



## Retrospective study on sero-epidemiology of peste des petits ruminants before its official confirmation in northern Tanzania in 2008

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### Abstract

A retrospective sero-epidemiological investigation of Peste des petits ruminants (PPR) was carried out in Ngorongoro district, situated in northern part of Tanzania and bordering Kenya. The study involved collection of field information from 101 respondents who own goats and sheep in four villages which had experienced a 'rinderpest-like' syndrome in domestic small ruminants between first suspected cases of PPR in 1995 and official confirmation of the disease in Tanzania in 2008. A total number of 198 serum samples from goats and sheep collected in 1998 and 2004 for different research projects or suspected disease investigation were retrieved from the Veterinary Investigation centre (VIC) Arusha and subjected to competitive ELISA test for detecting antibodies to PPR virus. Findings of this study suggest that PPR was in northern Tanzania at least four years before official confirmation and reporting based on clinico-pathological grounds, local field-based reports from livestock field officers and District Veterinary Officer. The seroprevalence of PPR from 198 serum samples analysed was 12.6% with the serum samples collected from suspected PPR cases showing significantly ( $p=0.000$ ) higher seroprevalence (71.4%) than that in samples collected for investigation of other diseases (5.7%). Interviewed farmers were aware of PPR including clear description of clinical signs of the disease. Although farmers were aware of efforts made to control the disease, only 32% of them had their animals vaccinated against PPR. The low vaccination coverage suggests continued prevalence of PPR in the study area. It is concluded that there is limited capacity with respect to veterinary disease surveillance, reporting and control of transboundary and emerging diseases which need to be addressed in the country.

**Key words:** Peste Des Petits Ruminants, Sero-Epidemiology, Northern Tanzania

### Introduction

Peste des petits ruminants (PPR) is an acute highly contagious viral disease of domestic and wild ruminants caused by *Morbillivirus* in the family Paramyxoviridae. The PPR virus is antigenically and biologically related to rinderpest virus and clinically it mimics rinderpest in goats (Luka et al., 2011). The PPR virus can be differentiated into four lineages (1-4). The disease is clinically manifested by fever, diarrhoea, oculo-nasal discharges, erosive stomatitis and crusting scabs along the lips, development of pneumonias in late stages and high mortality rates (EMPRES, 2009). The disease severity is influenced by several factors including PPRV lineage, animal species, breed, immune status etc.

PPR was first described in Cote d'Ivoire in 1942 (Gargadennec and Lalanne, 1942). In East Africa, evidence of PPR was first detected serologically in

Kenya and Uganda (Wamwayi et al., 1995) and clinical disease confirmed in the two countries in 2007 (EMPRES, 2009). The disease was first reported in Tanzania in 2008 when it was confined to the Northern Zone in districts bordering Kenya (Kivaria et al., 2009; Swai et al., 2009). The purpose of this study was to assess the status and efficiency of trans-boundary animal disease (TAD) surveillance, emergency preparedness and response using Peste des petits ruminants as an exemplar disease.

### Materials and Methods

A retrospective study was carried out in Northern part of Tanzania in Ngorongoro district between June and August 2010. Ngorongoro was considered an appropriate study site as it was the district where first cases of Peste des petits ruminants were suspected as 'rinderpest-like disease' in 1995 and later on confirmed

in 2008. Study villages were purposively selected from Loliondo division where incidences of rinderpest-like disease were reported since 1995. These villages were: Enguserosambu, Oloirien-Magaidur, Sakala and Soitsambu. A total number of 101 respondents, as recommended by Matata et al (2001) for a purposive study, were interviewed in the four study villages.

A structured questionnaire survey was used to collect information from owners on awareness of rinderpest-like disease in goats, clinical signs observed, year when they had seen the disease for the first time in their flocks and the duration taken from occurrence to response from government. Additional information on the PPR disease in Tanzania was collected using in-depth interview of key informants who were staff under the Ngorongoro district veterinary office, zonal Veterinary Investigation Centre (VIC) located in Arusha and the epidemiology unit in the Ministry of Livestock Development and Fisheries. In-depth interviews focused on the status of disease surveillance and emergency preparedness with respect to coordination, contingency planning, communication, early warning and diagnostic capacity of trans-boundary animal diseases (TADS) in Tanzania. Additional information was collected through retrieval of grey literature and field surveillance data available at the Ngorongoro district veterinary office.

Field work was complimented by retrieval of 198 serum samples from VIC Arusha which were subjected to PPR serological assay. The serum samples were collected from goats and sheep before official confirmation of PPR in Tanzania through different research projects on animal diseases or suspected diseases (Rift Valley fever or Peste des petits ruminants). Unfortunately, we could not be able to identify species and sexes for all 198 serum samples retrieved from VIC Arusha.

Serological assay was carried out by the VIC Arusha using a monoclonal antibody-based competitive enzyme-linked immunosorbent assay (c-ELISA) according to Choi et al. (2005). Details of laboratory procedure and interpretation of results have been published by Swai et al (2009).

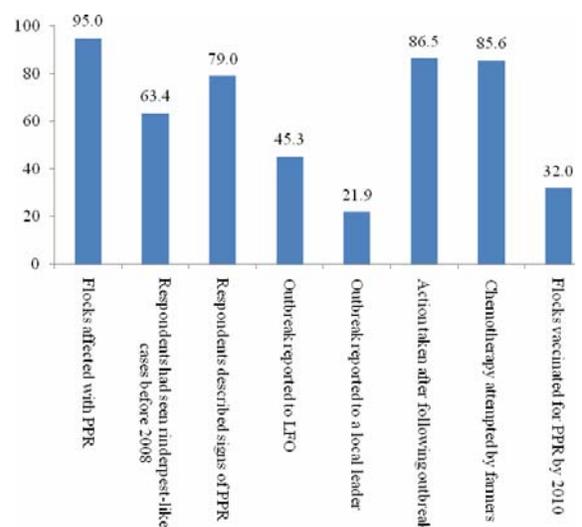
Data collected were entered and stored in MS-Excel and later exported to Epi Info programme (CDC, 2008). Analysis of data involved computing descriptive statistics and comparing proportions by Chi-squared test using the same statistical programme. A critical probability of 5% was used as a cut-off value for statistical significance.

## Results and Discussion

Information from grey literature accessed during the study indicated that PPR was first suspected in

Loliondo area in October 1995 (Anon, 1995), thirteen years before official report in 2008. The 1995 was considered to be a rinderpest incursion and efforts were directed towards confirmation of this rinderpest as well as ruling out presence of PPR (Wambura, 2000). The current study could not retrieve and analyse serum samples collected in 1995 but the likelihood of seroprevalence of PPR in Tanzania was ruled out by a countrywide survey carried out in 1998 by Wambura (2000). Description of clinical signs and, the timeline of PPR suspected and confirmed cases summarised in Table 1 suggest that PPR might have been introduced in northern Tanzania earlier than the official confirmation in 2008 (Figure 1 & Table 2). This is further supported by serological assay in the current study and analysis of trans-boundary animal disease cases reported before official confirmation of PPR in the country. Findings of this study and experience from neighbouring countries of Kenya and Uganda suggest a period of 5 to 12 years between detection of positive seroconversion to official confirmation and reporting of clinical PPR disease in East African (Wamwayi et al., 1995; EMPRES, 2009).

Out of 198 serum samples analysed, 25 (12.6%) were seropositive to PPR virus. The seroprevalence (71.4% of 25) in serum samples collected for PPR-suspected case investigation was significantly higher than the seroprevalence (5.7%) in serum samples collected for either RVF-suspected case investigation or toxoplasmosis survey ( $p=0.000$ ). It was also observed that the seroprevalence of PPR in animals sampled in Ngorongoro district (18.3% of 104 samples) was significantly higher than the seroprevalence of PPR in samples from other districts (6.4% of 94 samples) neighbouring Ngorongoro district. The overall prevalence of PPR recorded in this study falls within



**Fig. 1: Awareness, attitude and practices of farmers with respect to PPR in Ngorongoro district.**

range that has been reported in other countries (Wamwayi et al., 1995; Khan et al., 2007, Swai et al., 2009). The high seroprevalence in samples collected from PPR-suspected cases suggest a significant association between clinical signs observed by farmers and local animal health workers during 2004 PPR-suspected outbreak. Furthermore, it shows lack of emergency plan and preparedness for dealing with trans boundary animal diseases that existed during that period.

Interview of key informants indicated that districts in northern regions neighbouring Kenya were officially notified of the PPR threat by the Ministry of Livestock Development and Fisheries in June 2008. It was also noted that although PPR was first suspected in

Ngorongoro in 1995, the first official attempt to respond was during 2004 when the VIC Arusha conducted field investigation as well as collection of serum samples for laboratory confirmation. Due to lack of laboratory diagnostic capacity, the 2004 samples from suspected cases were not processed. Based on laboratory results in this study, it is very likely that PPR was at least in Ngorongoro by 2004 due to high seroprevalence of PPR in clinically sick animals that presented signs suggestive of PPR. It was until the suspected PPR outbreak of 2008 when samples were analysed outside the country at a French research centre, the Agricultural Research Centre for International Development (CIRAD) when the country was officially declared to be infected with PPR.

**Table 1: Timeline of Peste des petits ruminants (PPR) events in Ngorongoro district between first suspected cases in 1995 to official confirmation in 2008**

Period	Villages	Description of disease event	Remarks
1995	Soitsambu, Sakala, Oloirien-Magaidur	PPR cases suspected and follow up made by DVO <sup>‡</sup> with formal report to VIC Arusha and Ministry requesting for further investigation	Cases in goats and sheep characterised by stomatitis-pneumo-enteritis syndrome, high morbidity and mortality, haemorrhagic gastroenteritis, “zebra” stripes and bronchopneumonia. Considered a new disease by herders.
2002	Sakala, Oloirien-Magaidur	Disease with PPR-like signs described in September monthly report from Orgosorok ward	Severe watery diarrhoea in goats, especially kids, did not respond to chemotherapy; tentatively diagnosed as clostridial enterotoxaemia
2004	Soitsambu, Sakala, Oloirien-Magaidur	PPR cases suspected and follow up made by DVO with formal report to VIC Arusha requesting for further investigation	Cases mainly in goats characterised by stomatitis-pneumo-enteritis syndrome; recorded in one flock morbidity 54% and case fatality 18%.
2006	Pinyiny-Masusu, Malambo, Sakala, Soitsambu, Oloirien-Magaidur	Disease with PPR-like signs described in field monthly reports for August and September	Cases reported in goats only characterized by respiratory distress, cough and severe diarrhoea. Tentatively diagnosed and reported as CCP
2008	Oldonyosambu, Ololosokwan, Soitsambu	Field monthly reports for February as well as reports by herders indicated abnormal mortalities in goats and sheep	VIC Arusha informed by telephone and follow up started in March leading to official confirmation of PPR in October 2008

<sup>‡</sup>DVO stands for a District Veterinary Officer

**Table 2: Seroprevalence of PPR in 198 serum samples collected in 1998 and 2004 from northern districts of Tanzania**

Source district	When collected	Reason for collecting the samples	No. analysed	No. positive	Seroprevalence of PPR (%)
Karatu	2004	Toxoplasmosis survey	36	0	0.0
Mbulu	2004	Toxoplasmosis survey	24	0	0.0
Monduli	2004	Toxoplasmosis survey	34	6	17.6
Ngorongoro	1998	Suspected RVF	52	0	0.0
Ngorongoro	2004	Suspected PPR	21	15	71.4
Ngorongoro	2004	Toxoplasmosis survey	31	4	12.9
Overall	1998 & 2004	Toxoplasmosis survey & investigation of suspected RVF and PPR	198	25	12.6

Out of 101 farmers interviewed, all (100.0%) were aware of PPR outbreak in Ngorongoro district during field visit. Of the 101 farmers interviewed, 96 (95.0%), respiration distress (52.1%), oral lesions characterised by ulceration (45.8%). It was further observed that farmers reported suspected cases to either local field extension (44.8%) officer or local leader (21.9%). Although 86.5% of the farmers interviewed reported that the government responded to the PPR outbreak by launching vaccination campaign, only 32.0% of these farmers had their animals vaccinated against the disease when visited in 2010. The low vaccination coverage in affected areas in the northern Tanzania is far below the minimum recommended coverage of 75-80% (Rossiter and James, 1989) and this implies continued prevalence of PPR in Ngorongoro. It was further noted that 85.6% of farmers who had PPR in their flocks attempted treating affected animals using antibiotics. Application of antibiotics in managing clinical cases of PPR has been reported in other countries and it is believed to increase survival rate of sick animals (Wosu, 1989). This practice may modify the epidemiology of PPR and if not checked, indiscriminate use of antibiotics may also contribute to development of resistance in small ruminant population.

The current study has shown the importance of developing emergency preparedness plan for dealing with disease outbreaks especially transboundary and emerging infectious diseases. In order to avoid delayed confirmation and response to suspected disease events, it is important to learn from what happened in northern Tanzania so that we can serve animal populations from devastating diseases.

### Acknowledgements

We would like to thank farmers in Ngorongoro district as well as officials who provided useful data for this study. Technical staff of VIC Arusha is thanked for assisting laboratory analysis of the serum samples. We particularly thank the Southern African Centre for Infectious Disease Surveillance (SACIDS) for supporting the first author (EDK) through a research grant from Rockefeller Foundation (DSN 310) on resource mapping in Ngorongoro district and the Ministry of Livestock Development and Fisheries for supporting laboratory work and permission to pursue Master of Veterinary Medicine (MPVM) to one of co-authors (PLM).

### References

Anon, 1995. Report of stomatitis-pneumoenteritis of small ruminants from Ngorongoro District Veterinary Officer to the Veterinary Investigation Centre Arusha. Unpublished report.  
 CDC, 2008. Centers for Disease Control. Epi Info program version 3.5.1. Atlanta.

Choi, K.S., Nah, J.J., Ko, Y.J., Kang, S.Y. and Jo, N.I. 2005. Rapid competitive enzyme-linked immunosorbent assay for detection of antibodies to Peste des petits ruminants virus. *Clinical and Diagnostic Laboratory and Immunology*, 12(4): 542-547.  
 EMPRES, Emergency Prevention System. 2009. Peste des petits ruminants (PPR): an increasing threat to small ruminant production in Africa and Asia. *Transboundary Animal Disease Bulletin* No. 33. pp 1-8. Available at <http://www.asf-referencelab.info/asf/files/publicaciones/EmpressFAO.pdf>  
 Gargadennec, R.G. and Lalanne, A. 1942. La peste des petits ruminants. *Bulletin des Services Zootechniques et des Epizooties de l'Afrique Occidentale Française*, 5: 16.  
 Khan, H.A., Siddique, M., Arshad, M.J., Khan, Q.M. and Rehman, S.U. 2007. Sero-prevalence of Peste des petits ruminants (PPR) virus in sheep and goats in Punjab province of Pakistan. *Pakistan Veterinary Journal*, 27(3): 109-112.  
 Kivaria, F.M., Kwiatak, O., Kapaga, A.M., Geneviève, L., Mpelumbe-Ngeleja, C.A.R., Tinuga, D.K. 2009. Serological and virological investigations on an emerging *peste des petits ruminants* virus infection in goats and sheep in Tanzania. A paper presented at the 27<sup>th</sup> Tanzania Veterinary Association Scientific Conference. Arusha, Tanzania.  
 Luka, P.D., Erume, J., Mwiine, F.N. and Ayebazibwe, C. 2011. Seroprevalence of Peste des petits ruminants antibodies in sheep and goats after vaccination in Karamoja, Uganda: Implication on control. *International Journal of Animal and Veterinary Advances*, 3(1): 18-22.  
 Matata, J.B., Anandajayasekeram, P., Kiriro, T.N., Wandera, E.O. and Dixon, J. 2001. Farming systems approach to technology development and transfer. FARMESA, Harare. P: 424.  
 Rossiter, P.B. and James, A.D. 1989. An epidemiological model of rinderpest. II. Simulations of the behaviour of rinderpest virus in populations. *Tropical Animal Health and Production*, 21: 69-84.  
 Swai, E.S., Kapaga, A., Kivaria, F., Tinuga, D., Joshua, G. and Sanka, P. 2009. Prevalence and distribution of Peste des petits ruminants virus antibodies in various districts of Tanzania. *Veterinary Research Communications*, 33: 927-936.  
 Wambura, P.N. 2000. Serological evidence of the absence of Peste des petits ruminants in Tanzania. *Veterinary Record*, 146: 473-474.  
 Wamwayi, H.M., Rossiter, P.B., Kariuki, D.P., Wafula, J.S., Barret, T. and Anderson, J. 1995. *Peste des petits ruminants* antibodies in East Africa. *Veterinary Record*, 136: 199-200.  
 Wosu, L.O. 1989. Management of clinical cases of peste des petits ruminants (PPR) disease in goats. *Beitr Trop Landwirtsch Veterinarmed*, 27(3): 357-361.