Food and Agriculture Organization of the United Nations

World Organisation for Animal Health
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PPR Episystem Approach

A Concept to Guide PPR Eradication Strategy

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GLOBAL FRAMEWORK FOR THE PROGRESSIVE CONTROL OF TRANSBOUNDARY ANIMAL DISEASES

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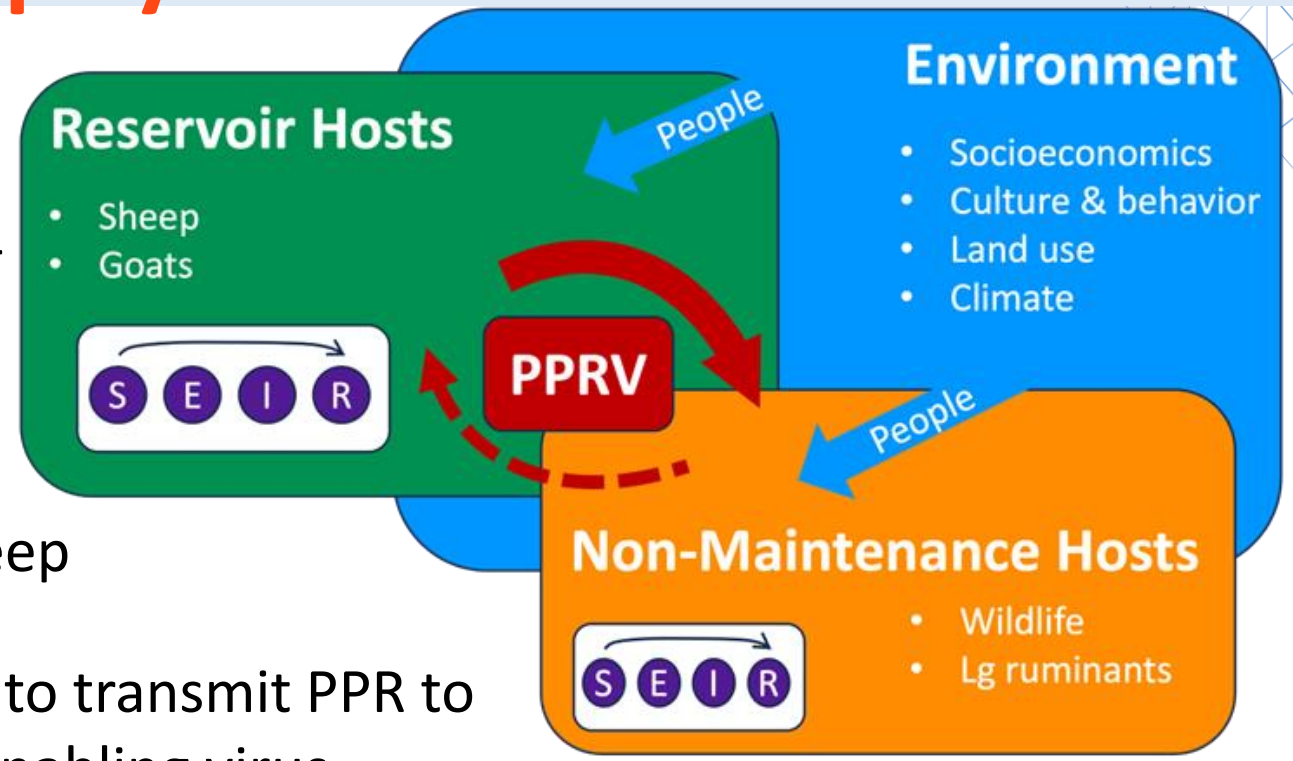
PPR Episystem

- What is a viral episystem?
  - **A virus episystem is a set of interconnected host populations capable of maintaining circulation and transmission of the virus indefinitely**
- It Includes the biological, epidemiological, environmental, and anthropogenic aspects of disease maintenance on a defined geographic and temporal scale
  - This defines the interactions between viruses, hosts, vectors, and environment

PPR Episystem

- An episystem is not static!
- Context determines component importance
- Working definitions must be continuously re-evaluated
- The core of an episystem is the population component capable of sustaining PPR virus transmission over prolonged periods i.e., Sheep & Goats.
- Not all susceptible species have been shown to transmit PPR to the extent that they have a practical role in enabling virus maintenance, i.e., Cattle, Wildlife, Camels & pigs
- **These are considered dead-end hosts that do not contribute to virus maintenance**



Episystem description

- An episystem is more than geography and requires empirical data to be constructed and described. Key source of the data is:-

❖ **Conventional epidemiology**

- Host Contact
- Surveillance
- Modeling

❖ **Participatory epidemiology**

- Host population density/dynamics
- Herd management practices
- Animal movement/trade
- Value chain identification

Identifying how people contribute to disease maintenance connects the episystem to the people and processes that can best help with eradication

❖ **Remote monitoring.**

- to provide health surveillance systems with environmental data to identify the moments when they are conducive to the emergence of diseases.

❖ **Molecular epidemiology**

The Structure of Episystems

An episystem:

- May consist of one large population but more commonly consists of several interlinked sub-populations
- Small ruminant holdings of an ethnic community often share common herding and contact patterns and can be considered a population
- Movement and transhumance over a geographical area is often a feature that must be considered

The Structure of Episystems

- Can include value chains or marketing chains
- Can be a network of populations at different locations and not necessarily in a contiguous zone
- PPR outbreaks may not necessarily be a true representation of where the virus is circulating (incidental outbreak areas)
- Outbreak reports might be often a consequence of infection in areas with effective surveillance mechanisms, or relatively higher animal health infrastructure, whereas the virus may predominantly be circulating in areas with weak surveillance and/or weak animal health services deliveries (remote and hard-to-reach areas – virus sustenance areas)
- These remote and hard-to-reach areas may need a specific focus

Episystems typically transcend international borders and may involve more than one regional economic community

Episystems assessment

- Evaluate existing epidemiological data to determine the PPR risk factors in the country – This information
  - Conventional epidemio-surveillance data
- Livestock farming and production systems operating in any given country
  - Livestock mobility in search of pasture & water; to include porous border crossing
  - Contact patterns
  - Access to animal health services
  - Value chains may also be an important determinant in transferring infection
    - ✓ Live animal markets may play an important role as super-spreaders (hyper-dynamic population constantly changing)
    - ✓ Challenging issue if entering and exiting from Live Animal Markets is unregulated

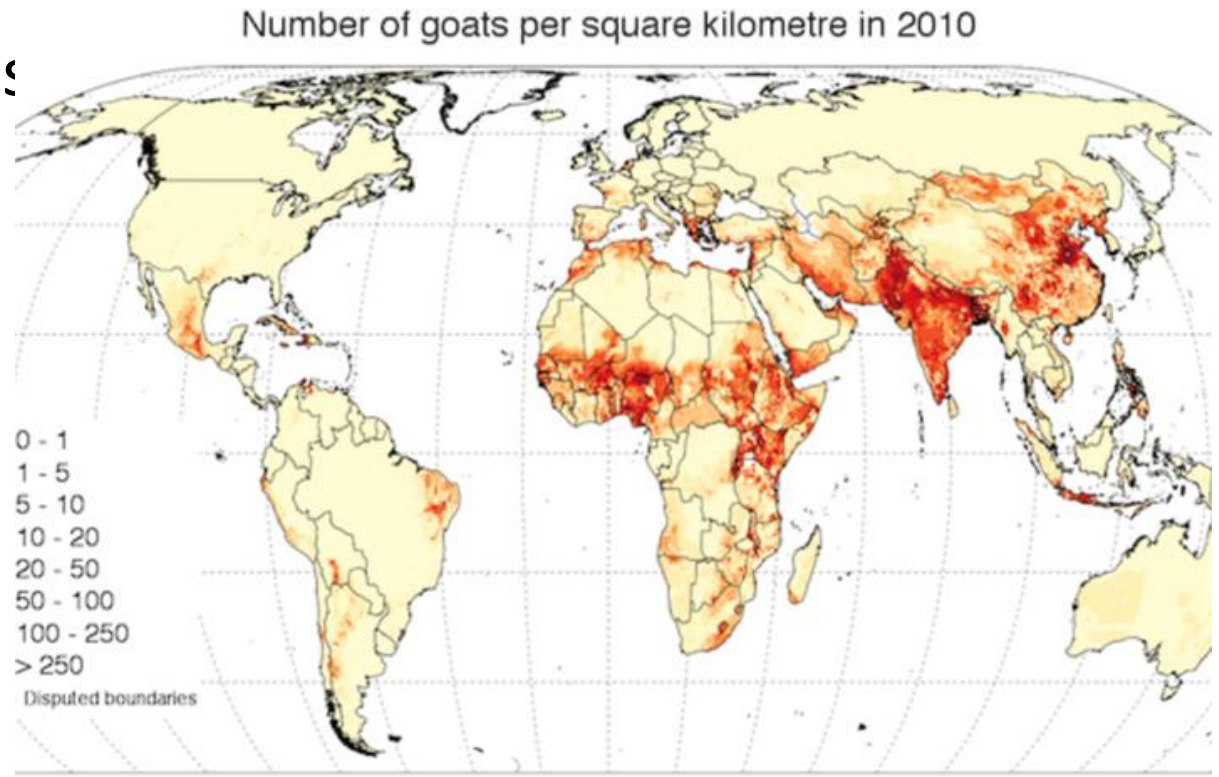
This information should be readily available as it qualifies a country to move from stage below stage 1, and stage 1 to stage 2 of the PPR progressive stepwise approach pathway of the PPR eradication process.

Episystems assessment

Risk Mapping

Examples of Risk Factors

- Sub-populations and their interactions
  - Livestock and wildlife
  - Density and intensity of interactions
  - Critical community size
- Movement pathways and seasonal congregations
- Vaccination levels and gaps
- Insecurity
- Linkages to other systems



Episystems assessment

The identified risk factors be used in finding evidence of disease presence in the suspected areas.

- Participatory Epidemiology :

Provides information on sub-populations in terms of mobility, contact patterns, outbreak patterns

- Understand risk from the ground upwards
- Triangulation of information
- Interactive risk participatory mapping
- Best bet scenario for the episystem

Episystems assessment

- Molecular epidemiology

Analysis of the genetic sequence and clustering (molecular epidemiology) of strains detected in an episystem are:

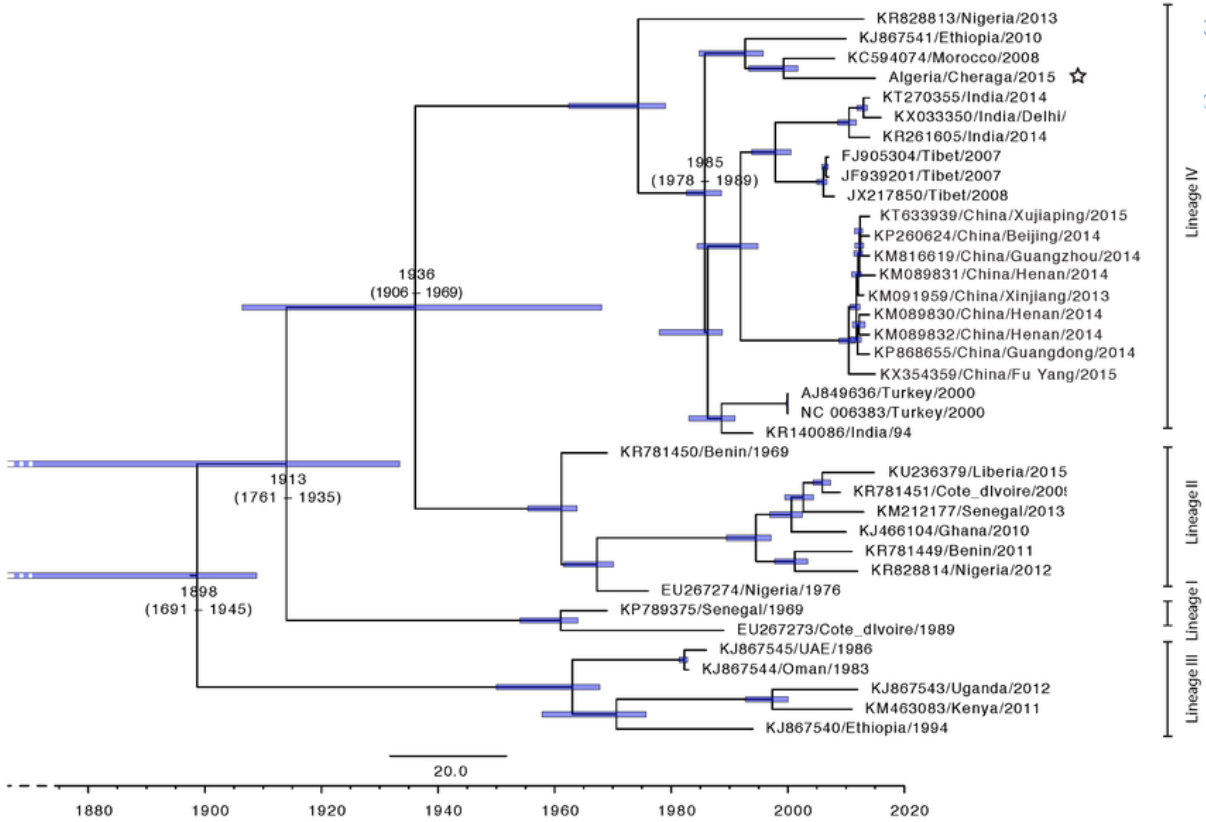
- The best epidemiological supporting tool to delineate episystems
- Easily achievable if appropriately planned
- Internationally available services for testing and analysis

- Provide for testing episystem hypotheses through molecular epidemiology
  - Cluster analysis
  - Ancestor analysis and divergence timelines

Episystems assessment

Viral sequence data can be used to:

- Reveal transmission networks
- Estimate epidemiological parameters
- Infer cryptic circulation in unsampled populations or hosts
- Identify the source of a new outbreak



Full genomes not always necessary if there's an agreed international standard (e.g., N and F genes?)

Examples of PPR Episystems

Possible episystems

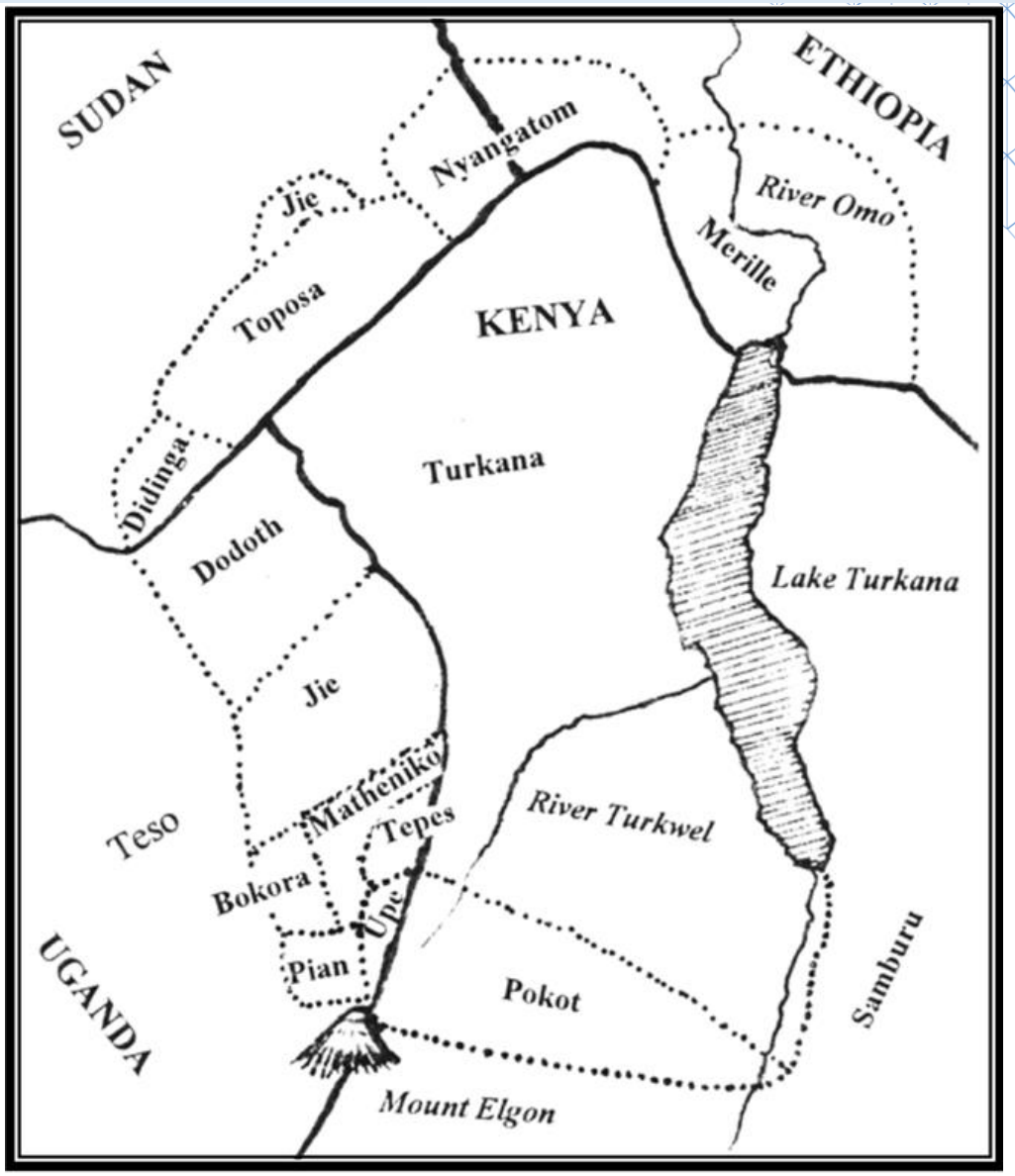
- **Karamojong cluster**

Areas of Uganda, Kenya, South Sudan and Ethiopia
Areas with complex transhumance and livestock exchange patterns

- **Lake Chad Basin**

Communities from CAR, Chad, Cameroon, Nigeria and Niger
Pastoral groups practice long distance transhumance

- **Mano River countries:** Guinea, Liberia and Sierra Leone
- The Somali communities in Ethiopia, north-eastern Kenya, Somalia, and Djibouti
- The Maasai communities in Kenya and Tanzania
- The China – Mongolia – Kazakhstan



Episystems address key gaps for disease control

- How are small ruminant populations connected?
  - Can overcome issues with gaps in surveillance
  - Connectivity between populations = one very large population for vaccination
- How do small ruminant populations change over time/space?
  - Can maximize the value from vaccination campaigns
- How do the episystem components contribute to PPRV maintenance and spread?
  - Can address variations in breed/species susceptibility
  - Can identify contributions from wildlife reservoirs or large ruminants

Episystems for PPR eradication

As countries move into eradication phase (stage 3) Vaccination strategies generally need to focus on ‘core’ host populations:

- Highly endemic areas
- Large herds
- Areas with high animal contact

(e.g., large markets, pastoral areas etc.)

An episystem approach identifies key transmission links and maintenance populations to guide interventions

These must be empirically validated!

Episystems for PPR eradication

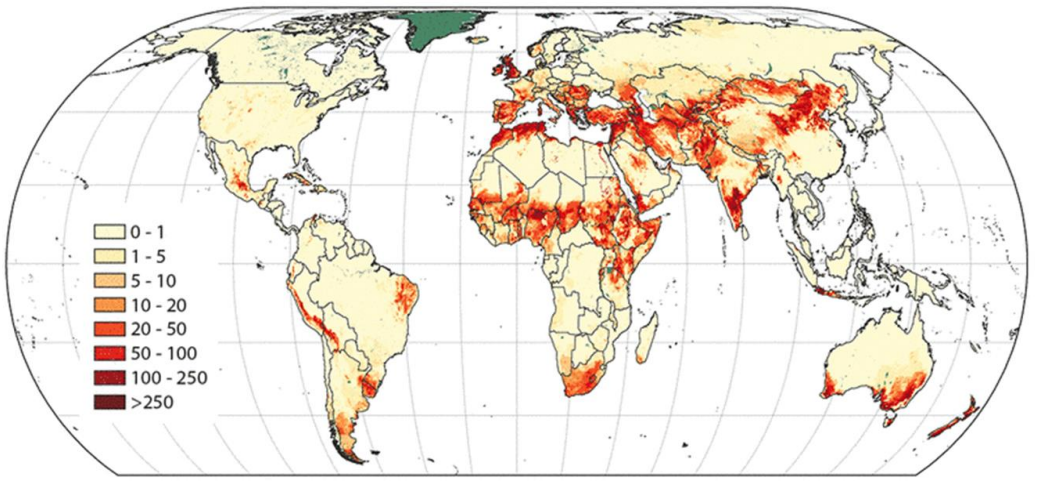
- Eradication strategies and implementation plans need to address episystems in a holistic and integrated manner
- Requires an accurate understanding of the international nature (if exists) of episystems
- Conventional and participatory epidemiology offer good tools for characterizing episystems
- Molecular epidemiology as a supporting tool for confirming the extent and structure of episystems.
- Interventions should target the core populations responsible for maintaining PPR virus and sustaining transmission
- Often requires integrated international action

Episystems vs Risk based approaches

The Episystem approach is based on evidence. Empirical data required to identify PPR episystems also contributes to efficient elimination/eradication campaigns. This is the appropriate tool for eradication efforts.

Risk based approach relies on probability of diseases being their based on presences of risk factors. This approach was optimal during control stage but not appropriate for eradication stage.

FAO 2015 – Global sheep distributions



Episystems are only as good as how we define them

- An episystem approach offers many advantages
  - To maximize their utility, a strong evidence base is needed
- Each episystem is different, none are static.
  - Assumptions about the contributions of populations, species, climate, human behavior, etc. must be validated and continually updated whenever possible
- Viral sequence data is more accessible than ever
  - Can help infer maintenance communities, transmission dynamics, reservoirs, etc. with low effort and cost
  - Incorporating sequencing into ongoing surveillance activities should be a priority

Conclusion

The role of specific small ruminant sub-populations in the PPR episystem determines when, where and how actions should be taken to achieve eradication

Management and monitoring should be based on the episystem and the strategy to interrupt virus circulation in the episystem.

The 20:80 rule: 20% of the population accounts for 80% of the transmission

Thank you