

SURVEILLANCE AND RISK MITIGATION MEASURES FOR ILLEGAL AND UNREGULATED MOVEMENT OF ANIMALS ACROSS BORDERS OR THROUGH MARKETS

Hong Yin¹, Jijun He¹ & Xiangtao Liu¹

***Summary:** This report briefly describes the illegal and unregulated movement of animals across borders and within countries with respect to the control of diseases of veterinary or public health importance in Asia, with particular reference to Southeast Asia and the People's Republic of China (PRC). The introduction and spread of peste des petits ruminants and foot and mouth disease in PRC and their control are summarised and analysed as examples of risks posed by animal movements. The surveillance of animals in farms, markets and slaughterhouses, and other risk mitigation measures, such as standstill of animals, quarantine and control of animal movement, vaccination zones and closure of live animal markets, and the effectiveness of these measures are discussed.*

1. Introduction

Livestock movements are considered a major factor in the transmission of transboundary animal diseases, including some important diseases that pose a threat to the livestock industry, such as peste des petits ruminants (PPR) and foot and mouth disease (FMD). In Asia, illegal or unregulated movements of animals among or within countries have been reported in several countries. Smith *et al.* [7] identified new sources of livestock entering the region, with reported movement of large ruminants from India and Bangladesh to Myanmar and Thailand, and it was also noted that increasing numbers of cattle were being imported from Australia into Vietnam and Malaysia. In Southeast Asia, there has been a marked rise in demand for beef, lamb and pork in recent years, due to the increasing population, continued economic development and the transition towards a more meat-rich diet in the region. This increase looks set to continue for a long time. The high demand for meat in the People's Republic of China (PRC), and its consequently high value, continues to drive the movement of livestock towards PRC from neighbouring countries, for example Vietnam, Laos, Myanmar and Thailand. Thailand and Laos play an important role in transit movements of livestock destined for PRC and, to a lesser extent, Vietnam. Vietnam is an important market for large ruminants in its own right, and is also a transit country for animals moving from Thailand, destined for PRC [7]. At present, much of the movement to PRC is unregulated, with livestock being moved unofficially across national boundaries. Within individual countries in Southeast Asia, there are quite frequent livestock movements between different areas due to the need for breeder animals to improve local herds and to serve customer demand for fresh meat. The distribution and spread of PPR and FMD viruses in the region are a reflection of the trade-driven movement of livestock, both from outside and within a country [1, 4]. This report will briefly describe the outbreaks of PPR and FMD in PRC during the past decade and their relationship with the illegal and unregulated movement of animals across borders or through markets. The current situation and risk reducing strategies will be discussed.

1 Lanzhou Veterinary Research Institute, Chinese Academy of Agricultural Sciences

2. Illegal and unregulated movement of animals across borders or through markets in some regions in Asia

2.1. Illegal and unregulated movement of animals across borders

Three kinds of animal movements have been recognised in Asia, including illegal animal movement, sharing of grassland in border regions and unimpeded cross-border movement of wildlife. A joint study by scientists from PRC, Laos, Myanmar, Thailand and Vietnam has suggested that high prices for animals and animal products have been driving movements of livestock to PRC, particularly from Southeast Asian countries. It is estimated that almost one million head of large ruminants are moved into PRC from neighbouring countries each year. Chinese law prohibits the importation of live animals from countries where FMD is endemic. Consequently, none of the movements of live, FMD-susceptible animals from mainland Southeast Asia into PRC are currently official. There are also reports of movements of large ruminants from India and Bangladesh to Myanmar and Thailand and cattle from Australia being imported into Vietnam and Malaysia [7]. In East Asia, there is almost no illegal animal movement between PRC, Japan, Korea (Democratic People's Rep. of) and Korea (Rep. of), nor is there any in the west region along the borders between PRC and Kazakhstan, Kyrgyzstan, Afghanistan and Pakistan due to the strict border control measures in place. However, sharing of grassland is quite common in the border regions between PRC, India and Pakistan and cross-border movements of wildlife, such as wolves, foxes and some wild ruminants, have also been reported. Cross-border movements of gazelles between PRC and Mongolia have been observed by local people and veterinarians, and these animals may be carrying FMD virus [3]. Last but not least, every year in early spring and late autumn, a great number of migratory birds regularly cross the region and could transmit pathogens to local poultry.

2.2. Illegal and unregulated movement of animals through markets

In Asian countries, people traditionally prefer fresh meat and therefore market-associated animal movements are frequent in many countries. Livestock markets continue to be important components in the movement pathways of livestock across the region. The key markets identified as important areas for gathering and mixing of livestock include Photong market in Tak Province, Thailand, through which the majority of cattle move after entering Thailand from Myanmar, and Tra-Linh assembly market in Cao Bang Province, Vietnam [7]. In PRC, it is difficult to estimate how many markets are currently operating in the whole country. They range from big markets, such as bazaars with thousands of animals being gathered together for trading purposes, to small markets in a commune or village with less than a hundred animals. In some mountainous areas, a trader may move around with a truck or small tractor carrying livestock or poultry. In some places, renting a male breeding animal is a popular practice. There are also cases where a herd of animals could be transferred to a new owner as a gift. In these situations, proper quarantine measures are applied in some countries and only animals with suitably documented health status and vaccination records are allowed to be traded in the markets. However, in some countries, due to the lack of professional veterinarians, no quarantine is practised, and animals without suitably documented health status and vaccination records could enter markets, resulting in a serious risk of disease transmission or potentially leading to outbreaks.

3. Introduction and rapid spread of peste des petits ruminants in PRC

PRC has a small ruminant population of about 600 million animals, representing a substantial portion of the livestock industry and providing a major source of income for farmers. In 2007, PPR, a disease never previously described in PRC, was diagnosed in Ali, Tibet. The Ministry of Agriculture (MOA) and the local government authorities immediately took the necessary control measures and the small-scale outbreak was rapidly controlled. PPR outbreaks were recognised in PRC again in 2013. On both these occasions, the disease was considered to have been introduced from abroad, with movement of animals or vehicles as the likely source of introduction. Unfortunately, within a short time the disease was transmitted to 255 counties in 22 provinces, covering most parts of PRC, and resulting in 48,705 small ruminants being affected, of which 21,336 died, and a further 90,963 animals were culled.

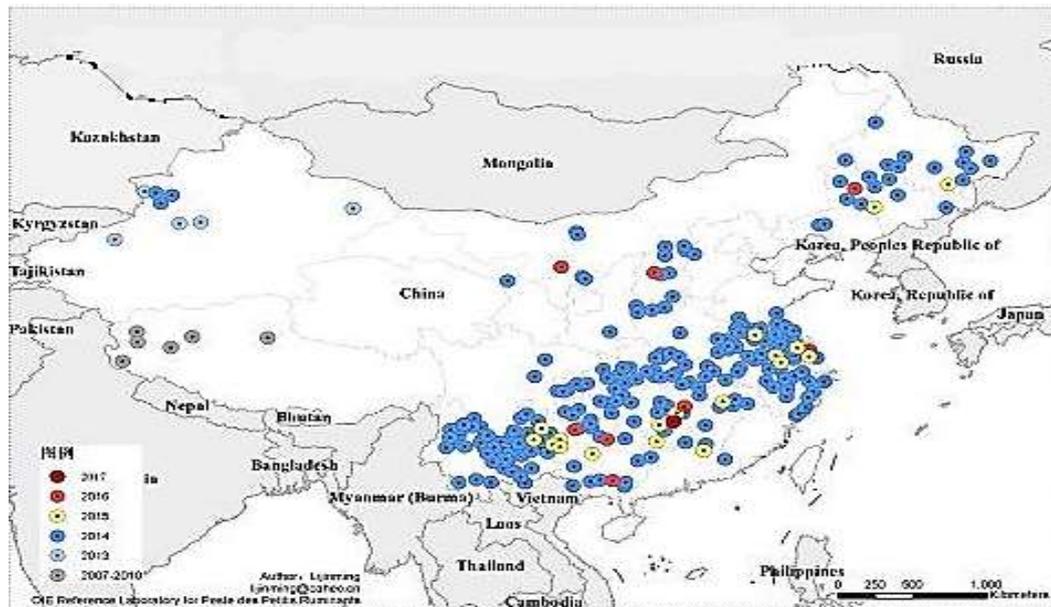


Fig. 1. PPR outbreak events in PRC since 2013



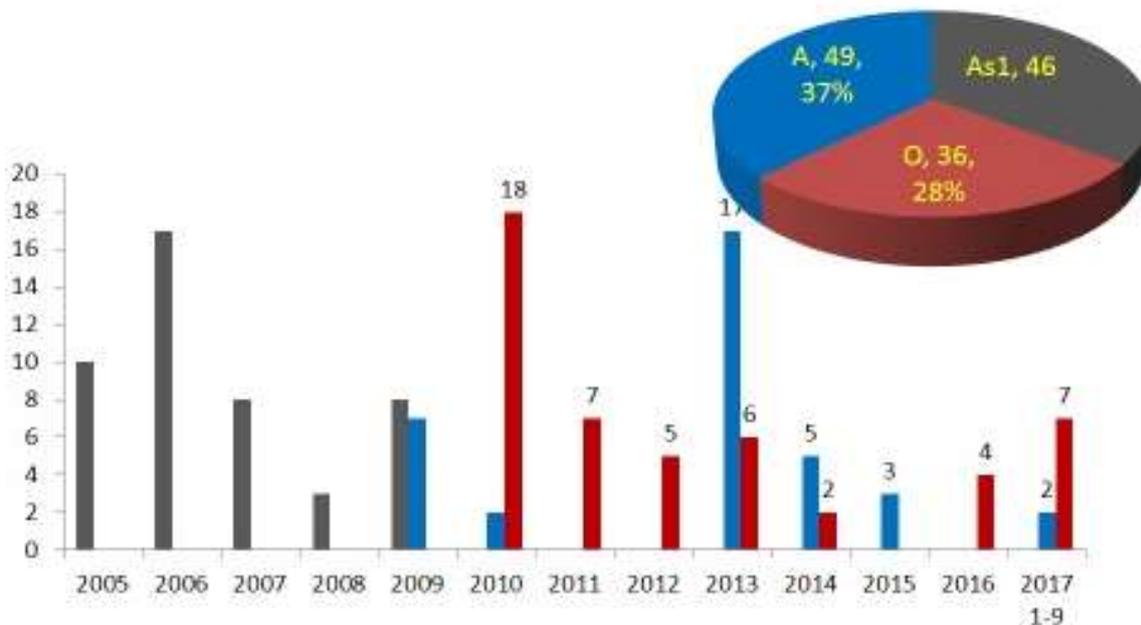
Fig. 2. Animal movements and relation to PPR outbreaks in PRC

Figure 2 shows animal movements from markets in one city during outbreaks of PPR in PRC; lines in red indicate movements resulting in infection with PPR virus or outbreaks.

An investigation by the China Animal Health and Epidemiology Center suggested that the outbreaks and rapid spread of PPR were closely related to trade in livestock or unregulated animal movements. The data revealed that, since March 2014, 90% of occurrences were correlated to animal movements, 10% were due to co-grazing or mating with breeding rams or movement of people. It was discovered that animals from Shandong, Jiangsu, Sichuan and Yunnan provinces were responsible for spreading the disease. For example, out of 585 consignments of small ruminants moved from Jining and Heze cities in Shandong province, the destinations of 457 were traced, of which 149 were believed to have been responsible for outbreaks of PPR. Similar situations were also confirmed in other cities [8, 9].

4. Animal-movement-related FMD outbreaks and disease spread in PRC

PRC prohibits the importation of animals from FMD-endemic countries as some of the animals might be carrying infectious pathogens such as FMD virus (FMDV), including virus types that may not exist in PRC. The illegal movement of animals into PRC thus poses a major threat to the local livestock industry.



Total of 131 outbreaks reported to the OIE between 2005 and Sept. 2017.

Two epidemic types: O and A; no Asia1 clinical cases since 2009; the situation is generally stable with sporadic outbreaks occurring locally in PRC.

Fig. 3. FMD situation in PRC between 2005 and September 2017

In 1999, FMD caused by FMDV serotype O/Mya-98 was first diagnosed in Guangdong province. Prior to this outbreak, FMD in PRC had been caused by the locally prevalent FMDV strains. Since then, several exotic FMDV strains, including serotypes O, Asia 1 and A, have been introduced into PRC. Although no substantial evidence has been found that the outbreaks of FMD were caused or initiated by animal movements, the potential role of such movements across the country's long borders cannot be ignored. As it can take several days between an animal becoming infected with FMDV and its displaying clinical signs of disease, it is therefore possible for an infected animal to pass through a number of market areas, come into contact with many susceptible animals and even cross national borders before it displays clinical signs of disease [5, 6].

In the case of FMDV serotype O/Mya-98, 36 outbreaks have been recorded since 2010, distributed in most parts of PRC, with animals in 13 provinces being affected.

FMDV O/PanAsia, which was introduced in 2011, occurred only in 2011, 2012 and 2013.

FMDV O/CATHAY strain was confirmed in 2016 in Sichuan province.

FMDV O/Ind-2001 strain has been recorded in 2017, in Xinjiang Uygur Autonomous Region.

FMDV A/Sea-97 strain was first detected in 2009 in the central part of PRC. Subsequently, 36 outbreaks were recognised in 12 provinces.

FMDV Asia 1 was reported in 2003, in Xinjiang, and then became widely distributed in PRC. However, it has not been identified in the country since 2009.

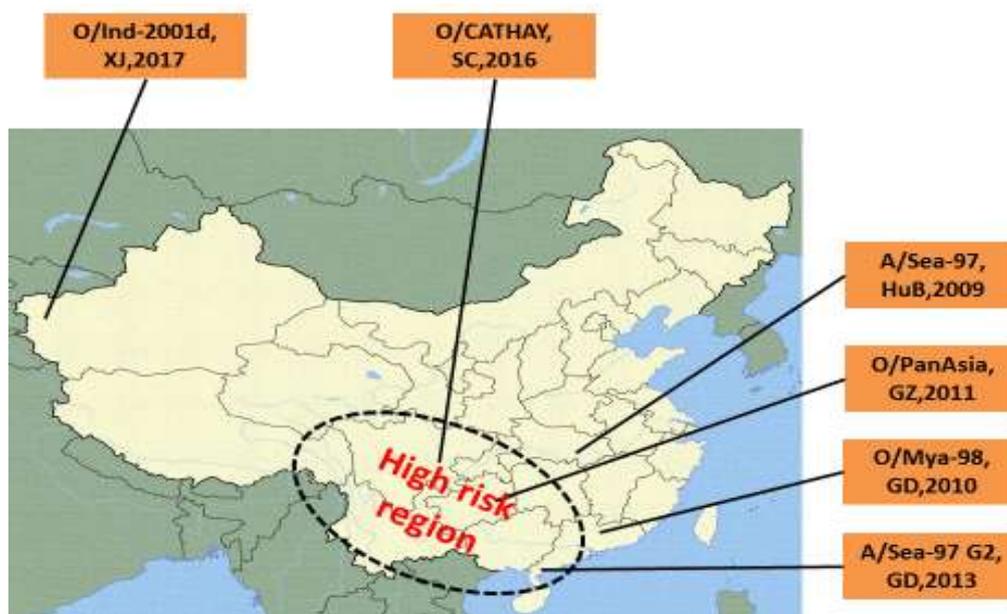


Fig. 4. FMD virus types responsible for outbreaks in PRC and outbreak starting points

A review of the relationship between animal movements and FMD outbreaks in PRC during the past five years (2013–2017) was carried out. It was found that out of 46 FMD outbreaks, 38 occurred in farms or backyard holdings and were believed to be unrelated to animal movements. The remaining eight outbreaks were due to animal movements, four of them occurring in pig slaughterhouses and the other four were regarded as imported cases.

5. Surveillance and risk mitigation measures for illegal and unregulated movement of animals

5.1. Surveillance of animals

Surveillance is essential to prevent diseases entering and moving along the livestock market chain. Surveillance at farm level is clearly preferable so as to source populations and/or control the health status of animals that are permitted to move through endemic areas, rather than just ensuring that livestock are free from disease at the start of their movement. FMD is a serious concern for most countries in Asia and many countries conduct a surveillance programme. In FMD free or partially free countries, e.g. Singapore, the Philippines and Malaysia, thousands of samples are collected from farms and tested serologically. In FMD endemic countries, such as Laos, Myanmar, Thailand and Vietnam, clinical and serological surveillance are routinely practised. In PRC, in 2016, molecular and serological surveillance was conducted in specific disease-free zones, including Hainan Province, Yongji County, Liaoning Province and Shandong Peninsula. An FMD epidemiological survey was conducted in farms in Northeast PRC; samples from pig slaughterhouses in 12 provinces were used for FMD surveillance. A special FMD epidemiological investigation was carried out in border areas in the south-east of PRC, including Guangxi, Yunnan, Guizhou and Guangdong provinces. In 2017, about 4,000 oesophageal-pharyngeal fluid and tissue samples have been tested by RT-PCR for the detection of the FMDV genome, and 9,000 serum samples have been tested by liquid phase blocking ELISA (LPBE) and 3ABC ELISA for the detection of antibodies against FMDV structural proteins (SPs) and nonstructural proteins (NSP). The results of surveillance are a great help in enabling governments to devise their control strategy and modify existing control programmes. However, the shortage of funding and the lack of well-equipped laboratories, experienced staff and reliable and affordable reagents are constant constraints on surveillance in some countries.

5.2. Good laboratories and reliable methods

Laboratories can play an important role in reducing risk, and this is often neglected in some countries. There needs to be a sufficient number of laboratories, at county level, provincial level, and central governmental level, and a laboratory network should be established. In terms of quality assurance, the central governmental laboratory should be ISO:17025

accredited, in line with OIE standards. Inter-laboratory proficiency testing should be carried out to make sure that laboratory diagnostic results are reliable. Local surveillance and monitoring should be routinely conducted. Samples collected from local livestock farms, zoological collections, local wildlife and imported animals should be tested and the results exchanged through the country's laboratory network. For epidemiological research purposes, rapid, pen-side methods need to be developed; these should be specific and stable, and most importantly, should not be expensive.

5.3. Joint control strategies by the countries involved

In Asian countries, particularly in Southeast Asian countries, much of the cross-border animal movements occurring throughout the region are unofficial. This means that traders moving animals across borders are avoiding checks or controls on health or vaccination status. Hence, improved regulation and control of animal movement are required in order to reduce the risk of transboundary animal diseases spreading through movement of livestock. It is impossible for one country to solve the problem on its own; all the countries involved need to discuss together and take joint action, for example by exchanging information on disease status, monitoring animal movements, identifying new movement routes and establishing joint check points. In some countries, the regulations on animal exports and imports need to be reviewed and modified. Recently, government officials from PRC, Laos and Myanmar met to discuss the control of illegal animal movement across borders, and some agreements were made. Hopefully, this will lead to actions being taken and the risks from animal movements being mitigated. Within a country, buffer zones should be set up along borders where there is a potential for animal movements, and animals leaving the country should be strictly controlled. Regulations on animal trade and movement should be enforced and fines and sentences for non-compliance increased. Traders and smallholders should be made aware of the potential consequences of the occurrence of an exotic disease due to trade or their having accepted animals from outside.

5.4. Active contribution by exporting countries

Bartels *et al.* [2] concluded from the available data that South Asia, and especially India and Bangladesh, is a particularly high risk source for FMD. A significant number of large ruminants are informally imported from these two countries to PRC, Thailand and Vietnam, passing through Myanmar because of its geographical proximity. It is suggested that animals could well be transported via two or even three countries before reaching their final destination. It is not solely the responsibility of importing countries to block the movements of animal from abroad, and the exporting countries should contribute to the work of controlling illegal animal movements. The establishment of export zones may help to develop a safer source of livestock from within the region. Development of these systems and official recognition of trade may allow producers within the region to benefit directly from the higher value export markets in the countries with a high price differential, e.g. PRC and Vietnam.

5.5. A safe trade pathway replacing illegal animal movement

At present, there are few official international pathways available to traders in Asia, and those that exist can take a very long time and are usually very expensive. Consequently, illegal animal movement cannot be completely stopped in the short term. There is therefore a need to open up official animal movement routes in order to facilitate direct trade. Due to the lack of an official pathway directly into countries in Southeast Asia and PRC, livestock from FMD free countries, such as Australia and the Philippines, enter the region via neighbouring countries (most likely Thailand, Malaysia or Vietnam), increasing the risk of infection by pathogens during transit. The official pathways will benefit not only governments (through reduced costs of disease control and increased revenues from official taxes) but also livestock traders and producers, but will require the cooperation of governments within the region to develop standardised and practical approaches to manage the risks involved in livestock movement. The costs and benefits to traders all along the market chain will need to be considered when designing new cross-border protocols for livestock movement, to ensure that the official pathways are supported by traders while also minimising the risk of exotic disease incursions in the destination countries.

5.6. Strict quarantine and control of animal transportation within a country

Within a country, there is also a need for improved control of animal movement, including identification and methods of ensuring and documenting vaccination of animals before they are moved. A farm accreditation scheme should be adopted and animal surveillance should be routinely carried out by the Veterinary Authorities. Negative laboratory test results and vaccination are essential requirements before transportation. Policies on local transport of livestock and their products and by-products should be strictly implemented. Traders and their transport carriers should be licensed. Quarantine checkpoints must be well maintained and inspection procedures scrupulously followed. Where necessary, a country-wide ban on the movement of animals can be applied. A good example of this was for the control of PPR outbreaks in PRC in 2014. In spring, when the disease started to spread, the Chinese Ministry of Agriculture (MOA) realised it was closely related to animal movement and decided to launch a programme that included a standstill of small ruminants in the whole country, with particular emphasis on avoiding movements from high-risk areas to low-risk areas. This, coupled with control strategies including vaccination, aetiological surveillance of small ruminants and enhanced quarantine of animals, greatly reduced the outbreaks of the disease, which was rapidly brought under control. Since 2015, the occurrence of PPR has been greatly reduced, with eight outbreaks in 2016 and only three so far in 2017.

5.7. A good system for monitoring animal movement

For animal movement control, a good system is critical. In PRC, a new system has been used, which can continuously monitor the trends of livestock movement into and through a province, with respect to the origin, the destination and the route followed. This is a very transparent and informative system; all the documents and information can be accessed on line. In the case of long distance movement, the Veterinary Authorities along the route will be kept informed. The quarantine checkpoint can therefore easily identify the origin of an animal, and its health status, vaccination status, etc. Although the system has not been in place for very long, it has been working well and has contributed greatly to the control of animal movements.

5.8. Good management of livestock or poultry markets

Animals passing through livestock or poultry markets will come into close contact with pathogen-carrying animals or susceptible ones, facilitating the transmission of diseases such as FMD and avian influenza. Market management is important for reducing the risk as it would be impossible to close down livestock or poultry markets in Asian countries permanently. In market quarantine practice, it is not possible to conduct serological tests as these methods usually take a long time. Consequently, experienced veterinarians are needed for clinical examination purposes. By applying strict clinical examination and by managing livestock in consignments (i.e. rejecting a whole consignment based on the observation of clinical signs of infection in at least one animal in that consignment), the risk of FMD-infected livestock entering a zone has been significantly reduced (by approximately 99% in cattle, buffaloes and pigs and almost 80% in small ruminants) in Laos and Myanmar. For animals entering markets, the accompanying documents on their health and vaccination status should be presented. The trade and destination of animals should be recorded. It is important to raise awareness among traders and farmers regarding the potential risk of infectious diseases. The central and local governmental veterinary authorities should have the right to close markets in some emergency situations. In PRC, during the outbreaks of PPR in 2014, markets for small ruminants were closed throughout the country. In the context of avian influenza prevention and control, and in particular to prevent the transmission of highly pathogenic avian influenza to humans, poultry markets were closed in areas where human cases had been reported. All these measures have proved very effective.

Conclusion

Animal movements across borders and over vast distances within a country can play a crucial role in the transmission and spread of important infectious diseases, such as FMD and PPR. This situation poses a threat to animal health and a threat to the livestock industry in Asia, and especially Southeast Asia. Control of animal movements has proved an effective means of controlling these diseases. Some of the measures that have proved effective include surveillance of animals at their point of origin, control of animal movements, quarantine, check points, good market management and closure of livestock or poultry markets. There is also a need to develop new detection and diagnostic methods.

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