Dr Adama Diallo, Dr Geneviève Libeau, Dr KIMANI Tabitha, Dr Joseph Domenech

FAO Consultant, Cirad, East Africa FAO-ECTAD, OIE

Research, including the Global Research and Expertise Network (PPR-GREN)
Introduction

Research needs for diagnostic tests

Research needs in vaccine, epidemiology

Research needs in the socio-economic impacts of peste des petits ruminants

Concluding remarks
Introduction

The tools that are key elements in the global control and eradication of PPR are:

• Thermotolerant vaccine available;
• Diagnostic tools;

BUT

To facilitate and speeding up the course of the program, research is needed:

• Not only to improve the vaccine and diagnostic tools,
• But also to increase our knowledge of PPR epidemiology and of socio-economic impacts of the disease.
Research needs for diagnostic tests

Preparatory phase of a global strategy for PPR eradication

- At early stage, specify current identity of circulating PPRV strains
- Precise the potential epidemiological role of other animal species
- Allow follow-up of viral circulation during vaccination campaign
- Allow follow-up of viral evolution and pathogenicity changes / immune selection during global vaccination

- Constantly refined and assessed/adapted to situations that may evolve along the pathway

By 2030 contribute to the successful outcome of this initiative comparably to rinderpest
Precise the potential epidemiological role of other animal species

**PPRV may cause disease in other species**

- **Cattle**
  - Sub-clinical infection:
  - Seroconversion
  - Rare clinical signs: RP-like in buffaloes (India)

- **Camels**
  - Respiratory syndrome,
  - Cachexia & Death
  - Seroconversion??

- **Wild artiodactyls**
  - Potentially part of the epidemiology, but role still unclear
  - Increased impact of PPR resulting in spillovers and large die-offs
  - Not vaccinated = Sentinel population?

Food and Agriculture Organization of the United Nations
Precise the potential epidemiological role of other animal species

• To attest of seroconversion after PPRV infection/vaccination:
  ✓ The current ELISA tools will remain to be validated in camel, cattle as well as in different wildlife populations.

• To address these species (wildlife), new methods of sampling or testing can reinforce the efforts in PPR control
  ✓ Adapted and validated to unusual test samples (feces, saliva, urine etc.).
  ✓ For non-invasive sampling,
  ✓ Avoid cold chain: filter papers matrix

Success of control should rely on all innovations made in the field of virus identification

- Great need remains for rapid and affordable diagnostics for resource-limited areas:

- Basic requirements of such tests:
  - Suited to situations with no power supply;
  - Operative/interpretation with non-trained staff;
  - Ex: LFD

PPRV strains current identity and follow up during vaccination campaign
PPRV strains current identity and follow up during vaccination campaign

- Success of control should rely on all innovations made in the field of virus identification
  - Needs for multi-disease diagnostic tests to identify several different viruses in a single test.
  - Considering PPR control program includes, to be cost-effective, other priority diseases of SR
    - Multiplex PCR assays (specific primer sets)
    - NGS method approaches for detection of any pathogen present in a clinical sample, and for new pathogen discovery (random primers).
  - Allow for pathogen sequencing directly from clinical material, but they will need to be constantly refined and assessed for their use to become more widespread.
PPRV (Morbillivirus, MV, CDV) characterised by a high plasticity of its genome (ss-RNA).

Genetic evolution potential results in different genotypes/phenotypes.

Sufficient plasticity for emergence of immune selected mutants during the control pathway.

Follow up viral evolution and pathogenicity changes immune selection during global vaccination.

Genome structure of a RNA-Morbillivirus.
Follow up viral evolution and pathogenicity changes, immune selection during global vaccination

- Emergent mutants in susceptible hosts especially neutralization-resistant mutants
- Permanent or sporadic use of vaccines over decades before final eradication
- H protein, important immunogenic component.
- Neutralization-resistant mutants could jeopardize very reliable tests.

Three-dimensional structure. MV-H homodimer (Muñoz-Alá et al., 2015)

In-depth comprehension of functional domains of this proteins is highly relevant for the improvement of serological diagnosis tests.
Other needs/ Conclusion

- Develop a murine model:

- Validation of DIVA & companion ELISAs

Based on the relevant performance characteristics of improved tests, help will be given to determining testing strategies and planning disease control measures.
Improvement of Vaccine for PPR control and Eradication Programme

• Taking into consideration the low price of sheep and goats, Investing in PPR control will be better Justified if placed in the general context of improvement of small ruminant productivity for Poverty Alleviation
• This Implies:

➢ The Control of at least another Important Small Ruminant Disease along with PPR

➢ Consideration of Regional Priority Diseases

➢ Consideration of Multivalent vaccination Strategy
Distribution of PPR

PPR

Capripox

CCPP
Research needs for Small Ruminant Multiple Vaccine Development

Recombinant CAPRIPOX-PPR
DIVA Strategy to enable Differentiation between Infected from Vaccinated Animals will allow conducting Disease Surveillance at the same time as the Vaccination

DIVA RECOMBINANT VACCINE

Research needs for PPR vaccine improvement: DIVA Vaccine Development

Rescue of recombinant peste des petits ruminants virus: creation of a GFP-expressing virus and application in rapid virus neutralization test

Induction of protective immune response against both PPRV and FMDV by a novel recombinant PPRV expressing FMDV VP1
• Natural hosts for PPRV

✓ SHEEP, GOATS

✓ WILD SMALL RUMINANTS

✓ CAMELS (?)

✓ BUFFALOES (?)

✓ CATTLE (?)
Research needs in PPR epidemiology

• Gaps and challenges

Factors involved in the Pathogenicity in Sheep and Goats

- THE VIRUS
  - FOR RPV: Classification possible into: Highly virulent, virulent and less virulent
  - FOR PPRV: Classification not yet clear

- MORBIDITY/MORTALITY Rates: 0 to 100%
  - Goats are more sensitive than sheep. Not always the case
  - Duration unknown

- Animal Species:

- Virus Excretion:

- Survival of Virus in environment:
Research gaps in socio-economics

• Small ruminants are important for the poor
• Thus Main Killer (s) of Small Ruminants are Important for the Poor
• We need to convince politics in Developing Countries to embark on programme to mitigate the threat to small ruminants productions
• We need to provide sufficient information on:
  ▪ the small ruminant value chains in each country
  ▪ the impact of diseases on different value chains actors
  ▪ Impacts of costs measures (vaccination strategies and delivery mechanism)
Small Ruminant Value Chains are influenced by:

- Consumer demand -> incentives, preferences
- Agro-ecological factors
- Farming system and access to technology
- (access to) Resources, livelihoods, poverty
- Frameworks of laws, institutions, governance
- People’s/actors behaviors, cultural customs and rules

Any can become important driver for PPR introduction, spread and control
• Approaches to generate data on value chains

- **Farming system analysis**: farming system definitions, assess role and importance of goats and sheep within livelihoods, livestock sector and agriculture

- **Animal value chain analysis**: input and product flows driven by economics/incentives

- **Social Network Analysis**: Animal movement and actor behavior to identify risk factors and critical control points
Impacts of disease

• Research should aim at:
  ▪ Developing analytical tools and frameworks:
    o to aid better understanding of how PPR morbidity and mortality affects roles,
      uses and services of small ruminants at households, national and regional levels
    o Extend analysis to include impacts of post-producers
    o Incorporate small ruminant holistic development issues in modeling to advocate
      for PPR control within small ruminant development programs and resilience
      building activities particularly in Horn of Africa
  
  ▪ Generating epidemiological and other small ruminant production indices
    and economic data to assist in socio-economic analysis

  ▪ Developing tools and frameworks to model costs and benefits of long
    term control programmes to assist countries justify for long term funding
Global Research and Expertise Network (PPR-GREN)

Objectives

- To update the Global Strategy when new information is made available such as:
  - Improved vaccines, diagnostic assays
  - Socio economic results or new investigation methods
  - Alternative delivery systems able to reach all production systems
  - Improved operational methods and strategies for strategy implementation
Objectives (cont.)

- To support the implementation of the Global Control and Eradication Strategy
- To play an advocacy role with policy-makers at national, regional and international levels

The Global Research and Expertise Network on PPR (PPR-GREN) will build strong partnerships between:

- Researchers
- Technical bodies
- Regional organisations
- Well-recognised experts and development partners.
Electronic conference

To prepare this PPR platform, an electronic conference involving 307 subscribers was held in 2014.

Major conclusions:

- PPR-GREN to be primarily a forum for scientific and technical consultation and discussion.
- To include other important diseases of small ruminants.
- To establishing a strong research group as a major component of the platform.
- PPR-GREN to operate under the FAO/OIE GF-TADs PPR Working Group
Thank you

Dr Diallo Adama, Dr Kimani Tabitha, Dr Geneviève Libeau, Dr Joseph Domenech
FAO Consultant, East Africa FAO-ECTAD, CIRAD, OIE

a.diallob@outlook.com; j.domenech@oie.int; genevieve.libeau@cirad.fr;
Tabitha.Kimani@fao.org