity was 4-67%, while flock mortality was 1.5-25%. Some flocks showed the full range of PPR signs, while others were predominantly respiratory, diarrhoea, or oro-nasal syndromes. These syndromes were associated with different local disease names (olodua – term for rinderpest, olkipei – lung disease, oloirobi - fever, enkorotik - diarrhoea). BTV co-infection was associated with severe oro-nasal lesions. This clinical variability makes the field diagnosis of PPR challenging for livestock keepers and veterinary personnel, leading to mis-diagnosis, and over- or under-reporting. Greater access to pen-side antigen tests would improve the field diagnosis of PPR.

Title: Epidemiology of peste des petits ruminants in Democratic Republic of Congo: Challenges towards Global Eradication Plan

Presenter and co-authors: Bwihngane Ahadi Birindwa

Abstract: Peste des petits ruminants (PPR) or “goat plague” is an acute viral disease of small ruminants caused by PPR virus (PPRV). The disease was first reported by FAO and OIE in Democratic Republic of Congo (DRC) in 2008 and since then it has spread to several regions including a recent outbreak reported in North and south Kivu in 2019. We have previously

diagnosed the PPRV using reverse transcriptase polymerase chain reaction (RT-PCR) in goats and sheep and we have identified and characterized the lineage III based on the sequencing of the nucleoprotein (N), fusion (F) and hemagglutinin (H) genes. The prevalence of PPRV specific antibody by competitive enzyme-linked immunosorbent assay (cELISA) in South Kivu, Eastern of DRC was high (64.7 %) with risk of high prevalence in cattle. Thought cattle are not susceptible to the disease they might play role of potential reservoirs and become a big challenge for global eradication plan because they are always reared in a communal grazing system and sharing water sources with goats and sheep in the country. A multilevel nominal logistic model indicated that the likelihood of goats and sheep being infected with PPRV increased significantly when animals shared water sources, herd size increased, animal age increased, exotic breed, communal grazing systems and farm-to-farm animal exchange. The daily losses associated with morbidity due to PPR were estimated at US$30.2 for sheep and 37.1$ for goats per farmer and approximatively US$11 for sheep and US$121 for goats due to mortality rate due PPR per farmer

Title: What strategy for a PPR vaccination in Mauritania?

Presenter and co-authors: Andrea Apolloni

Abstract: In 2015, FAO and OIE launched a global eradication program (GSCE) based on vaccination. The success of GSCE shall depend on the implementation of vaccination campaigns, accounting for husbandry practices, mobility and the periodicity of small ruminants' population renewal. In Mauritania, PPR outbreaks occur annually despite ongoing annual vaccination campaigns since 2008. Here, we developed a mathematical model to assess the impact of four vaccination strategies (including the GSCE one), the importance of their timing of implementation and the usefulness of individual animal identification on the reduction of PPR burden. The model was calibrated on data collected through ad-hoc surveys about demographic dynamics, disease impact and national seroprevalence. Numerical simulations were used to estimate the number of averted deaths over the next twelve years. The model results showed that the GSCE strategy prevented the largest number of deaths (9.2 million versus 6.2 for random strategy) and provided the highest economic return among all strategies (Benefit-Cost Ratio around 16 versus 7 for random strategy). According to its current cost, identification would be a viable investment that could reduce the number of vaccine doses to

distribute by 20%-60%. Whilst the implementation of the identification system is crucial for PPR control, its success depends also on a coordinated approach at the regional level.

Title: Control of PPR in Tajikistan

Presenter and co-authors: Rajabalii Muzaffar

Abstract: Animal husbandry is the second profitable branch after crop production in Tajikistan. The branch of agriculture provides the main income of the population of the country. 98% of farmers use distant grazing systems in summer and winter. Yearly over 2 million sheep and goats walk along the same pathway, spring to the summer and in autumn to the winter pastures. During the period animals cross the border with the IR of Afghanistan, PR of China, Uzbekistan and Kyrgyzstan. The first outbreaks of PPR were registered in 2004 with high mortality in sheep and goats in three districts of Tajikistan, (Tavildara, Farkhor and Rasht). The districts are located near the border. The analysis showed that outbreaks occur throughout the year. However most often the disease is occurred in the autumn and winter.

Control and fighting against the disease, monitoring of spreading of pathogens, vaccination of animals especially in the border areas are very important. The main problems in Tajikistan are lack of funding anti-epizootic measures, insufficient virology and serological equipment and diagnostics of Veterinary laboratories and inadequate retraining of veterinary specialists.

Action for the future:

- Expanding and deepening cooperation of veterinary services of regions, cities and implementation of joint action for the prevention and eradication of TBDs especially PPR;
- Attract additional investments for strengthening the resources of the Veterinary Institutions (Veterinary units, veterinary stations, veterinary pharmacy, veterinary border points and others).

Title: Importance of stakeholder's participation in the vaccination of endemic diseases of livestock: the case of peste des petits ruminants in Mali

Presenter and co-authors: Michel Dione

Abstract: In Mali, successful control of PPR is hindered by critically low participation of farmers to vaccination. Key challenges identified include limited involvement of livestock value chain stakeholders in the vaccination process and low capacity of vaccinators such as private veterinarians. We evaluated the impact of innovation platforms (IP) as a mean for engaging stakeholders in the vaccination process. Desk review, key informant interview and net-mapping were used to understand the context of livestock vaccination in Mali, while vaccination coverage and sero monitoring together with group interviews were used to measure the impact of the intervention. IPs were created in 24 communes in three regions such as Sikasso (15), Timbuktu (5) and Mopti (4). They developed work plans and implemented activities focusing on improving interaction among key vaccine chain delivery stakeholders such as farmers, private veterinarians, vaccine manufacturers, public veterinary services and local leaders; involving them in the planning, implementation and evaluation of vaccination programs and fostering knowledge sharing, communication and capacity building among them. After two years of implementation of IPs, vaccination coverage for SRs increased significantly (more than double). During the first year, sero-prevalence for PPR increased from 57% (CI95: 54%-60%) at baseline to 70% (CI95: 67%-73%) post vaccination in Sikasso region, and from 51% (CI95: 47%-55%) at baseline to 57% (CI85: 53%-61%) post vaccination in Mopti region. A sustainable vaccination strategy for Mali will benefit from consolidating IP model, supported by Government investment to strengthen and adjust the underlying public-private-partnership.

Title: Strengthening PPRV surveillance using participatory disease surveillance in lowland pastoralist regions of Ethiopia

Presenter and co-authors: Jones, BA, Regassa, G, Adugna, W., Simachew, K., Chaka, H, van't Klooster, G

Abstract: Ethiopia is considered to be endemic for peste des petits ruminants virus (PPRV), but due to limited surveillance capacity the data on frequency and distribution of PPR disease occurrence has been scarce, especially in lowland pastoralist areas, hindering the planning and monitoring of control interventions. To address this, the Ministry of Livestock, Vétérinaires

Sans Frontiéres and FAO Ethiopia established a participatory disease surveillance (PDS) system for PPR-like disease in the pastoralist areas of Afar, Somali, Oromia and SNPP regions supported by the EU-funded SHARE project during 2016-2019. A training-of-trainers course in PPR epidemiology, diagnosis and surveillance was conducted for 21 veterinarians from the federal ministry and the four regions, followed by 13 regional training courses for 376 veterinarians and animal health assistants from 190 woredas. The trained personnel were supported with transport, field costs and PPRV rapid diagnostic antigen test kits (penside test) to carry out PDS in their areas, with the objectives of identifying current PPR disease and identifying high-risk areas for PPR occurrence. 184 PDS exercises and/or outbreak investigations were carried out during 2016-2019, resulting in the identification of 117 PPR confirmed outbreaks, which were controlled through targeted vaccination. Information collected during PDS on small ruminant contact networks and movement patterns were used to delineate epidemiological area for vaccination. The capacity to make a rapid diagnosis using the penside test created enthusiasm for reporting and investigation of outbreaks among livestock keepers and veterinarians, and there was an overall improved general awareness of PPR disease and its control.

Title: Development of a homologous lineage, thermostable Vaccine for control of Peste des Petits Ruminants (PPR)

Presenter and co-authors: Asma Latif

Abstract: PPR (Peste des petits ruminant) is an enormusly contagious and transboundary viral animal disease affecting predominantly sheep and goats as well as wild small ruminants which is capable of destroying whole of the susceptible host population by provoking epidemics and pandemics, thus damaging economy, undermining food security and livelihood of poor farmers. The current study describes the development of a homologous lineage, live attenuated, thermostable vaccine for control of Peste des Petits ruminants (PPR). A total of 239 clinical samples were collected from 43 suspected outbreaks of PPR reported in different provinces of the country during 2012-2014. The samples were confirmed by Ic-ELISA and RT-PCR. Out of 18 viruses recovered in cell culture system, one isolate (PAK-LRS-13/NARC) appeared more resistant at high temperatures maintaining reasonable required titer after heat treatments. Based on thermostability characteristics, the attenuation of a local thermo-tolerant strain of PPRV was conducted by serially passaging. In order to monitor the degree of attenuation and progressive

loss of pathogenicity, the pathogenicity trials were conducted on goats. PPR vaccine was prepared by thermo-stabilization method used for RP vaccine. The efficacy of this newly developed PPR vaccine was evaluated by carrying out experimental immunization in goats. Dynamics of humoral immune response was monitored. Challenge protection studies were carried out in animals previously inoculated with PPR vaccine made by Nigerian strain (75/1) and newly developed thermostable vaccine formulation. Results of humoral immune response revealed that immunization with vaccine prepared from local thermostable strain of PPRV with the new formulation provided equally good protection in goats. This shows that the newly developed thermostable vaccine would be beneficial in eliminating cold chain associated problems present in existing vaccine and also help in progressive control of PPR in the country

Title: Study on early events of PPR virus pathogenesis and evaluation of PPR DIVA vaccines in goats

Presenter and co-authors: Muneeswaran Selvaraj , Mana Mahapatra, Pippa Haws, Richard Kock and Satya Parida*

Abstract: Across the developing world, Peste-des-petits ruminants virus (PPRV), places a huge disease burden on agriculture, in particular affecting small ruminant production and in turn increasing poverty in many developing countries. The current understanding of PPRV pathogenesis has been mainly derived from the closely related rinderpest virus (RPV). There are few studies that have focused on the late stages of pathogenesis of PPRV and very little is known about the processes underlying the early stages of pathogenesis. It is believed that PPRV primarily replicates in the respiratory epithelium before disseminating throughout the host. The application of reverse genetics techniques provides a tool to gain a better understanding of the molecular factors underlying virus host range and pathogenesis. Recently, we have established reverse genetics system for PPRV and engineered a GFP tagged PPR virus (rMorrocco 2008 GFP). Further, we have infected goats with this GFP tagged virus, sacrificed them 6 hourly intervals up to 96 hours post-infection and demonstrated that PPRV primarily replicated inside the pharyngeal tonsil by 18 hours post-infection and then caused viremia and secondary replication in the epithelial cells. Although two safe and efficacious live attenuated vaccines (Sungri 96 and Nigeria/75/1) are available for PPR control, current serological tests do not enable to differentiate between naturally infected and vaccinated animals (DIVA). This poses a serious problem for the sero-surveillance programs. Using reverse genetics we have modified

both the PPR vaccine viruses (Sungri 96 and Nigeria/75/1) as DIVA vaccines and able to differentiate between vaccinated- and infected goats.

Title: Host Transcriptome and Protein-Protein Interaction Analysis Reveals the Role of Interferon Stimulated Genes in the Differential Resistance to PPRV in Cattle and Goats

Presenter and co-authors: Tirumurugaan K.G

Tirumurugaan.K.G1. Rahul Pawar1, G. Dhinakar Raj2 and Satya Parida3 1-Dept. of Animal Biotechnology, Madras Veterinary College, Tamil Nadu Veterinary and Animal Sciences University (TANUVAS); 2- Director, Centre for Animal Health Studies, TANUVAS; 3- The Pirbright Institute, Pirbright, Surrey, GU24 0NF

Abstract: Peste des petits ruminants virus (PPRV) is known to replicate in a wide variety of ruminant species with the domesticated cattle and buffalo to be the dead-end hosts. Understanding the contribution of host factors to virus pathogenesis and the resulting species-specific susceptibility / resistance will help in developing better control measures. In this study, we generated the RNAseq data from the peripheral blood mononuclear cells infected with PPRV (from cattle and goats) and identify the differentially expressed genes and interaction of selective immune related pathway genes that favor increased PPRV replication. We also report the interaction of functionally annotated immune-related pathway genes that are differentially expressed across goat and cattle upon exposure to PPRV by STRING analysis. Upon PPRV infection we could identify 12 and 22 genes that were up-regulated in goat and cattle respectively. The up-regulated genes include the Interferon stimulated genes (ISGs) with significantly higher levels in cattle and validated selected gene targets (interacting PPIs) by qRT-PCR in in-vitro experiments. Upon exposure to PPRV the expression of Phosphodiesterase 12 (PDE12) a 2′,5′-oligoadenylate degrading enzyme was significantly increased in goats contributing to the decreased resistance to viral pathogens. A model has been proposed based on the data generated providing the role for the type I interferon, the ISG and the interacting proteins contributing to the differential susceptibility in large and small ruminants

Title: Plan to increase PPR vaccine production in Sudan

Presenter and co-authors: Fatima Abdelazeem Taha

Abstract: Sheep and goats are reared by poor developing countries in Africa. Peste des petits ruminants and sheep and goat pox are among the commonest of the diseases that affect small ruminants entailing a huge economic loss. The two diseases are priority animal diseases to be considered in poverty alleviation policy in areas where they are endemic. PPR has been reported in Sudan since 1971 and till now from all over Sudan with high percentage beside the continual reported incidence of PPR in sheep and goats in the Sudan with the documented cases of PPR in camels and Gazella dorcas Large scale production of PPR vaccine in Sudan is needed to cover the above 60 million heads of sheep and goats because the local availability of the PPR vaccine will enable the authorities to carry out vaccination program in order

- To decrease the disease incidence in Sudan
- To prepare the country to be declared free of PPR
- To be have good share in global intensive efforts by (FAO).

The aim of our research:

To increase the vaccine production in Sudan and control the 2 diseases in one shot : 2 phases of 3 phase research were done

- Phase 1- PPR- SGP acombine vaccine production
- Phase 2- experimental vaccination in sheep and goat
- Phase 3- field trails vaccination Results of phase 1 and 2 was good enough to go ahead in phase three

After phase three if we obtain good result we will shift to produce combine vaccine to benefit from our lab possibilities to increase production.

Poster Presentations

Title: Sero-prevalence and Epidemiology of Peste des petits ruminants in goat and sheep in South Kivu, Democratic Republic of Congo

Author(s): BWIHANGANE AHADI BIRINDWA

Abstract: A study was conducted to genetically characterize the circulating peste-des-petits ruminants virus (PPRV) isolates, to determine the prevalence of PPRV specific antibody and associated infection determinants, in Eastern Democratic Republic of Congo (DRC). A total of 240 and 80 samples from non-vaccinated asymptomatic goats and sheep respectively to detect exposure levels through serology and in addition 150 samples (whole blood, oculonasal swabs and tissues) were also collected from small sheep and goats showing acute PPR clinical signs to confirm the presence of PPRV. A semi-structured questionnaire was used to identify associated risk factors in the risk population. The overall PPRV seroprevalence was at 45.3% through cELISA with the likelihood of goats and sheep being infected with PPRV increasing significantly when animals shared water sources, herd size increased, animal age increased, exotic breeds are reared, sheep and goat flocks are raised as mixed herds, animals are reared in communal grazing systems, different goat species are raised together, and when there was exchange of animals between farms. An overall of 64.7% of the animal found sick during the study tested positive for the disease through RT-PCR using Phylogenetic analysis based on the sequencing of the N, F, and H genes indicated that PPRV circulating in Eastern DRC clustered genetically with PPRV strains of lineage III alongside PPRV strains from Eastern African countries. There is therefore a need to control to protect livelihoods and to avoid further spread of the virus in the country and across central and eastern Africa.

Title: Development of a homologous lineage, thermostable Vaccine for control of Peste des Petits Ruminants (PPR)

Author(s): Asma Latif

Abstract: PPR (Peste des petits ruminant) is an enormusly contagious and transboundary viral animal disease affecting predominantly sheep and goats as well as wild small ruminants which is capable of destroying whole of the susceptible host population by provoking epidemics and pandemics, thus damaging economy, undermining food security and livelihood of poor farmers. The current study describes the development of a homologous lineage, live attenuated, thermostable vaccine for control of Peste des Petits ruminants (PPR). A total of 239 clinical samples were collected from 43 suspected outbreaks of PPR reported in different provinces of the country during 2012-2014. The samples were confirmed by Ic-ELISA and RT-PCR. Out of 18 viruses recovered in cell culture system, one isolate (PAK-LRS-13/NARC) appeared more resistant at high temperatures maintaining reasonable required titer after heat treatments. Based on thermostability characteristics, the attenuation of a local thermo-tolerant strain of PPRV was conducted by serially passaging. In order to monitor the degree of attenuation and progressive loss of pathogenicity, the pathogenicity trials were conducted on goats. PPR vaccine was prepared by thermo-stabilization method used for RP vaccine. The efficacy of this newly developed PPR vaccine was evaluated by carrying out experimental immunization in goats. Dynamics of humoral immune response was monitored. Challenge protection studies were carried out in animals previously inoculated with PPR vaccine made by Nigerian strain (75/1) and newly developed thermostable vaccine formulation. Results of humoral immune response revealed that immunization with vaccine prepared from local thermostable strain of PPRV with the new formulation provided equally good protection in goats. This shows that the newly developed thermostable vaccine would be beneficial in eliminating cold chain associated problems present in existing vaccine and also help in progressive control of PPR in the country

Title: Control of Peste des Petits Ruminants in cross-border regions of Africa with uncontrolled cross-border livestock movements

Author(s): Edward Okoth Abworo

Abstract: Porous national cross-border areas can present as locations with pockets of Peste des Petits Ruminants (PPR) incidences that are difficult to control due to small ruminant production activities that are associated with animal movements across the borders for purposes of trade or in search of feed and or water for animals. The level of PPR risk uncontrolled movements of livestock across the borders poses and mechanisms for minimizing such risks are not well documented in many transboundary areas in Africa. The epidemiology and control (Eco-PPR) project, funded by European Commission and The International Fund for Agricultural Development (EC-IFAD) and implemented by International Livestock Research Institute (ILRI), proposes tools and approaches for the quantification of risk of PPR transmission through transboundary livestock activities and for the identification of approaches control of PPR in transboundary geographical pockets often not targeted by national disease surveillance and control programs. Evidence from these studies will inform the progressive control and eradication of PPR in Africa.

Title: Peste des petits ruminants (PPR) in Mongolia

Author(s): Dulam Purevtseren

Abstract: In Mongolia, the first suspicious case of Peste des petits ruminants (PPR) was detected in Myangad soum of Khovd province on August 17 of 2016, and this first case of PPR was diagnosed at the State Central Veterinary Laboratory (SCVL) by analyzing the sample which was delivered by the vets of Provincial Veterinary Laboratory. Moreover, diagnosis for PPR detected in sheep and goats in western Mongolia in August 2016 was confirmed and certified by an international reference laboratory. In addition to the domestic sheep and goats, PPR was diagnosed in Mongolian saiga (Saiga tatarica) which is listed as critically endangered species in IUCN Red List. Over 10000 individuals of saiga inhabit in Govi-Altai and Khovd provinces and a total of 5400 individuals was threatened by PPR infection and declined between January and June of 2017. As well as, wildlife species such as black-tailed gazelles, wild sheep and ibex are susceptible to PPR infection and the number of those species is declining. For this reason,

not only Mongolia researchers but also international researchers and gamekeepers are paying attention on this issue. So far, sero- surveillance of PPR is being conducted nationwide every year in Mongolia.

Title: Epidemiology of Peste des petits ruminants in small ruminants and its control programme in India

Author(s): BALAMURUGAN VINAYAGAMURTHY

Abstract: Peste des petits ruminants (PPR) is an acute, highly contagious, World Organisation for Animal Health (OIE) notifiable and economically important transboundary viral disease of sheep and goats. In this study, analysis of the PPR outbreaks data was carried out to know the epidemiological status of PPR in sheep and goats in India since the disease reported. On analysis of the outbreak reports from the past several years, it was observed that PPR features among the top ten diseases reported in small ruminants. Among the viral diseases, PPR stands first with the highest reported diseases in sheep and goats and is the major cause of mortality accounts for 36% in sheep and goats. PPR is enzootic in India as quite a number of outbreaks have occurred in the past and now occurring regularly throughout the country, round the year in all the seasons but was encountered most frequently during the lean period with wide geographical distribution. The PPR risk zones analyses showed wide variations in the different states with different levels of endemicity. Temporal analyses showed a gradual increase in outbreaks since the disease reported in India with the highest peak during 2005-2007. At present, the disease has been brought under control in goats and sheep by available effective and safe live attenuated cell culture PPR vaccine. The epidemiology of PPR is likely to change due to vaccination as the disease occurs more severely in the naïve population. Decreased numbers of outbreaks in the recent past years as well as changes in the disease patterns, severity and distribution might be due to the effectiveness of vaccines and regular vaccination of sheep and goats. Further a declining trend in reported PPR outbreaks in some states (Andhra Pradesh, Telangana, Chhattisgarh, and Karnataka) during the past five years due to implementation of strategic vaccination and control measures under ongoing national PPR control programme, which was initiated during 2010-11 and is being continued in all the states of India from 2014. Recently DAHF department, Ministry of Animal husbandry and fisheries, Govt. of India prepared the strategic planning for National PPR Control and Eradication Strategy (NPCES) by

2025 by following OIE with a hope that PPR in the direction of RP will be eradicated in India within a decade or even earlier.

Title: Development of diagnostic test system based on a recombinant nucleocapsid viral protein of Peste des petits ruminants virus

Author(s): Denis Kolbasov

Abstract: Peste des petits ruminants (PPR) is a highly contagious acute or subacute viral disease of sheep and goats. When performing diagnostic and monitoring serological studies, a technological and sensitive method of enzyme-linked immunoassay (ELISA) is preferred. This work was aimed at studying the characteristics of the components of ELISA experimental test systems for PPR-diagnosis based on a recombinant nucleocapsid (N) protein in indirect-ELISA using a protein A peroxidase conjugate or in competitive-ELISA using a peroxidase IgG conjugate obtained from polyclonal rabbit sera against the nucleocapsid protein. We have received a clone of E.coli pET32a/N/10 that contains a plasmid with a protein N gene fragment of 1530 b.p. and expresses a virus-specific major polypeptide 70 kDa. An opportunity of constructing a PPR diagnostic test system using the indirect-ELISA in which a protein A peroxidase conjugate was used in order to detect the PPR-specific antibody bound to the antigen was demonstrated in the experiments with sera taken from reconvalescents goats. The antibody from the blood serum of rabbits immunized with a purified recombinant N-protein was shown to react basically with the same epitopes as the antibody from the PPR-positive goat serum. The sera of PPR-vaccinated goats with neutralization titers ≥ 1:64 and pigs immunized with a purified PPRV were positive in the competitive-ELISA in which the purified recombinant N-protein and the IgG-based peroxidase conjugate isolated from a rabbit N-protein specific serum were used.

Title: Molecular epidemiology of Small Ruminant Morbillivirus in Niger: an update

Author(s): Dr Abdoul Malick HAIDO

Abstract: Like many West African countries outbreaks of peste des petits ruminants (PPR), an economically important disease of goats and sheep, are regularly reported in Niger. The causative virus, small ruminant morbillivirus (SRMV), can be differentiated into four genetically distinct lineages. In 2018, a study identified three SRMV lineages circulating in the

country in 2001 (lineages I and II) and 2013 (lineage IV). In this present study more recent samples were collected from goats and sheep in locations throughout Niger between 2011 and 2017. Twelve SRMV positive samples were characterized by sequencing of a segment of the nucleocapsid protein (N) gene. Phylogenetic analysis of the sequences identified viruses from lineages II and IV only. The analysis also indicated a shared origin of the viruses from Niger with SRMVs from neighbouring countries suggesting transboundary movement.

Title: Intranasal Peste des Petits Ruminants virus vaccination in goats using natural mucoadhesive polymer as vaccine delivery system: Hematological and humoral immune responses.

Author(s): Chukwunonso Ezeasor

Abstract: Peste des petits ruminants (PPR) is a highly contagious and economically important transboundary viral disease of sheep and goats. This study explores the immunomodulatory potential of Irvingia gabonensis gum polymer extract for mucoadhesive intranasal vaccine delivery against PPR virus in goats. Twenty (20) male West African dwarf goats (6-9months) were divided into 4 groups (n=5). Attenuated 75/1 PPR lineage 1 strain, a homologous PPR vaccine was used for this study. Group 1 was vaccinated via the intranasal route using I. gabonensis polymer as vehicle; Group 2 was vaccinated intranasaly with reconstituted vaccine only; Group 3 was vaccinated via subcutaneous injection while Group 4 served as the non-vaccinated control. Hematology and blocking ELISA was done weekly for 4 weeks post vaccination to evaluate the systemic immune response. H-based PPR-bELISA detected antibodies against PPR by 7 day post vaccination (dpv), reaching a peak by 21dpv with mean Percentage inhibition (PI) of 78.2% ; 69.6% and 87% in Groups 1, 2 and 3, respectively. The unvaccinated control animals remained negative. The hematocrit, hemoglobin, Red cell count and total leucocyte counts did not differ significantly between groups. However, low neutrophil to lymphocyte ratios (NLR) which differed significantly ($P<0.05$) from the controls were observed by 14dpv to 28dpv in the vaccinated groups. The findings of this study shows that intranasal PPRV vaccination may induce systemic immune response and the use of I. gabonensis gum polymer as mucoadhesive vaccine delivery system had an immunopotentiating effect on intranasal PPRV vaccination