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Review Article

REGIONAL EPIDEMIOLOGY AND ASSOCIATED RISK FATORS OF PESTE DES PETITS RUMINANTS IN ASIA – A REVIEW

Munibullah Munibullah[1, 2, 3], Yanmin Li[2]*, Kainat Munib[4], Zhidong Zhang[1, 2]

[1]State Key Laboratory of Veterinary Etiological Biology, Lanzhou Veterinary Research Institute, Chinese Academy of Agricultural Sciences, Lanzhou, China, [2]College of Animal Husbandry and Veterinary Medicine, Southwest Minzu University, Chengdu, Sichuan, China, [3]Department of Clinical Studies, Faculty of Veterinary and Animal Sciences, PMAS-Arid Agriculture University Rawalpindi, Pakistan, [4]Department of Sociology, Allama Iqbal Open University, Islamabad, Pakistan

Email: drlym@163.com

Abstract: Peste des petits ruminants (PPR) is *World Organization* for Animal Health (OIE) notifiable, economically important transboundary, highly contagious, and an acute viral disease of small ruminants. The disease is caused by the PPR virus (PPRV). PPRV belongs to the genus *morbillivirus* of the family *paramyxoviridae*. The recent epidemiological and molecular characterization of PPR virus isolates subdivides them into four genetically distinct lineages (I, II, III and IV). The disease is endemic across Asia, the Middle East and African regions and is considered a major obstacle to the development of sustainable agriculture across the developing world due to its huge burden on the economy and development of the affected countries and has recently been targeted by the Food and Agriculture Organization (FAO) and the OIE for global eradication by 2030. PPR-endemic countries should join the regional force, and implement regional road maps for the progressive and successful control and elimination of PPRV. In this review, the regional epidemiology of PPR outbreaks and associated risk factors, including animal factors (age, species and sex), environmental factors (season, spatial distribution of disease in various locations) and trade associated factors with special reference to the PPR affected countries in South, Central and East Asia are comprehensively discussed.

Key words: epidemiology; PPR-virus; risk factors; control; eradication; Asia

Introduction

Peste des Petits Ruminants (PPR) are a worldwide prevalent infectious disease of domestic and wild small ruminants and a threat to food safety, prosperity of humans and animals across Asia, the Middle East and African regions (1, 2, 3). PPR infection was first described in Côte d'Ivoire, West Africa in 1942. In 1987, PPR appeared in the Middle East and has since then been confirmed in Saudi Arabia (4), Jordan (5), India (6), Bangladesh (7), Pakistan (8), Iraq (9), Afghanistan (10), Turkey (11, 12, 13, 14), Kazakhstan (15), Tajikistan (16), China (18) Nepal and Bhutan (17). PPR has received a growing attention because of its continuing spread and economic impacts (19). Phylogenetically, PPRV can be classified into four distinct lineages based on the fusion (F) and nucleocapsid (N) genes. PPRV lineages I and II are confined to West Africa. Lineage III is limited to East Africa and Middle East. Lineage IV was found only in Asia, but has spread into African territories over the past double decades (3, 17, 20, 21, 22, 23, 24). *The* disease *is characterized* by fever, stomatitis, oculonasal discharges pneumonia and diarrhea. With different outbreaks condition morbidity & mortality rates *vary and can reach* up to 100% (19). In acute cases of PPR mortality fluctuates from 70-80% with duration between ten and twelve days. The postmortem inspection revealed dark red parts (congestion) in

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different lobes of the lungs, small and large intestines (25). On behalf of existing epidemiological data, the virus exists in 65 countries in the world, with more than 20 countries additionally categorized as "at risk". A recent cost-benefit investigation, determined that the worldwide eradication of PPR will provide $74 billion profit over fifteen years (26). Developing countries have more than 90% of the world's small ruminant population, providing food, trade revenue from animals and animal goods; also improve economic strength and livelihood of smallholder holdings (27). Mass vaccination of sheep and goats in endemic countries might be a sensible tactic to control PPR in the first phase of disease eradication (3, 28, 29).

Succeeding Rinderpest eradication in 2011, the FAO & OIE authoritatively stated PPR as next targeted disease, to be controlled, eliminated and eradicated. Although there are some tasks completed for the progressive control of PPR in different countries of the region, however it is essential to understand regional disease epidemiology and to establish a countrywide control and eradication program for PPR, which will link with the regional control and eradication setup. Similarly, it is essential to have broad socioeconomic assessments, disease mapping (hot spot) and documentation of the role of buffalo, cattle, yak, camel, wildlife and other species in the transmission dynamics of the disease. Through collective struggles of indigenous, national and international experts and political will, there is high possibility that this shocking disease can be controlled and finally eradicated in the near future (30). Epidemiological approaches concerning PPR eradication will provide significant welfare and sustainability to vulnerable populations of Africa, Middle East and Asia. This review will provide a regional road map for the eradication of PPR in Asia through a clear regional definition of the epidemiology and associated risk factors of PPR for scientists, policymakers and stakeholders of FAO/OIE.

Regional PPR status in Asia

Throughout the developing world, predominantly in Asia PPR is a major risk for the development of sustainable sheep and goat production. The infection in Asia was first described in southern India and causes significant economic losses. Like, in South Asia Association for Regional Cooperation (SAARC) countries, the overall annual estimated losses by PPR in small ruminants were about 3,012.59 million US$ (31, 32). PPR remains endemic in most of the SAARC-countries of the region except Sri Lanka. Maldives and Bhutan had sporadic outbreaks. Recently in 2021, Chinese experts obtained a regional least cost path (LCP) of PPR trans-boundary spread by domestic and wild animal interface at natural grazing zone between China, India, Kazakhstan, Pakistan and Tajikistan (33). The countries in South Asian *region have varied* capacities, capabilities and facilities in the fields of epidemiology, diagnosis and vaccine production. Bangladesh, India, Nepal and Pakistan *have developed a national action plan* for the eradication of PPR in accordance with *the global eradication campaign* (32). Regional predictable pooled prevalence of PPR in small ruminants in Asia is shown in Table.1. A pooled prevalence (pooled analysis) is a statistical technique for combining the results of multiple epidemiological studies. It is often used when the results of individual studies do not allow for a firm conclusion to be drawn.

South Asia

Bangladesh

In Bangladesh, PPR was first reported in goats in 1993 and since then it has been endemically present in the country (35). Most of the previous PPR studies conducted in Bangladesh were based on either serology or clinical signs except a few recent publications with genetic characterization (36, 37). Phylogenetically, the Bangladesh PPRV strains belong to the PPRV lineage IV and formed a separate subgroup closely related to China-Tibet/07 and Indian/TN/VEL/2015 PPRV isolates proving the regional transmission dynamics of the disease. The overall PPR seroprevalence was 21% in 2008, ranging from 6% to 49% in different geographical locations/districts in Bangladesh (38). D*ue* to seasonal disparity the maximum prevalence observed in rainy period, 11.30%, in contrast to midsummer 6.40% also winter period 8.25%. This dissimilarity may be due to diverse topographical zones and study duration. The maximum frequency of PPR was observed in August, 13.75% and October, 11.51% in contrast with the results of Sarker and Islam (39) and Abubakar et al. (40) Who documented

Table 1: Regional predictable pooled prevalence of PPR in small ruminants in Asia (34)

Country	Study population	Pooled estimate prevalence (%)	95% CI (Confidence interval)	Heterogeneity (x2)	*p*-value
Bangladesh	41,418	31.02	26.60–35.45	7,945.5	<.0001
China	1632	42.93	0–88.72	1503.58	<.0001
India	43,838	39.7	33.73–45.68	15,824.5	<.0001
Kazakhstan	679	0.59	0.07–1.11	0.08	0.774
Mongolia	1950	0.81	0.41–1.21	0.18	0.674
Nepal	460	82.61	79.15–86.08	0	—
Pakistan	56,984	43.55	38–22–48.88	8,936.32	<.0001

the peak prevalence in December (31.68%) and 9.43% in April respectively. Outcomes shown that the lowermost incidence was in May (4.09%) in contrast to Abubakar et al. (41) And Sarker & Islam (39) who investigated the lowest incidence in June. This discrepancy may be due to diverse organizational practices, study period and diverse geographical situation, like in Bangladesh mild winter in October to March; humid summer in March to June; warm rainy monsoon from June to October, however Pakistan has four seasons: a cool, dry winter in December to February; a hot, dry spring in March to May; the summer rainy season in June to September; and the retreating monsoon from October to November, on the other hand, in India spring is from Feb to March, summer is from April to June, Monsoon is from July to mid-September, Autumn is from September to November, however, in Nepal, the warmest months are June-July, The winter month with the lowest temperature is January, spring is from Feb to March. Bangladesh faces analogous problems like India, Nepal and Pakistan regarding future control and eradication targets.

India

In India PPR is endemic and is a major threat to about 223 million small ruminants in the country, causing economic damage of about 247,542.3 US$ annually (21, 42). Animals' movement through the borders of states usually acts as a source of epizootic occurrence of PPR, particularly; unrestricted transportation during religious and social festivals pointedly contributes to disease epidemiology and associated risk factors in the region (44). Singh et al. (45) discussed the relationship between migration of animals and transmission of PPRV in nature. Movements of animals between various regions are common, particularly, in the sub-Himalaya, Gujarat and Rajasthan regions (44, 6). Hence, the close relationships between PPR epidemics and movement of small ruminants have been investigated (43, 45). Consistently according to Mahajan et al. (46), the risk of PPR is greater in nomadic animals than in local non-migratory animals. Furthermore, malnutrition, transportation stress and parasitic infestation are the main issues of nomadic flocks which lead towards immunosuppression and susceptibility of flocks to PPRV infection. These findings were also technically supported by the outcomes of other studies who reported PPR outbreaks in migratory and nomadic small ruminants of Himachal Pradesh (47), Rajasthan region (48) and Punjab province of Pakistan (49). In India maximum outbreaks are documented during the winter periods. Hence, immunization takes place prior to the onset of the winter season. The goat PPRV *strains* identified in the recent epidemic of Tripura indicated 99.2 to 99.6% nucleotide resemblances with the Bangladesh strains (50). The overall epidemiological investigation conforms the trans-boundary communication of PPRV with the adjacent neighboring countries.

Nepal

The First outbreak of PPR was investigated in Nepal during 1995 (17, 21) from the Bara, Mahottari, Dhanusha, Sarlahi, Gorkha and Rauthat regions (51) and about 68 districts of Nepal have documented PPR epidemics in all ecological zones with significant economic losses in small ruminant population (52, 53). The PPR virus circulating in different countries of Asia, including Nepal belongs to the lineage (IV) (24) however, the F and N gene sequencing based study

has shown that the virus found in Nepal, India and Bangladesh is more closely related than virus found in the rest of the country (21). According to Acharya et al. (53), eco-zone wise distribution of PPR showed that the PPR outbreaks were reported mostly in the mountain followed by hills and the least in Terai. High incidence of PPR in the mountains may be due to excessive movements of nomadic herd of sheep and goat, common pasture, low vaccine coverage in mountain as compared to other eco-zones. Hence, strategic vaccination campaigns, proper biosecurity, movement control, risk analysis and the early diagnosis need to be implemented for the control of PPR in the country and also the same strategies for the region. The above studies justify the regional links of virus transmission, temporal and spatial pattern of disease distribution in the region, virus lineage distribution and other complex phenomenon of the virus regionally.

Pakistan

In Pakistan PPR was documented in the commencement of 1990s, however, became important during Rinderpest (RP) Eradication Campaign in 1995. During the previous double decade, enormous investigations commenced towards epidemiology of PPR and its risk factor identification, laboratory analysis, immunization and progression in prevention and control strategies (54). The virus circulates endemically in small ruminants throughout Pakistan; PPR outbreaks have risen to terrible level connecting innovative zones (55, 56). Though both sheep and goats are prone to PPRV, however, according to 50 laboratories established outbreak investigations including Zahur et al. (56); PPR is more severe in caprine (goats) than ovine (sheep) which are in Contrast to African region where PPR commonly affects goats (57). A maximum number of PPR cases are recorded during the summer period with a peak during the period between April - July and then the frequency fall again indicating the temporal pattern of PPR (58). A local scarcity of fodder and poor nutritional position of the animals, possibly play a crucial role in the transmission of PPR (59). Current immunization is strongly recommended in certain zones of Pakistan. The vaccine used is created on Nig75/1 strain belonging to lineage II, while in Pakistan field isolates are belonged to lineage IV. Even if the PPR vaccine production capability is present in the country however there is no planned vaccination program going on and there are huge gaps exist between animal producers, livestock officials and policymakers (30, 62, 63, 64).

Central Asia

Afghanistan

PPR is endemic throughout Afghanistan. In Afghanistan, mostly small ruminants are kept by Kuchi nomadic pastoralists and represent the most significant economic strength of 75% rural population. These nomadic pastoralists cover huge ranges of the country, with interrupted stays (stops) at livestock markets, summer grazing zones, and then settling in rural points (villages) during the winter period. Epidemiological the Kuchi communities were identified as the primary sentinel group to be targeted for PPRV investigation because of their way of lifestyle and have great influence on the spread of the disease in Afghanistan and to neighboring countries of the region (63). Afghanistan was qualified in April 2016 for stage 1 of the FAO/OIE Global Strategy for the Control and Eradication of the PPR progressive pathway. In 2018, about 12.5 million small ruminants in Afghanistan were immunized since 2015. In addition to vaccination, between 2015 and 2017 about 3,004 serum samples in pre and post-vaccination stages were collected and tested in the Central Veterinary Diagnostic and Research Laboratory. The number of outbreaks in seven Asian regions increased between 2015 to 2019, including Afghanistan, which had 824 outbreaks reported (63, 64). Afghanistan is a conflict-hit country due to Taliban militancy having a lack of advanced diagnostic tools and research institutions, so poor data is available on PPR in the country; however, there is an animal movement from Afghanistan to Khyber Pakhtunkhwa and Baluchistan provinces of Pakistan; hence it is observed in these provinces that PPR is reported in large scale by Pakistanian veterinarians and researches (Personal Observation). It is necessary to investigate PPR from root and to know the epidemiology of disease for a better contribution in the region.

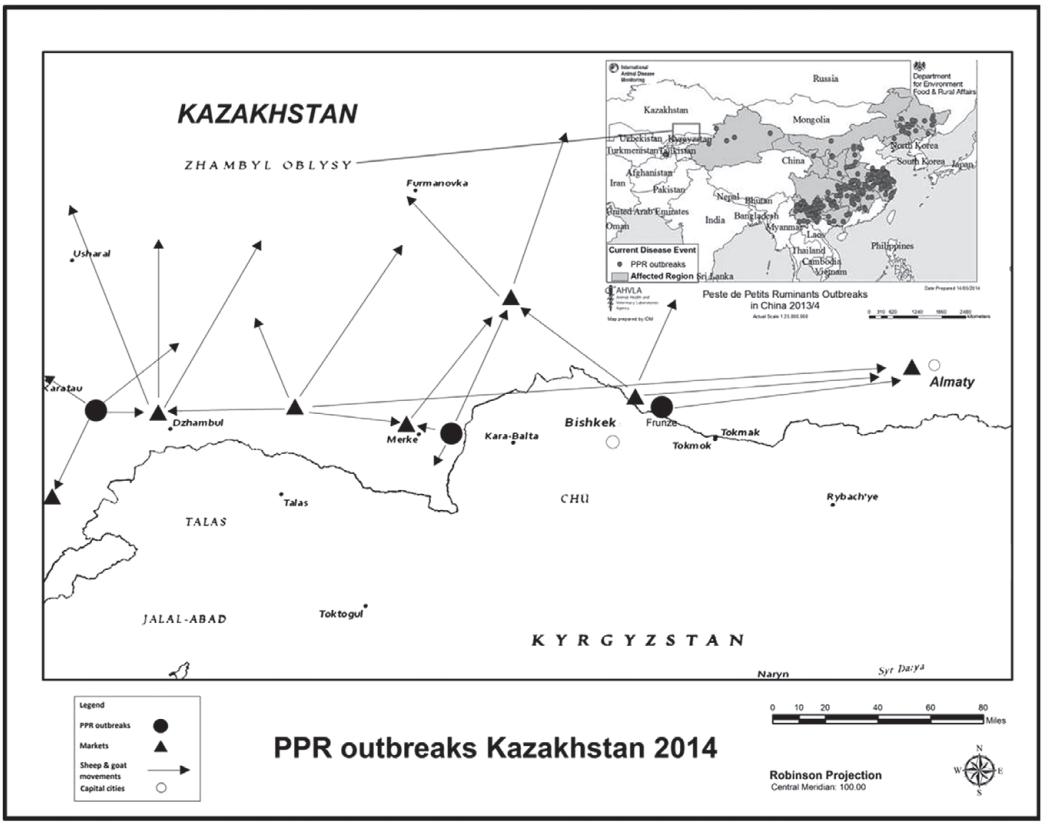

Figure 2: MMap of recent PPR outbreaks reported in Asia and Zhambyl oblast marked by the rectangular box on the conti-nental map (AHVLA 2014). The oblast map extracted to show the three outbreak sites (black dots) reported in this study in the Zhualy, Merke and Korday districts (rayon) and showing small ruminant movement and trade patterns (arrows) (65)

Kazakhstan

An epidemiological sero-survey of livestock in Kazakhstan was documented in the period between 1997-1998. In this survey several OIE List-A diseases in Central Kazakhstan were investigated. Kazakhstanian are nomadic livestock producers, because most of Kazakhstan is unsuitable for agriculture due to its semi-arid range land status. About 958 serum samples from different animals (sheep, cattle and goats) were tested for antibodies against different infections, including PPR with few reported seropositives for PPRV (15). Up to the end of 2014; no PPR cases were officially reported to the OIE from Kazakhstan. Kock et al. (65) Reported clinicopathological, epidemiological and genetic characterization of PPRV in three farm level outbreaks in Zhambyl region in southern Kazakhstan for the first time. Phylogenetic investigation based on partial N gene classification facts conorms the lineage IV PPRV spread, similar to the situation in China. The isolated viruses were 99. 5 - 99. 7% similar to the PPRV isolated in 2014 from Heilongjiang Province in China and therefore this investigation suggest the cross boundary transmission of PPRV. Despite the vaccination of an adult sheep and goats, there is a risk of further maintenance of virus in young stock. Along livestock trading and pastoral routes, threat to both small ruminants and endangered susceptible wildlife populations throughout Kazakhstan and to the neighboring regions.

Mongolia

Between 2016–2017 PPRV was introduced in livestock due to infection in Mongolian saiga antelope and other endangered wild ungulates (66). In fall 2016, PPRV outbreak among domestic small ruminants was confirmed in western region of Mongolia; (67, 68). A total, 83,889 sheep and goats from about 1,081 families were affected by PPR in 14 districts of 3 provinces, of which 12,976 small ruminants expired. The overall case-fatality was 15.5% (57). The saiga antelope

(*hereafter saiga*) occupies <20% of range area in 2 provinces (Khovd and Gobi-Altai) of Mongolia, this historic range representing 36,000 km^2 of desert steppe bordered by lakes, high mountain regions and sand dunes (68). In 8 soums sheep and goats are >1.5 million, dominated by livestock and covering both mountain and desert steppe areas which are considered as the saiga seasonal grazing range (69). Mapping of PPRV outbreak suggest that wildlife might be infected before (possibly in July 2016) the first case was confirmed in December 2016 and also that wildlife infections was closely following the temporal pattern of the livestock outbreak. Strong epidemiological investigations show that these cases were fragments of the same PPRV outbreaks, suggesting spillover of virus from livestock at multiple locations and time points and subsequent spread among wild ungulates with a decline of 80% saiga, raising substantial concerns for the species' survival. Consideration of the entire ungulate community (wild and domestic) is essential for elucidating the epidemiology of PPRV in Mongolia, addressing the threats to wild ungulate conservation, and achieving global PPRV eradication (66).

Tajikistan

PPR was reported in Tajikistan annually between 2005 and 2014. In 2005, samples from sick and dead goats from different farms in Tajikistan demonstrated the occurrence of PPR in Central Asia (70). In 2006, seroprevalence of PPR in small ruminants was reported in Tajikistan and Kyrgyzstan in samples taken from livestock before the vaccination campaign started in the Central Asian region; however, no virus was isolated (71). A study conducted by Kwiatek et al. (16) in which sporadic occurrence of PPR in three districts of Tajikistan was described. The causal strain (PPR Tajikistan) was characterized and the sequence of its N gene was compared with 43 other strains isolated since 1968 in Africa, the Middle East and Asia. The local veterinarians described the outbreaks first as *Pasteurellosis*, but later on it was described as the sporadic occurrence of PPR in Tajikistan. Tajikistan is deficient in research and innovation so limited work has been reported on PPR; however, the disease is endemic in neighboring countries like Afghanistan, Iran and Pakistan. It is important to include Tajikistan in the regional control and eradication program in the future to tear out the root of the disease (PPR) from the Geo-strategically and socioeconomically point of view.

East Asia

China

In 2007, the first epizootic of PPR reported in the Ngari region of Tibet in China, resulting 5751 deaths of sheep population (18). In October 2007, wild bharals (*pseudois nayaur*) were infected in Ge'gyai region. Specimen from domestic small ruminants and bharals were closely associated (72). PPR emerged in Xinjiang in China during 2013, and quickly spread to the rest of the country, including Anhui, Guangxi, Guizhou, Hunan, Hubei, Shanxi, Yunnan, Xinjiang, and Zhejiang Provinces by the first half of 2014 (73). Chinese isolates found these two epizootics were closely linked to isolate obtained from neighboring countries belonging to lineage IV, with diverse divisions (74). Interestingly, Xinjiang has borders with Afghanistan, India, Kazakhstan, Kyrgyzstan, Mongolia, Pakistan, Russia and Tajikistan. Several neighboring countries have reported PPRV infection. The PPRV strain recognized in Xinjiang during 2013–2014 showed a greater genomics resemblance to the strains obtained from Pakistan, Tajikistan and Tibet region (75, 16). In 2008, PPRV was controlled by using stamping-out procedures, animal movement control, and increased screening of herds, while the first vaccination was carried out in 2010 (76). In bird eye view, the details of PPRV transmission dynamics to China fully discovered and observed that the two outbreaks of PPR in China may be independent incidents originated by the communication of the virus from the neighboring endzootic states. Similarly, the threat of further spread from China to neighboring states cannot be ignored (77).

Regional distribution of host in the region

Sheep and goats are usually a host of PPRV, but goats are affected more rigorously as compared to sheep (19). Clinically sheep rarely suffer, even though high mortality and morbidity rate has

been documented, but it is anticipated that sheep embrace inborn resistance to clinical disease (78). PPR has also been investigated in farm / domesticated animals, i.e. buffaloes, cattle, goats, sheep, yaks and camels (59, 66, 79, 80). However, field outbreaks from a zoological group were also reported in Alain (81). PPRV also has been reported in gazelle world widely (4). Consistently the evidence of the disease also exists in Dorcas Gazelles (*gazella dorcas*), Antelope, Laristan sheep (*ovis orientalis laristani*), Nubian Ibex (*capra ibex nubiana*), Nigale (*tragelaphinae*) and gemsbok (*oryx gazella*) (82). PPR has been investigated, found in wild animals, including Saiga antelope (*saiga tatarica mongolica*) and Sindh Ibex, (*saiga tatarica mongolica*) (66, 60, 83).

Disease pattern and seasonal occurrence

Movement of animals within the same country or trans-boundary migration is responsible for the dynamic of the disease incidence. In dry season animal movement takes place in search of water and fodder (6). In tropical regions, PPR constantly appeared in an epidemic. PPR has been often fatal and typically occurs as a sub clinical in arid and semi-arid areas (19). PPRV is constantly circulating between age groups of 4-24 months. However, morbidity and mortality are observed high in all the age groups (4).

Climatic factors affect occurrence of PPR. PPR outbreaks, mainly decline in rainy season due to increased nutrition, health status, fodder availability and decreased animal movement. In dusty and dry season (Dec-Feb) there is poor nutritional status of animals that leads to disease spreading and cases reach peak in rainy season. Khan et al. (58) investigated the highest frequency of PPR in Dec-Feb & Sept-Oct while Abubakar et al. (40) identified maximum case reports in Jan-Apr and 33% of cases detected in March. In China, a study conducted regarding patterns of seasonality of the disease with a peak in April in 2014 (77). According to Abubakar et al. (76), most of PPR cases arise in the beginning of spring with a peak during the rainy period indicating the temporal pattern of disease. According to reported data, we could conclude that the disease is present throughout the year with the severe discrepancy in different weathers.

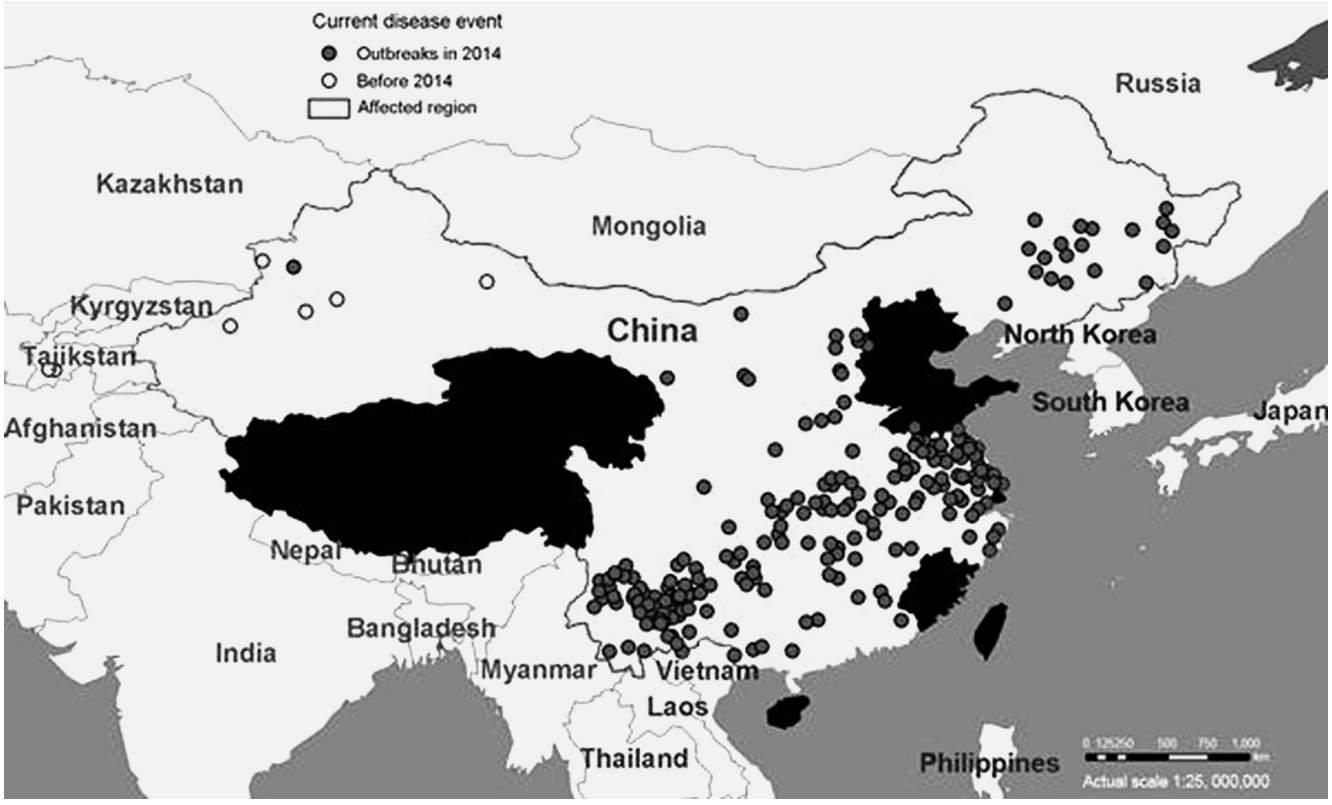

Figure 2: Outbreaks of peste des petits ruminants virus (PPRV) across China during December 2013–May 2014. Data are from ProMed alerts during the period described (76)

Associated-Risk Factors of PPR

Animal Factors

Age

Age is one of the main animals associated risk factors for PPR. The mature animals are more probable to be seropositive for PPR as compared to younger animals (56).

Species

Although PPR affects sheep, goats and as was recently reported that PPR affect also other species, including cattle, buffaloes, camel and wild small ruminants (Sindh ibex). PPR has diverse severity and prevalence among various species, even in goats and sheep's. Prevalence of PPR is higher in goats in comparison with sheep in numerous documentations of many regions (40, 45, 84, 85, 86, 87, 88). Transmission of PPRV amongst the wildlife population at risk significantly associated with closed contact rate among a population of diverse or similar species (72). China investigates PPRV in free-living bharals (pseudois nayaur) in the Tibet region (49). So it is investigated that PPRV, circulates in wild animals and acts as a potential source of virus for domestic species with the possibility of wild small ruminants serving as a reservoir of PPRV and playing an important role in PPR control strategies and could also act as a constraint to the region as well as worldwide eradication of PPR on the other hand in the future.

Sex

Jalees et al. (85) Described that sheep indicated greater sero-positivity in the female's than in males. Furthermore, this scene has been supported by Nanda et al. (6) who reported that male is generally slaughtered at younger stage and female goats and sheep are kept in flocks. These situations remain the same in neighbor countries like, India, Nepal, Afghanistan, and Kazakhstan etc.

Environmental Factors

Season

Seasonal animal movements can spread PPRV over significant distances across states and even continents. Though the disease is endemic in different countries of the region yet few case reports of its seasonal occurrence exist. The incidence of PPR is decreased in rainy season, due to sufficient amounts of forage accessibility leading to increased resistance against the disease (40). Seasonal movements, large flock size, inadequate veterinary services and mixing of animals that visit animal market are the main risk factors of PPR outbreaks in different regions (87). In dry season, small ruminants typical travel long distances in search of forage and water (19). In tropical regions, epidemic form of PPR occurs, however the disease is often lethal and typically occurs as a sub clinical in arid and semi-arid areas (57). So for control strategies zonal division with the countries of Asian region is essential to categorize regions with hot, humid, arid and semi-arid spots, as well as to categorize regions on the basis of sporadic, endemic and epidemic occurrence of PPR.

Spatial distribution of PPR in various locations

Although both sheep and goats are prone to PPRV and incidence of disease takes place yet the pattern of disease are not always the same, like in the African region PPR is observed mostly in goats, however in Southwestern Asia sheep are more affected by PPRV (89). In Pakistan, as compare to India, Bangladesh, Nepal, and Afghanistan, PPR affects both sheep and goats, but in many areas it is seen that only goats are affected (90) consistent with the results of Obi et al. (91).

Trade-associated factors

Trading of small ruminants and associated factors play an important role in the spread and propagation of PPR outbreaks (92). Trade associated consequences of PPR caused a numerous economic influence and the direct production losses in the region. For example, goat entrepreneurship in Laos is the smallest livestock sector trade, the current rise of mutton prices in Vietnam and China has pointed a "goat boom" in South East Asia. Laos is a landlocked country with "porous" borders now "at risk" of PPRV spread due to: closeness and trade with China and other Asian countries. Trade, travel or natural infection can transmit an organism into a

previously unaffected country or region. PPR free countries protect their native production system by excluding import of animal products from PPRV affected regions or import make conditional upon a series of counteractive actions. Overall local, national, and international efforts for the control of trans-boundary animal diseases, including PPR must be designed for achieving the "optimal" level of protection, where the marginal cost of control is equivalent to marginal benefit (93).

Conclusion

The Asian region has millions sheep and goat population and certain countries of the region have an endemic situation. Most of the countries have no organized epidemiological investigation and vaccination campaign of PPR in their territories; PPR is continuing threat to food safety and economy. Although various projects launched by the FAO & OIE for the progressive control and even for risk based eradication of PPR in different countries; however there is a need to understand, comprehensive regional epidemiology, associated risk factors and geostrategic importance of PPR endemic countries for progressive control strategies. This goal could only be achieved by the combined efforts of local, national and regional stakeholders as well as local, national and regional political will; along with continuous financial as well as strategic support and strengthening by international agencies and stakeholders.

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REGIONALNA EPIDEMIOLOGIJA IN Z NJO POVEZANI DEJAVNIKI TVEGANJA ZA KUGO DROBNICE V AZIJI – PREGLED

M. Munibullah, Y. Li, K. Munib, Z. Zhang

Izvleček: Kuga drobnice (angl., Peste des petits ruminants, PPR) je gospodarsko pomembna, čezmejno nevarna, visoko nalezljiva, akutna virusna bolezen drobnice, ki jo je potrebno prijaviti Svetovni organizaciji za zdravje živali (OIE). Bolezen povzroča virus PPR (PPRV). PPRV spada v rod virusov *Morbillivirus* iz družine *Paramyxoviridae*. Nedavna epidemiološka in molekularna karakterizacija izolatov virusa PPRV deli izolate na štiri genetsko različne linije (I, II, III in IV). Bolezen je endemična v Aziji, na bližnjem vzhodu in v Afriki. Zaradi močnega bremena za gospodarstvo in razvoj prizadetih držav velja za glavno oviro pri razvoju trajnostnega kmetijstva v državah v razvoju. Organizacija Združenih narodov za prehrano in kmetijstvo (FAO) in OIE sta nedavno določili, da je bolezen potrebno do leta 2030 izkoreniniti po vsem svetu. Države z endemijo PPR bi se morale pridružiti regionalnim silam in izvajati regionalne načrte za postopen in uspešen nadzor in izkoreninjenje PPRV. V tem pregledu so izčrpno obravnavani regionalna epidemiologija izbruhov PPR in povezani dejavniki tveganja, vključno z dejavniki živali (starost, vrsta in spol), okolja (letni čas, prostorska razširjenost bolezni na različnih lokacijah) in trgovine, s posebnim poudarkom na državah s PPR v južni, osrednji in vzhodni Aziji.

Ključne besede: epidemiologija; virus PPR; dejavniki tveganja; nadzor; izkoreninjenje; Azija