

PESTE DES PETITS RUMINANTS IN AFGHANISTAN

by

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DVM, Kabul University, Afghanistan, 2008

A REPORT

Submitted in partial fulfillment of the requirements for the degree

MASTER OF SCIENCE

Department of Clinical Sciences
College of Veterinary Medicine

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2010

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Abstract

Peste des petits ruminants (PPR) is an economically important and highly contagious disease of sheep and goats. It is characterized by enteritis, stomatitis, pneumonia, and discharge from the nose and eyes. This report contains a review of PPR and its epidemiology in Afghanistan and other PPR- endemic countries followed by recommendations for dealing disease in Afghanistan. Studies showed that PPR is still endemic in Afghanistan's neighboring countries including Pakistan, Iran, Tajikistan, and China. From January of 2009 to January of 2010, 852 outbreaks of PPR were reported to the OIE from 24 different countries. However, this study focuses on Afghanistan and some neighboring countries (Iran, Tajikistan). Animal clinics and Veterinary Field Units (VFUs) reported 7,741 cases of PPR from 2008 to 2009 in different parts of Afghanistan. A study by the Food and Agriculture Organization (FAO) in 2009 showed that PPR is endemic in various parts of Afghanistan. Seroprevalence of PPR varied from 0% in Kapisa to 48% in Herat province of Afghanistan. The last chapter of this report includes recommendations and guidelines regarding prevention and eradication of PPR from Afghanistan. These recommendations could help improve animal health and the economy of Afghanistan in the future.

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CHAPTER 1 - General information about Peste des Petits Ruminants

Introduction

Peste des petits ruminants PPR (goat plague, Kata, Abu nini, Pseudo-Rinderpest or Pneumonia-enteritis complex) is a highly contagious disease of sheep and goats that starts with a sudden high fever followed by watery discharge from the nose, mouth and eyes. Later on, diarrhea accompanies these clinical signs^{1, 2}. Peste des petites ruminants virus (PPRV) is the longest member of Genus Morbillivirus and Family Paramyxoviridae. PPRV, Rinderpest virus, which causes similar clinical signs, and other members of Genus Morbillivirus (Measles Virus, Canine distemper virus, Phocine distemper virus and dolphin morbilliviruses) are closely related to each other³.

Peste des petits ruminants is reportable to the World Organization for Animal Health (OIE) and is an economically important disease in parts of Africa and some Asian countries. PPR is also present in east African and Middle East countries and indeed in most third world countries where people rely on agriculture and animal products. Clearly, control of the import and export of small ruminants and vaccines is needed to prevent this disease^{2, 3}.

Causative agent

Peste des petits ruminants virus is a single stranded RNA virus belonging to the order Mononegavirales, family Paramyxoviridae and genus Morbillivirus; it is sensitive to heat, and its half life is 2.2 minutes at 56°C and 3.3 hours at 37°C⁴. Peste des petits ruminants virus has six structural proteins: fusion protein (F), haemagglutinin protein (H), polymerase or large protein (L), matrix protein (M), nucleocapsid protein (N) and phosphoprotein (P). The outer layer forms the matrix protein (M), which plays a significant role in the budding process. The haemagglutinin (H) helps the virus to bind to a host cell receptor, and the fusion protein (F) helps fuse the viral envelope to the host cell membrane; as a result, a viral nucleocapsid enters the host cell cytoplasm and starts multiplication^{3,5}.

PPRV has 15948 nucleotides making it the longest member of the genus Morbillivirus. It replicates in the cytoplasm of a host cell and is released by the budding process. Nucleoprotein (N) combined with two other proteins (Phosphoprotein and Large protein) covers every copy of the ribonucleocapsid, which consists of single stranded RNA of the negative sense; in fact, this is the basic structure that RdRp (RNA dependent RNA polymerase) uses as a template for transcription and replication. PPRV is categorized into four lineages (lineage 1, 2, 3, and 4) according to fusion protein sequence analysis^{3,5,6}.

Host range

Given that this is a small ruminant's disease, sheep and goats are the common hosts. Additionally, wild small ruminants like gazelle, ibex, gemsbok, and Laristan sheep can die from this disease. While cattle, buffalo, camel, and pig can be infected, they do not show clinical signs, or, rarely, they show only mild clinical signs. This disease has an immunosuppressive effect on large ruminants, so secondary infections can easily affect them. Cattle, which are not primary targets of PPRV, can harbor the virus and transmit it to sheep and goats⁴.

Moreover, cattle are dead-end hosts. Humoral immune response against PPR protects cattle from natural and experimental rinderpest virus (RPV)⁷.

Clinical signs of PPR

The PPRV incubation period is 4-7 days, after which a sudden fever is the first sign of disease. After a few hours of fever, necrotic lesions appears in the mouth (figure 1.1), and 2-3 days later diarrhea occurs. About 9-10 days from the beginning of infection, a sick animal typically will either die or recover^{2,4}.

The rectal temperature may rise to 104-106 F°, and the mucus membranes become congested, the necrotic areas get larger, and the lining of the mouth changes appearance. Because of pain in the mouth, sick animals keep their mouth open. Profuse oculo-nasal and oral discharges (figure 1.3), which are clear and watery at the beginning and that become mucopurulent, yellow, thick, and sticky afterward, are seen in sick animals. This discharge and any necrotic and dying tissue have a foul smell².

Because of tracheitis, pneumonia, ulcers in the upper respiratory tract, and general inflammation of the respiratory tract, sick animals have tachypnea initially that changes

to dyspnea in the later stages. In extreme cases, sick animals breathe with an open mouth, extending their neck and head. A mucoprolent nasal discharge also causes difficult breathing. Associated respiratory tract signs are coughing, sneezing, and multiple erosions in the nasal and buccal cavities^{8,9}.

The feces of sick animals are soft in the early stages of disease but later become watery and foul smelling, sometimes containing blood. Because of diarrhea, sick animals lose body fluids and become dehydrated and thin².

Overall, sick animals have the following symptoms: fever, conjunctivitis, interstitial pneumonia, tracheitis, diarrhea, ulcers in the gastrointestinal, respiratory, and urinary tracts, dyspnea, mild ulcerative stomatitis, dry muzzle, and excessive nasal, oral, and ocular discharges. The animals are dehydrated, depressed, anorexic, dull, and sleepy^{1,2}.

Pathogenesis

The mouth and nose are the main routes for virus entry. Peste des petits ruminants virus is epitheliotropic and lymphotropic. The virus enters via the respiratory tract. The first replication starts in the retropharyngeal and mandibular lymph nodes and tonsils. After 2-3 days, viremia may develop, and 1-2 days later, the first clinical signs may appear. The virus is disseminated to a variety of organs like lymph nodes, bone marrow, spleen, mucosa of the digestive tract, and the upper and lower respiratory tract^{4,9}.

Gross pathology: Congestion of the oral mucosa and ileo-caecal valve is the only sign of the disease in peracute form. In the acute form of disease, the carcass looks dehydrated and emaciated, and the eyes are sunken because of dehydration, while dried discharges surround the nose and eyes^{4,10}. The inner surface of lips and gums and the

dorsal surface of tongue and cheeks, and lips have necrotic foci (figure 1.2). The hard palate, pharynx, and the upper portion of the esophagus also show lesions in severe cases. The abomasum is a main site for erosions but the rumen, the reticulum and the omasum occasionally are affected. The abomasum is characterized by a red surface that oozes blood. The duodenum and the distal end of the ileum may have strips of hemorrhage, which give a zebra-like pattern in the later stages. The large intestine is affected most severely, where congestion is evident around the ceco-colic junction, ileo-cecal valve, and rectum^{8, 9, 11}.

Bronchopneumonia in anteroventral areas, consolidation/atelectasis of lungs (figure 1.4), and pleuritis may be present in respiratory cases of PPR. The nasal mucosa, turbinates, larynx and trachea may have small erosions and petechiae. Yellow mucoid exudates and erosion cause a striated lining appearance in the nasal cavity. The lungs have pneumonic lesions and look dark red to purple. Blood and exudates with many small bubbles can be found in the trachea, and the tracheal mucosa has multifocal hemorrhages^{10, 11}.

Mesenteric lymph nodes appear soft and swollen, and may look enlarged and edematous. The spleen also looks enlarged and congested as do the kidneys and urinary tract. The vulvo-vaginal mucosa may have erosions².

Histopathology: Histopathological findings include mucosal lesions of the oral cavity, tongue, lips and hard palate, which are consistent with necrotic sites and hydropic degenerated epithelial cells in the stratum granulosum. These lesions may include necrosis of epithelial cells, and sometimes multinucleated syncytial cells are present.

Amorphous, eosinophilic and intracytoplasmic inclusion bodies appear in such epithelial cells¹.

Subepithelial tissues, mucosa, and submucosa of large intestine, and intestinal lamina propria show mononuclear cells, and giant cells with several nuclei are evident in the epithelium. The subepithelial tissue appears congested and edematous. While Goblet cells of the intestine fill with mucine and appears large, intestinal blood vessels are congested and villi appear shorter^{8, 10}.

Lungs are congested and show infiltration of mononuclear cells, granulocytes, and alveolar macrophages. Proliferation of type II pneumocytes and the presence of giant cells throughout the lungs are also characteristic of PPR^{8, 10}.

Transmission

Infected sheep and goats are the primary source for spreading disease to healthy flocks. Some studies show that cattle, buffalo, and camels become infected naturally or experimentally with PPRV, and some may die from the virus infection. Although, large ruminants rarely show clinical signs they can play a role in transmitting PPRV to small ruminants⁴.

Close contact is the common method for disease transmission since diseased animals transmit PPRV through their ocular, nasal, and oral discharges, which carry a significant amount of virus. Since the virus is not stable outside the host, a contaminated environment may play a role in transmission for a short period of time only². While the virus cannot survive for a long time in a dead animal, a study showed that recovered goats shed PPRV up to 11 or 12 weeks after recovery¹². The feces are another route of transmission of PPRV. Carrier goats help the virus remain viable from season to season.

Sometimes by introducing new animals to farms that have carrier animals, farmers facilitate an outbreak of disease. Semen, embryos, and milk may also contain the virus. Consequently, an infected male sheep or goat can infect many other animals in the breeding season. Newborn or nursing animals can be infected by an infected mother. Since carrier animals exist, seemingly healthy animals can spread PPR when they come in contact with healthy animals, or when they are brought to market for trade⁹.

Diagnosis of PPRV

Clinical signs are the primary and most important evidence of disease, but laboratory confirmation is required for definitive diagnosis of PPRV. Good sample collection, using virus neutralization, immune capture ELISA, Reverse Transcription Polymerase Chain Reaction (RT-PCR), Ager Gel Immune Diffusion (AGID) and Immuno-Histochemistry (IHC) is important for obtaining accurate test results. Samples from animals that have recently died or a less than one day old carcass should include the following tissues: mesenteric lymph nodes, spleen, eye swabs (3 swabs from each eye), uncoagulated blood, nasal swabs, swabs from buccal mucosa, and small pieces of each tissue. Samples from live affected animals should include eye swabs, nasal swabs, swabs of necrotic debris, uncoagulated blood, and a periscapular lymph node sample. Samples should be store at 4-8C¹⁰

Virus isolation for detection of PPRV requires primary cell culture of lamb kidney, and sheep or goat skin. Specifically, vero cell line may be used for culturing and detecting PPRV. Several blind passages should be done to determine the cytopathic effects (CPE) of the virus on the cell culture. Live virus isolation is a valuable technique, but it is time consuming if blinded passages are required. Furthermore, virus isolation is

labor intensive and requires tissue culture and sterile test samples, which may be unavailable¹⁰.

Agar gel immune diffusion (AGID) is another technique for diagnosis of PPR. This test is rapid, inexpensive, and simple, and is a very useful initial test. Lack of ability to differentiate PPR and Rinderpest (if there is any confusion) and poor sensitivity make it less useful given today's technology^{4, 10}.

Immunocapture enzyme linked immunosorbent assay (ELISA) is a good screening test for the detection of PPR and differentiation of PPR and RP. This test is designed to use polyclonal and monoclonal antibodies. Polyclonal antibodies (capture antibodies) have a high affinity for antigens, which increases the sensitivity of the test. On the other hand, monoclonal antibodies (mAb) react with a single defined epitope, which increases the specificity of the test. Thus, the monoclonal antibody-based immunocapture ELISA offers good sensitivity and specificity such that it is now an alternative to virus isolation for the OIE^{4, 10, 11}.

Polymerase chain reaction (PCR) is not only highly sensitive but it also can differentiate different strains of PPR. In fact, PCR can detect members of the same family and same genus and even interrelation of different lineages of the same virus. Therefore, it is used for structural and functional characterization of the virus. Couacy-Hymann et al^{13, 13} (2009)^{13, 13} showed that the immunocapture ELISA can detect antigens two days prior to clinical signs. Reverse transcription polymerase chain reaction (RT-PCR) can amplify the PPRV nucleoprotein gene three days prior to clinical signs. Couacy also claims that nucleoprotein gene (Np) detection of PPRV via RT_PCR is more sensitive than virus isolation¹³.

Differential diagnosis

Rinderpest is mainly a disease of large ruminants that was eradicated but reemerged recently¹⁴. It can infect small ruminants like sheep and goats. PPRV can cause subclinical disease in large animals. Sheep and goats are the usual source of infection for large animals¹⁵. This is because rinderpest and peste des petits ruminants viruses are immunologically related. Therefore, it is possible to protect sheep and goats from PPR by using an attenuated vaccine of the rinderpest virus. Besides the similarities, these two diseases have some differences: PPRV is 160-350 nm bigger than rinderpest virus (RPV); antibodies against PPRV cannot, or can only partially, neutralize the rinderpest virus, and the same is true for the RPV antibodies¹⁰.

Because peste des petits ruminants is highly contagious, spreads rapidly with high mortality and morbidity rates among animals of all ages, this may be one of the indicative signs. Febrile diarrhea with erosions in the mouth and depression also may indicate PPR. Other diseases have similar clinical signs and are sometimes mistaken for PPR: PPR may be confused with pneumonic pasteurellosis; contagious caprine pleuropneumonia; foot and mouth disease; blue tongue; coccidiosis; gastrointestinal worms¹⁵. It can be difficult to differentiate these diseases from each other. To differentiate Rinderpest from PPR requires laboratory confirmation; specifically, the RT-PCR can successfully differentiate rinderpest from PPR, and the virus neutralization test, the sandwich ELISA, the PCR, and haemagglutination tests are others that can differentiate PPR from RPV^{4,9}. The following paragraphs address the symptoms of diseases that may be confused with PPR.

Pneumonic pasteurellosis, caused by *Pasteurella hemolytica*, affects pulmonary tissue and causes difficult breathing. It may cause dark red/purple discoloration in the

anterior and cardiac lobes of the lung, which is sometimes confused with PPR. However, absence of diarrhea and oral lesions can distinguish these two diseases. Isolation of *Pasturella hemolytica* from the samples supports differentiation of these two diseases².

Contagious Caprine Pleuropneumonia (CCPP) is another disease confused with PPR. This disease is caused by *Mycoplasma* spp. Fever, difficulty breathing, and coughing are signs in common with PPR. Absence of diarrhea and mouth lesions but presence of fibrinous fluid in the chest cavity differentiates PPR from CCPP².

Foot and mouth disease (FMD) and bluetongue are two infectious diseases that have some similarity with PPR. Again, the absence of diarrhea, breathing problems, and foul smell of exudates, but the presence of lameness distinguishes FMD from PPR. Meanwhile, bluish discoloration of the oral cavity and presence of edema in the head region differentiate Bluetongue from PPR².

Figure 1.1 Caseous material on upper lip of a goat affected with PPR².



(FAO 1999)

Figure 1.2 Nodules in later stage of PPR around the mouth of affected sheep².



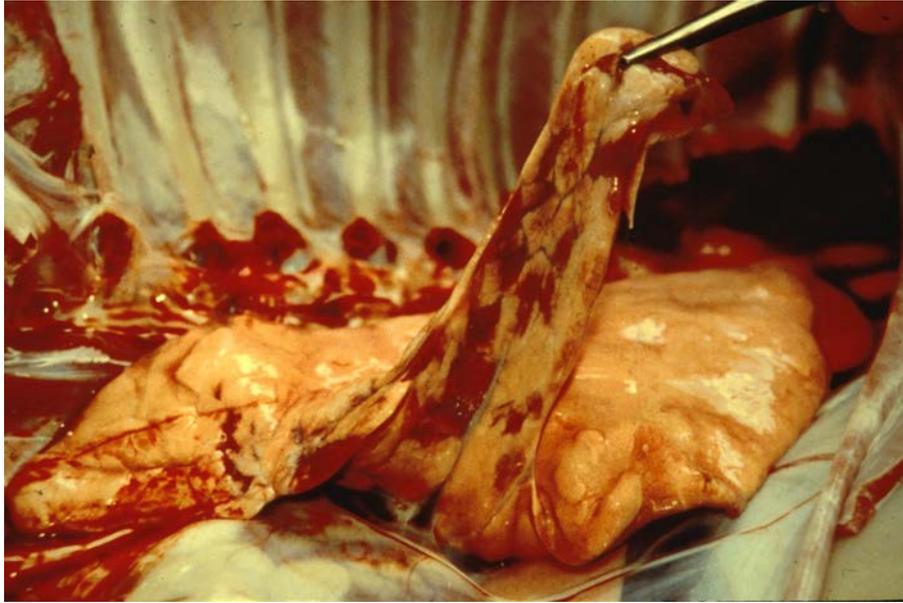
(FAO 1999)

Figure 1.3 Discharge from eyes and nose of goat in advanced stage of PPR².



(FAO 1999)

Figure 1.4 Early lesion of pneumonia in the lung of affected animal².



(FAO 1999)

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CHAPTER 2 - World status of PPR

Global status of PPR

Peste des petits ruminants is a highly contagious disease that causes marked economic losses in endemic countries. Initially, the World Organization for Animal Health (OIE) had classified PPR as a list A disease, but now it is classified as an economically important animal disease. It was first identified in West Africa in 1940¹, and cases were reported only from there until the mid 1980s. PPR appeared in Sudan in 1984. The disease extended to east Africa, and subsequently west and central Africa were also considered endemic areas^{2,3}. PPR is endemic in the Arabian Peninsula, Middle East, and Indian subcontinent and has been recognized in Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Saudi Arabia, the United Arab Emirates and Yemen, India, Nepal, Bangladesh, Pakistan and Afghanistan^{4,5}.

From 2009 to the beginning of 2010, the OIE listed outbreaks of PPR in various countries (Table 2.1). The highest number of outbreaks is in Guinea (103), and the lowest number is in the Maldives (1) and in Burkina Faso (2). China reported an outbreak of PPR that started on 01/06/2010 and is ongoing, affecting the provinces of Wujian, Ritu, Ali in Tibet. The incidence of PPR in other countries appears in (Table 2.1)⁶.

Table 2.1: Countries with number of outbreaks from January 2009 up to January 2010⁶.

Country	Number of outbreaks
Afghanistan	45
Benin	75
Burkina Faso	2
Cameroon	16
Cote D'ivoire	17
Ethiopia	75
Ghana	63
Guinea	103
Guinea Bissau	20
Iran	64
Kuwait	12
Maldives	1
Mauritania	12
Nepal	50
Niger	44
Palestinian	71
Senegal	25
Sudan	15
Tajikistan	1
Togo	47
Turkey	24
Uganda	2
United A. E.	2
Yemen	66

The following section addresses significant outbreaks of PPR, in particular countries surrounding Afghanistan and on the African continent (figure 2.1).

Pakistan

In 1991 in Pakistan, peste des petits ruminants appeared for the first time in the Punjab province⁷. A flock of 350 sheep and goats with no history of vaccination against PPR belonging to the Livestock Production and Research Institute (LPRI) of Bahadurnagar, was moved from that institute to Allahdad livestock farm of Punjab province in May of 2004. The flock was returned to the institute in November of 2004. In 2005, the flock showed clinical signs of PPR, and ELISA testing detected PPR antibodies in diseased and apparently healthy sheep and goats of this flock⁸.

Serum samples from ruminant flocks in 26 different parts of the North West Frontier Province (NWFP) and Federally Administered Tribal Areas (FATA) of Pakistan showed an overall seroprevalence of 18.20% during 2008-2009⁹. Also, NWFP ruminant flocks in Mardan, Hangu, and Kohat provinces tested positive for PPR antibodies. Indeed, 50 out of 160 serum samples from flocks in different parts of these regions tested positive for PPR antibodies with the competitive ELISA and AGID tests during 2008-2009¹⁰.

A survey conducted during 2003-2005 indicated that PPR is common in Pakistan, and another study carried out during 2004-2006 in Pakistan showed that PPR is endemic throughout the country. This study assessed 50 laboratory confirmed outbreaks of PPR in Pakistan and determined a 40.98% prevalence of PPR in Pakistan. The study also pointed out higher prevalence in the eastern, southern, and northern parts of the country than in

the west and south-western parts, and higher prevalence from January 2006 to April 2006^{7, 11}.

Iran

In 1994 PPRV was detected in an imported flock of sheep with clinical signs resembling RP¹². In 1995, for the first time, PPR was reported in the Llam province of Iran. Also, 39 affected flocks from eight other provinces were detected in the same year. Ultimately, PPR has been seen between 1995 and 2004 throughout Iran. During this time, 1,433 affected flocks were reported and caused more than \$ 1.5 million loss¹. In Urmia, 130 sheep from 5 flocks were also seropositive for PPR antibodies, although the animals didn't show clinical signs of PPR¹³. In Tehran, a flock of sheep tested positive for PPR. In this outbreak, mortality was higher in adult sheep at the beginning but shifted to lambs (2 weeks to 4 months of age) later in the disease outbreak. In 2005, PPR was seen in 16 provinces where 93 herds tested PPR positive¹⁴.

Despite vaccination, PPR spread to all parts of the country. The high susceptibility of Iranian sheep and goat breeds, ineffective quarantine, absence of passive and active surveillance, and varying import practices for sheep and goats were implicated as the main causes of rapid disease spread¹.

China

PPR has been detected in sheep and goats of the Ngari region of Tibet, with the first case being reported in Rejiao village during 2005-2006. Because of the similarities of this disease to Rinderpest and other diseases, it remained undetected for several years.

The PPRV present in Tibet belongs to lineage 4¹⁵. Dr.Zhang Zhongqui Deputy Director General, Animal Disease Control Center, on 14/07/2009 in Tibet reported the outbreak of PPR to the OIE. The outbreak started on 18/06/2008 and resolved on 11/12/2008¹⁶. In 2010, Dr. Zhongqui reported another outbreak of PPR in Tibet, which started on 14/05/10 and continues. In this outbreak of 133 cases, 69 deaths have been reported, and 1094 sheep and goats have been destroyed to date ¹⁷.

India

In 1987, PPR was reported in the Villapurum district in India for the first time, and after destruction of a huge number of small ruminants in 1993, it was reported again in different regions of India ¹⁸. In 1993, PPR outbreaks were seen in goat flocks in the West part of Maharashtra state, and in 1994, outbreaks of PPR were seen in the West part of Andhra Pradesh. Seventeen outbreaks in March 1994 and seven other outbreaks in April and July of the same year occurred in Andhra Pradesh. This epidemic caused 147 outbreaks with huge losses of livestock animals. In 1997 and 1998, epidemics of PPR occurred in Andhra Pradesh, but adequate diagnostic techniques identified the disease promptly, reducing the spread of the virus and number of casualties¹⁹.

Currently, sixteen states out of twenty eight in India are classified seroprevalent for PPR²⁰. Karnataka sustained many outbreaks of PPR, 624 from 1998 to 2007²¹. Additionally, Raghavendra et al, (2008) detected PPR antibodies in sheep and goat flocks in the Southern Peninsular of India. PPR is currently endemic in India²².

Turkey

Some evidence shows PPR in Turkey before 1999; lineage 4 strain was identified in a 1993 outbreak²³. However, the virus was officially declared endemic in 1999²⁴. A study by Azkuu, Aykut et al. (2002) in 18 different sites in Turkey showed that just two out of eighteen farms had no antibodies against PPRV, and overall prevalence for PPR was 29.2% and 20% in sheep and goats, respectively. Unfortunately, Turkey is surrounded by countries where PPR is endemic, and there is insufficient control on livestock import and export, especially in southeastern and eastern Anatolia. Many diseases, including PPR, have been introduced by imported animals. Overall, the disease is not constrained by geographical location but is present over all regions studied²⁴. Another study was launched by Al-Majale et al (2008) in five governorates where 41% of the population of goats and sheep exists; this study showed that true individual prevalence of PPR is 29% in sheep and 49% in goats; however, the prevalence of PPR in flocks was 60% in sheep and 74% in goats. This study blames poor veterinary services, live animal markets, and mixed raising of goats and sheep as risk factors for PPR. However, epidemiology of PPR is not completely understood in Turkey²⁵.

Africa

PPR was first identified in 1942 in Africa and again from 1942 to 1979; the disease has also been seen in western Africa in countries like Benin, Ghana, Nigeria, Togo, and Senegal. In eastern Africa, the disease was documented in 1980-1982. Afterward, the disease spread across the African continent²⁶. Javier et al (2008) reported:

“In Africa, PPR endemic zones include the countries located between the Sahara and the Equator, from the Atlantic Ocean to the Red sea. However, until recently neither southern Africa nor the eastern part of north Africa had been infected with this disease.”²⁷

In 1999, a national survey was conducted in Africa using 13,651 samples collected from seven regions of Ethiopia, and results showed that PPRV infection was present throughout Ethiopia with variable seroprevalence in different regions. In some weredas (administrative units), PPR’s seroprevalence was higher than 50%, but overall seroprevalence of PPR in Ethiopia was comparatively lower than in other countries in the survey. This survey also showed that lowland regions suffered more than highland regions. This survey determined species, age, and gender as important factors for seropositivity. Female goats and sheep and animals older than 3 years were more likely to be seropositive²⁸.

In 1971, a PPR outbreak occurred in South Gedarif, Sudan. Two caprine outbreaks occurred from 1971 to 1972 in Central Sudan, and in 1972 in Mieliq, outbreaks in sheep and goats from central Sudan and Khartoum and outbreaks in different parts of Sudan were reported. A study that was conducted in 2008 in Sudan showed that PPR is spread widely all over Sudan, and overall seroprevalence is 62.8%²⁹.

PPR is believed to have been identified in the rural village of Ain Chkef, Moula Yacoub of Morocco in 2008. This outbreak was confirmed by laboratory tests and reported to the OIE in the same year. The disease spread quickly, and on 4th August 2008, 92 outbreaks of PPR were detected²⁷.

In summary, PPR has been persistently identified in most of the African and Asian countries. PPR is circulating in the west, east, south, and central parts of the

African continent for decades but never reported from north part of the continent except to Egypt^{8, 27, 30} (new, 26,8). Near East, Middle East, Arabian peninsula, Southern Asia including India, Nepal, Bangladesh, Pakistan, Iran, and Afghanistan are also endemic for PPR^{9, 14}(14, 9). From the four lineages of PPRV, lineage 1, and 2 are reported from west Africa, lineage 3 is reported from east Africa, Arabia, southern India, and lineage 4 from Asian countries³⁰(new, pronab dahar).

Figure 2.1: World status of PPR in 2009 ³¹.

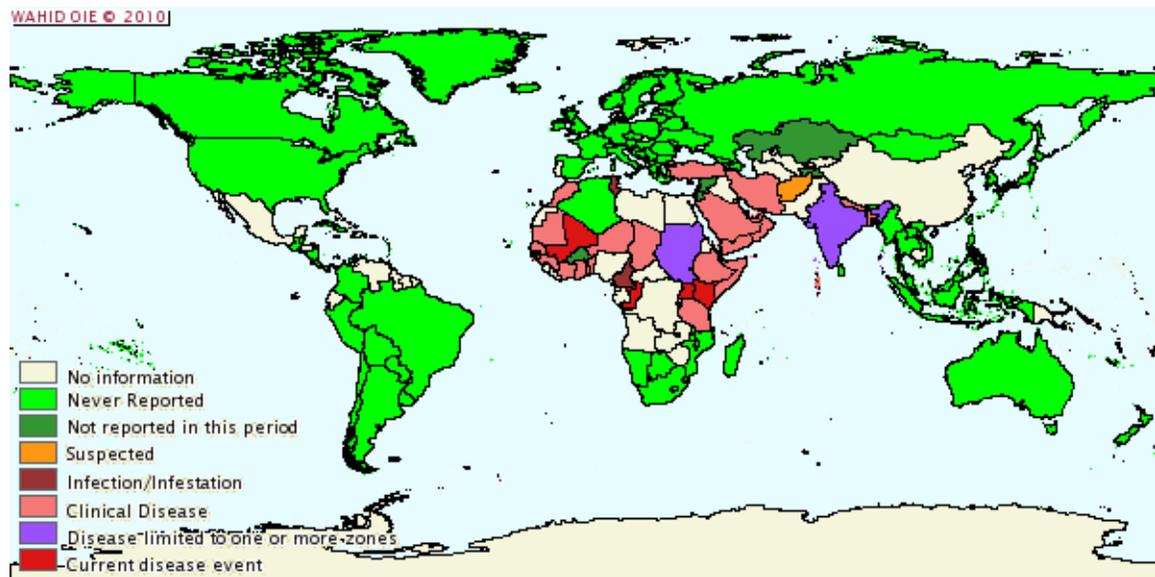
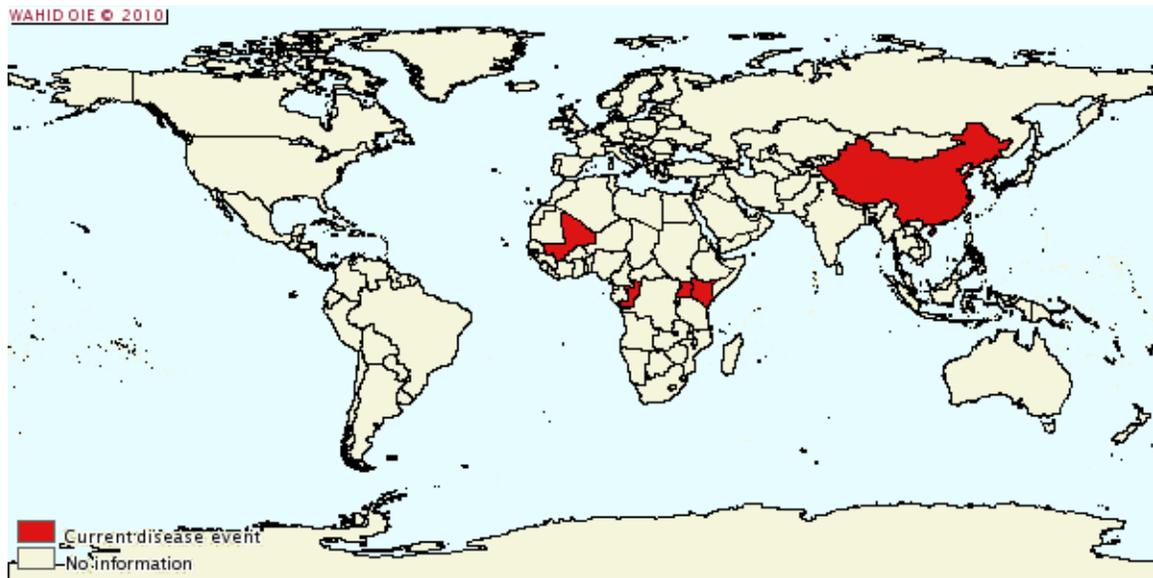


Figure 2.2: World status of PPR in 2010 ³².



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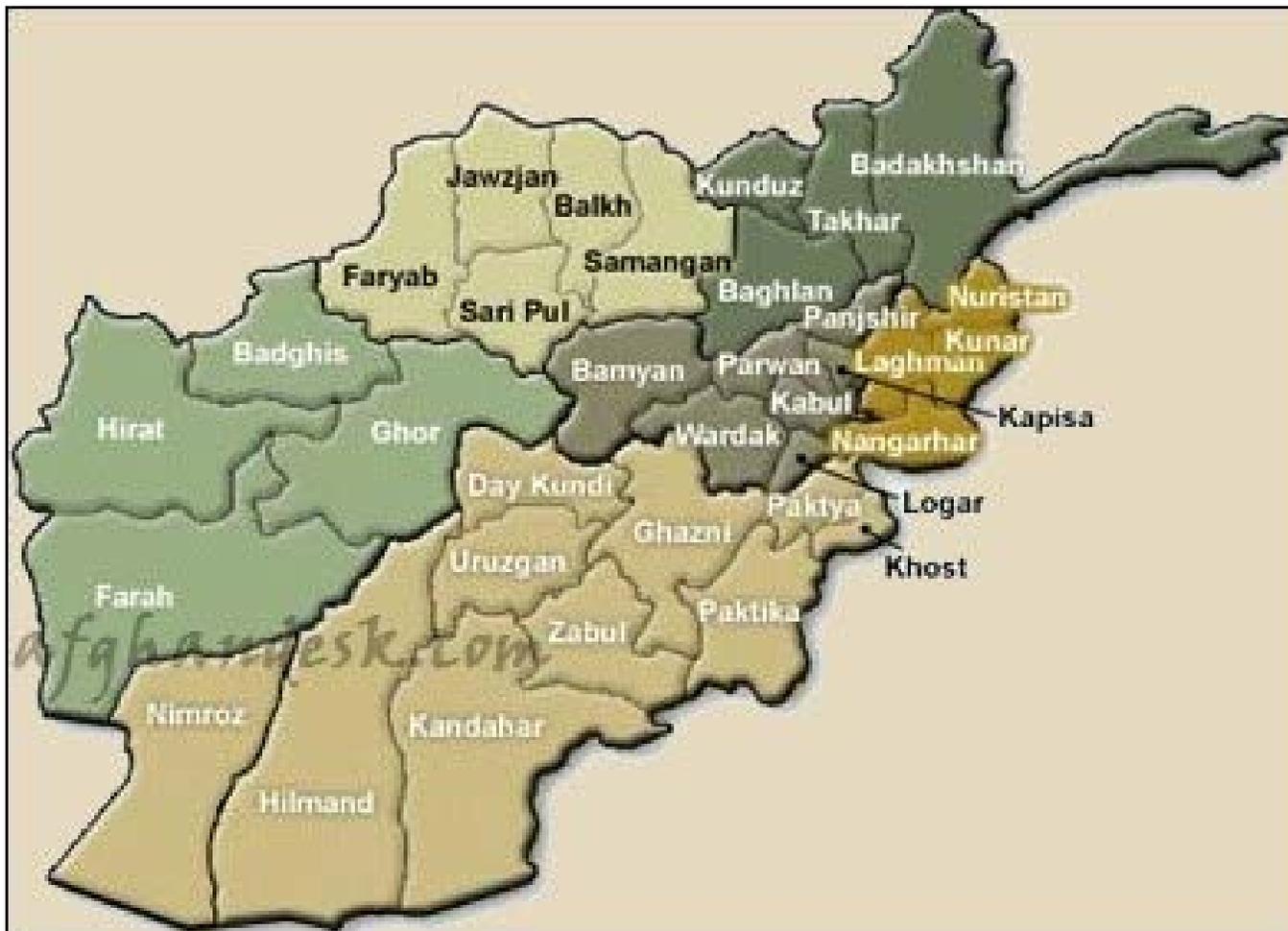
CHAPTER 3 - PPR Status in Afghanistan

General information about Afghanistan

Afghanistan is landlocked and surrounded by Pakistan on the south, Iran on the west, Tajikistan, Uzbekistan, and Turkmenistan on the north, and China on the northeast. Economically Afghanistan is dependent on livestock and agriculture. Historically, a series of wars have affected all economic infrastructures including agriculture and animal husbandry. In 1839 England invaded Afghanistan for the first time. In 1878 and 1919, England invaded Afghanistan for the second and third times. In August of 1919, Afghanistan declared its freedom from England. The Soviet Union invaded Afghanistan in 1980 and in 1989 withdrew its last troops. Then in 1992, Afghan warlords started a civil war that lasted until 1996. In the same year, the Taliban emerged and gained control of most of the country. In 2001, the Taliban government collapsed, and a United States-led International Security Assistance Force (ISAF) entered Afghanistan¹. As a result of these wars, 42% of Afghanistan's 28 million people were living below the poverty level (the minimal level of income considered for standard living in a given country) until 2007. Today 36% of Afghans are still living below the poverty line^{2,3}.

Afghanistan has 34 provinces (figure 3.1) and every province is further divided into districts. Kabul City is the capital of the country, and Kabul province has the highest population of all provinces. Afghanistan's geographical area covers 652,230 square kilometers, and twenty five thousand square kilometers of it is involved in agriculture⁴. Most of the country is covered by mountains and deserts, but much of it can be used for grazing sheep, goats, and cattle.

Figure 3.1: Afghanistan⁵.



PPR in Afghanistan

Afghanistan is an agricultural country where 90% of the population is engaged in agriculture and animal husbandry of 16 million sheep and goats and 3,7 million cattle ⁶. Most sheep and goats are owned by Kuchi (nomadic tribes) people, who also own camels, cattle, and sometimes other species like donkeys and dogs. Their main income is from sheep and goats. Kuchies travel seasonally from place to place with their animals and accordingly may spread and transmit many disease agents. Many people and animals are in danger of exposure to zoonotic and infectious diseases as a result of: uncontrolled movement of animals, absence of disease control strategies, absence of effective vaccines, inappropriate use of vaccines and commingling of sheep and goats with cattle, camels, and donkeys.

PPR is one of many infectious diseases in Afghanistan. The disease, unrecognized until 1995, is endemic in different parts of Afghanistan and causes substantial economic loss to the animal owners. In 1995 for the first time, PPR was suspected in serum samples of cattle collected for detection of rinderpest (RP) in Khost province. Later on in the same year, PPR virus was detected in serum samples of ill sheep and goats in the Kohack district of Arghandab, Kandahar. Samples were sent to the World Reference Laboratory for Rinderpest (WRLR) in England and the National Agriculture Research Council (NARC) in Pakistan to test for PPRV. From 1995 to 1999, Four hundred and seventy two positive samples from the east, south, southwest, and west of the country indicated 37.54% positive animals tested in these regions, which signalled spread of PPR in the country. In 1998, the acute form of PPR with 40-80% mortality was

reported from the following districts: Shindand of Farah, Zaranj of Nimruz; Ghoryan, Kushk, Robat Sangi of Hirat, and Chaparhar, Pachir, and Agam of Nangarhar ⁷.

Vaccination is the best option for preventing the disease in Afghanistan presently. Despite vaccination, PPR is currently present in all provinces from 2008-2009, seven thousand seven hundred and forty one cases of PPR were seen in fifteen specific provinces of Afghanistan (table 3.1)⁸.

Table 3.1: Number of PPR cases in different provinces of Afghanistan (2008-2009)⁸.

provinces	cases
Baghlan	35
Badghis	14
Balkh	2292
Bamyan	160
Farah	222
Faryab	253
Ghor	50
Hirat	702
Jawzjan	382
Kapisa	322
Kunduz	50
Panjshir	46
Parwan	126
Samangan	30
Saripul	3057

In 2009, Food and Agriculture Organization (FAO) conducted a study to determine the PPR status in Afghanistan. This study was done by Dr. Nawroz, an employee of FAO. The competitive ELISA was used to detect seropositive animals in 60 villages from 17 provinces. Animals were grouped into three age groups: 0-1 year, 1-2 years, and >2 years. Ten samples from each group were collected totaling 30 random

samples from sheep and 30 random samples from goats from each village. The study populations had no vaccination within the previous three years were never vaccinated.

The outcome of this study is summarized in (table 3.2)⁸.

Table 3.2: Number of seropositive sheep and goats in 17 provinces addressed in this study⁸.

Age (year)	seropositive goats			seropositive sheep			seropositive animals	Total animals tested	%seropositive
	0-1	1-2	>2	0-1	1-2	>2			
Provinces									
Badakhshan	4	8	9	2	3	3	29	299	9.6%
Badghis	21	12	14	18	15	15	95	360	26%
Baghlan	3	6	10	5	11	5	40	239	17%
Balkh	6	7	2	6	12	12	45	246	18%
Bamiyan	2	5	0	6	7	2	22	119	18%
Faryab	11	5	18	12	8	12	66	359	18%
Herat	48	67	41	55	44	60	315	659	48%
Jowzjan	2	0	1	1	1	1	6	59	10%
Kunduz	0	1	0	2	3	12	18	119	15%
Kabul	0	0	3	0	0	0	3	59	5%
Kapisa	0	0	0	0	0	0	0	30	0%
Nangarhar	0	2	5	1	0	0	8	179	4%
Panjshir	0	0	0	0	1	0	1	59	2%
Parwan	3	4	7	2	0	0	16	119	13%
Samangan	10	6	11	8	9	14	58	179	32%
Sar e Pol	0	2	5	1	3	14	25	119	21%
Takhar	3	10	15	8	5	2	43	845	5%

This table indicates that Herat province which borders Iran and Turkmenistan, has the highest numbers of seropositive sheep and goats (659 seropositive cases or 48% of seropositive sheep and goats) and is at the top of the list. Samangan with 32% seropositive sheep and goats is second, and Badghis, which borders Turkmenistan, with 26% of seropositive sheep and goats has the third highest prevalence rate. Kapisa is apparently free of PPR with 0% seropositive sheep and goats, but the neighboring provinces Panjsher and Kabul with 2%, and 5% respectively, do have a low number of seropositive animals. There is no significant difference of seropositivity species-wise; moreover, very few differences age-wise are noted (sheep and goats age >2 year have a higher percentage of seropositivity than sheep and goats age 0-1 year). This study covers mostly Northern provinces and so provinces that border Iran and Pakistan are not included. It is not possible to draw overall conclusion about seroprevalence of PPR in Afghanistan based on this study; therefore, country-wide surveillance of all infectious and contagious diseases, especially PPR requires additional study (2010).

Challenges to containment of PPR in Afghanistan

❖ *Lack of knowledge and poor animal husbandry practices.*

More than 90% of Afghans are tied to agriculture and animal husbandry, which means that risk to agriculture or animals, risk to peoples' lives. Afghans, who are involved in agriculture and livestock, derive their mean income from agricultural and animal products. Therefore, any additional risk increases poverty in Afghan society. PPR and other infectious diseases are great threats to livestock and economy. However, mitigating the spread and managing outbreaks of PPR and other infectious diseases in endemic countries like Afghanistan is complex. Animal owner education in the transmission of PPR and other infectious diseases can lead to keeping their animal herds safe. Currently, lack of knowledge is a major problem in Afghan agricultural society.

The majority of Afghans are non-nomadic. Specifically, they have a piece of land for planting crops, and they raise a few animals for their daily requirements. Sheep, goats, cattle, horses and poultry are the principle species that are raised, used, and sold. Besides these species, dogs are kept for protection and donkeys for transportation and farm work. Problem with this kind of husbandry is the commingling of various species. Farmers keep all animals together and feed and water them from the same source, which could be a route and source of disease transmission. Cattle are a reservoir species for PPR (infected with PPR but rarely show clinical signs). Therefore, commingling of cattle with small ruminants increases the chance of spreading PPR to small ruminants.

Afghanistan is also home to a group of nomadic people, the Kuchies, who travel from region to region seasonally. The Kuchies rarely mix cattle with small ruminants, which decrease the chance of PPR transmission from large to small ruminants. Constant

animal movement increases transmission and spread of PPR and other disease agents from one place to another. Since the Kuchies travel between Afghanistan and Pakistan and to many nearby provinces, they may introduce disease agents from one place to another. Additionally, Kuchies rarely separate sick and infected animals from the rest of the herd; therefore, the diseased animal may serve as a disease source for the rest of the herd and other animals they contact in their migratory movement. This movement could easily cause a disease outbreak and huge economic loss to many animal owners.

❖ ***Lack of governmental control over animal husbandry and trade***

To control zoonotic and infectious disease and improve animal products, the government must regulate agriculture production, specifically animal husbandry and trade. However, there is no governmental control of animals and animal products in Afghanistan. In fact, the government has no history of pro-active measures to avoid catastrophic loss or manage PPR or other infectious disease outbreaks to date. Instead, farmers who experience mass illness of their herds obtain vaccines or antibiotics from animal drug store and administer their animals. They slaughter severely ill animals, and wish for God to help them. When a disease outbreak is detected and reported, the government responds typically by announcing the outbreak and giving advice to the people via television. Since most of Afghans do not have access to television or the internet, such guidelines do not mitigate spread of the disease agent or decrease the risk of disease.

Unregulated animal trade with neighboring countries, such as Iran and Pakistan, and within Afghanistan is another big threat to Afghan animal husbandry. Afghan farmers buy and sell animals without knowing their previous vaccination and disease

history, and they mix the newly purchased animals with existing animals. If the newly purchased animal is diseased or is in the carrier stage and still shedding a disease agent, it could start an outbreak of infectious disease in the herd and beyond.

Animal products can carry PPR and other disease agents from place to place as well, but there is no control to ensure the products are safe for humans and other animals. This situation poses a serious threat to human health and to animals fed such products. Meat is the other main product of sheep, goats, cattle, and water buffalo that could play a role in transmitting PPR and other disease agents partly because there is no governmental control over slaughtering animals and determining the safety of meat. Butchers slaughter animals in open areas which contaminate environment. Contaminated environment and contaminated objects, people who handle meat, and nearby live animals could transmit PPR and other disease agents to healthy animals.

Jalabs, buy cattle, sheep, and goats in various parts of the country and sell them back in the same or other parts of the country. This type of animal movement could transmit PPR and other disease agents from one place to another. The Jalab and the person who buys the animal from the Jalab rarely know the health status or background of a newly purchased animal.

Since there is no sufficient border control, people import animals from Pakistan and other neighboring countries to an open trade area. People buy animals in these open markets and bring them back to their hometown or village, potentially introducing any diseases to their village and spreading disease to different parts of the country.

❖ *Lack of proper diagnostic facilities and accurate diagnosis*

Lack of slaughterhouses and control over animal slaughter is another factor in the spread of disease agents to animals. There are only two or three modern slaughterhouses in Kabul, Afghanistan (a slaughterhouse includes receiving/holding area, restraining/feeding area, slaughtering unit, refrigeration section, processing and predelivery section, and accommodation for personnel. Having a well-trained professional staff and adequate modern equipment is necessary for a slaughterhouse). Currently, producers and individuals slaughter their own animals wherever they want. Typically, local butchers slaughter animals in ruined structures and place the carcasses next to their shops, which could be next to a home, farms, or even inside the farms next to live animals. Blood and byproducts (intestine, intestinal contents, hooves) are left on the ground uncovered. Slaughtering diseased animals this way offers a prime opportunity for disease agents to spread via air and contaminated objects. Butchers prefer to buy cheaper animals to slaughter, which are likely to be sick animals. Sometimes, sick animals unable to eat and stand are slaughtered by owners, and the owners sell the meat to the butcher who sells it to the public. In the case of an outbreak of PPR or other infectious disease, owners often sell their sick animals, which may spread disease agents in any given region.

Lack of proper diagnostic facilities and methods is a major animal health challenge. Clinical signs are the only diagnostic method in many animal clinics in the country, despite modern testing methods. Polymerase Chain Reaction (PCR), Enzyme-linked Immunosorbent Assay (ELISA), Agar Gel Immune Diffusion (AGID), electron microscopy (EM), and immunohistochemistry (IHC) are advanced testing methods that may be used by some organizations like the Food and Agriculture Organization (FAO),

and the Central Veterinary Lab in Kabul. The European Union supported the Afghan government and Afghan society by rebuilding of central veterinary laboratory and other veterinary infrastructures in different parts of the country. The United State Department of Agriculture (USDA) reconstructed veterinary offices and provincial labs with the help of Provincial Reconstruction Teams (PRT). A fully equipped diagnostic lab was reconstructed by the Japan International Cooperation Agency (JICA) in Bamyan province. Unfortunately, due to lack of professional staff and electricity this lab cannot be used as intended. Japan and Italy equipped some labs in the Faculty of Veterinary Science, Kabul University⁹. However, most of the clinics in Afghanistan including of Kabul University's College of Veterinary Medicine teaching hospital do not use modern testing methods to diagnose disease. Therefore, a disease may be misdiagnosed in which case the attending veterinarian can't appropriately advise the owner regarding herd management. If the animal has PPR or other infectious diseases, it can shed the virus or bacteria in preclinical, clinical, and post-clinical stages. When the disease agent is not identified:

- The veterinarian may not be able to advise animal owners on treatment and control.
- The owner does not know what vaccine to use for the rest of the animals if vaccination is necessary.
- The owner doesn't know that other animals may become infected and does not recognize the importance of separating healthy animals from diseased animals.

- The owner doesn't know how long the incubation period of a disease agent is and is not taught how long to quarantine suspected animals.
- Many diseases, including PPR, can quickly escalate to epidemic status.

Lack of disinfection of contaminated objects and animal environments allows disease agents to remain and infect healthy animals. This is partly because farmers and animal owners use the same equipments to handle several species of animals for several years (feeding, watering, and equipment for cleaning waste and disposal). This equipment is likely to be used on both well and diseased animals. Even though PPRV can't survive in the environment for a long time, contaminated objects can transmit PPRV for a short period. Most animal owners do not understand disease transmission, so they are not aware of the risks of contaminated objects and surfaces, nor do they have any idea how to disinfect contaminated instruments and surfaces. Veterinarians rarely guide animal owners on how to dispose of used-disposable equipment or disinfect contaminated instruments (feeding and watering equipments injection needles that may have been used several times by owners, and equipment used for cleaning waste and disposal), putting healthy animals at risk.

Proper and timely vaccination against PPR and other diseases will avoid or reduce the spread of infectious disease; yet most animal owners hardly ever vaccinate their animals at the proper time of the year with adequate follow-up. Some will vaccinate their animals at the time of disease outbreak, which is not beneficial. Vaccination protocols are also questionable. Veterinarians and Paraveterinarians are helpful regarding vaccine administration but most of the animal owners prefer to vaccinate their animals themselves. The Kuchies purchase vaccines from animal clinics or drug stores and carry

them without using an ice bag and proper containers to keep the vaccine effective. They then administer the vaccine themselves, perhaps without knowing the proper dose and route of administration. This practice is not effective for producing immunity. Furthermore, careless use and handling of the vaccine itself could cause disease outbreak.

To summarize, PPR is one of the many contagious and infectious devastating diseases that are endemic in Afghanistan and cause great loss to the animal owners. Seroprevalence of PPR differs from 0 to 48% in different parts of the country⁸. Lack of knowledge, poor animal husbandry, lack of governmental control on borders and animal trade, lack of proper diagnostic facilities and methods, lack of proper and timely vaccination are the biggest challenges in Afghan society that create problems for the management and control of PPR and other infectious diseases.

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CHAPTER 4 - Recommendations regarding PPR prevention and eradication from Afghanistan

Introduction

PPR control and prevention in the short term and its eradication in the long term will help Afghan farmers and animal owners minimize animal morbidity and mortality and improve their economy. Veterinary Field Units (VFUs) which were established by United State Agency for International Development (USAID) and Dutch Committee for Afghanistan (DCA) are helpful in the prevention, management, control and eradication of PPR and other infectious diseases in the country¹. Ideally, every VFU is staffed by one or two veterinarians or paraveterinarians and VFUs provide a community based network of animal health clinics in the country. As of 2006 there are 403 Veterinary Field Units (VFU) in 278 districts of 31 provinces of Afghanistan^{2, 3}.

The first step in diseases eradication is to identify the incidence and prevalence of PPR in different parts of the country through country-wide surveillance. In the six month timeline of this plan which is detailed in the following pages, surveillance and educating animal owners should be completed. Highly susceptible populations of sheep and goats and regions of high and least risk should be identified. Educating farmers, Kuchies, and livestock owners should begin with awareness of the risks of zoonotic, infectious, and contagious diseases to their health, their animals, and their family, and to the economy of the Afghanistan.

After completing the project of surveillance and education of animal owners, eradication of PPR should begin. All requirements including fencing, equipment for quarantine, incineration or burying equipment, strict border control, feed and water for

quarantined animals, compensation to animal owners whose herd is destroyed or slaughtered) should be in place. Eradication should start in provinces with low incidence of PPR.

Once PPR is eradicated and no case has been seen for at least three years after eradication, the eradication program can be removed or used for eradicating other infectious diseases. Veterinary Field Units (VFUs), veterinarians, and paraveterinarians should be required to report any suspected or diagnosed case of PPR to the Veterinary Department in the ministry of Agriculture or every agency responsible for animal diseases and emergency response.

Short term recommendations

Prevention, Education, and Surveillance

Vaccination

PPR is an infectious viral disease and spreads quickly. Efforts should focus on prevention of the disease rather than treatment of sick animals given that there is no specific therapy and overall prevention could be cost effective. Prevention should always be the first action. Vaccination is the best choice for preventing disease outbreaks prior to eradication.

PPR vaccination is being used in Afghanistan by VFUs and veterinarians who are working in the field, but this vaccination is at the request of animal owners. In order to avoid disease outbreak, the vaccination of susceptible animals should be compulsory. Badam Bagh vaccine-production laboratory which is located in Kabul, producing antrax, black leg, and hemorrhagic septicemia vaccines. Veterinary Department of Ministry of

Agriculture is trying to restore the capacity of this lab to produce additional vaccines³.

PPR vaccine production should be a high priority for this lab.

- ✓ The following section addresses many vaccines available to prevent PPR⁴.

The sheep pox and PPR combined vaccine is a viro cell-based vaccine that is effective. This vaccine is derived from the Romanian Fanar (RF) strain of sheep pox and the Sungri/96 strain of PPRV. A single vaccination against both diseases could reduce the cost of vaccination, which helps poor animal owners and reduces the stress of vaccination on the animal.⁵

- ✓ The goat pox and PPR combined vaccine is another efficacious vaccine. This live, attenuated, combined vaccine carries F and H genes of peste des petits ruminants virus and has good thermostability⁶.

- ✓ Previously, the rinderpest tissue culture vaccine had been used against PPR until recently. This vaccine causes seroconversion. Given sero-surveillance and global eradication of RP, this vaccine is no longer allowed for prevention of PPR.

- ✓ Fortunately, a PPR homologous attenuated vaccine is now available for prevention of PPR. The Nigeria75/1 strain of PPR virus, developed in 1989, is attenuated by 74 serial passages in a monolayer verocell culture. Its effectiveness was tested on more than 98,000 sheep and goats during 1989-1996, and it showed no adverse effects. Furthermore, vaccinated animals did not transmit the virus to other animals, and they remained protected for at least three years. Ultimately, the PPR homologous attenuated vaccine is the only one permitted for use in sheep and goats⁷⁻⁹.

Most of the vaccines are imported to Afghanistan from foreign countries. The Dutch Committee for Afghanistan (DCA) has been the only organization that is allowed to import vaccines. As of 2006, DCA imported 4.5 million doses of PPR vaccine to Afghanistan².

Having vaccine production capability in Afghanistan could play a significant role in the country's economics and disease control. This is because autogenous vaccine is very important for the control of some contagious and infectious diseases. If Afghanistan had vaccine-producing capability, they could produce autogenous vaccine as well as vaccine based on the serotype of organisms that are present in Afghanistan. Therefore, the government should establish vaccine producing companies and encouraging foreign vaccine production companies to establish a branch or branches in Afghanistan.

Educating livestock owners

PPR and other infectious diseases can spread many ways. Consequently, educated people who are aware of the mode of disease transmission could avoid such spreading. Most Afghan farmers and animal owners are illiterate and are not aware of zoonotic and infectious diseases. Hence, their animals and they themselves are in danger of getting and spreading such diseases. While many ways exist to educate and inform the general public, some of them will be more effective and useful in some situations than others.

Guiding people via television and radio is helpful, but the majority of Afghans don't have access to TV, and some even lack access to radio. Therefore, using public media is not the most effective educational tool. Publishing and distributing guidelines in leaflets is also a helpful way of informing people, but many Afghans are illiterate,

rendering this method ineffective. Ultimately, the best way to educate illiterate people is to talk with them directly and show them how to practice healthy animal husbandry.

Kuchi Service Centers is a pilot project that the Ministry of Agriculture, Irrigation, and Livestock wants to implement. This project, with multiple stations or centers would be established in different parts of the country to educate the Kuchi and good livestock practice. Kuchi Community Councils would be established to identify needs and solutions to problems and would be responsible for operating and maintaining the Kuchi Service Centers. For this project, one Kuchi paravet for each Kuchi concentration area and one Kuchi Basic Veterinary Worker (BVW) for each migration unit (the designated number of Kuchi families that travel together and share summer and winter areas) would be trained. In this way, the Kuchi would be informed of the importance of preventive animal health care as well.¹⁰ However, the Kuchi Service Centers project does not include livestock owners education but it could help the project of educating livestock owners that is designed in this research. This project of educating livestock owners should be applied in all provinces.

Following are the five important overview points to successfully educate livestock owners.

- Ministry of Agriculture should lead the program:

The program should be conducted through Ministry of Agriculture. The president of veterinary service department of veterinary service should direct the project and should be responsible for all requirements. Ministry of Agriculture should apply for funds to support the project. USAID, FAO and other organization which are working in Afghanistan and have a background of helping Afghan society

should help Ministry of Agriculture to conduct the project. This project should be conducted through VFUs which covers about 300 districts in more than 31 provinces. Veterinarians and paraveterinarians whom are working in VFUs are already equipped with motorbike provided by USAID^{3, 11}. The Ministry of Agriculture should pay them extra salary and provide them with gasoline for their motorbikes and other necessary equipments for the education purpose.

➤ The project should be based on a feasible plan:

Prior to initiating the project all necessary equipment should be provided. VFUs should be ready and agree to conduct the project. Veterinarians and paraveterinarians should be given a one or two day seminar to learn how to educate animal owners. There should be one main office in Kabul for managing this project and one provincial office in every province. The project should be conducted in five provinces at a time for one month and then move to next five provinces. In this case, the project could cover all thirty-four provinces in seven months. VFUs should set up three meetings in three weeks with animal owners or every Afghan interested to learn. In the final week or at the end of the month, veterinarians or paraveterinarians should test the participants and report the procedure and result of the project to the provincial office.

➤ Having sufficient staff to conduct survey in all provinces:

In provinces with no VFUs or few VFUs, Veterinarians and paraveterinarians who are working and have clinics in the area should be hired. Veterinary student and basic veterinary workers (BVW) are the second choice to be hired in case of lack of enough veterinarians in the region. These new hired people which are not

part of VFUs should be given one day seminar to learn how to coordinate with each other and with provincial office. Since these veterinarians do not have exact coverage area like VFUs, provincial office should divide province by multiple regions and hire every two veterinarians for one region.

➤ Arrange useful equipment, instruments and facilities:

The Ministry of Agriculture should provide gasoline for the motorbikes of the veterinarians who work for VFUs but additional staff hired to implement this project should be provided with a vehicle or motorcycles. These motorcycles or vehicles should be rented or purchased by the Ministry of Agriculture and should be given back to the Ministry of Agriculture when service ends. Since there are 3 provinces without VFUs and some other provinces with insufficient number of VFUs; so that, there will be no need for more than 20 motorbikes or 5 vehicles. Teaching materials such as pen, markers, papers, computers, powerpoint projectors and screens, and generators for areas without electricity should be provided to each VFU by the Ministry of Agriculture. At the end of the project, computers, projectors, and unused materials should be given back to the Ministry of Agriculture. Curriculum and teaching topic should be provided by professional people. Colleges of Veterinary Medicine of Kabul and Nangarhar Universities could play a significant role regarding this issue.

➤ Gather farmers, animal owners, and tribal elders:

Gathering livestock owners and farmers is not easy. VFUs should specify a place for meeting and send invitation letters to all mosques in their covering areas to

invite all livestock owners, farmers, tribal elders, and Imam of the mosques to the meeting.

The first meeting should point out the risk of infectious, contagious, and zoonotic diseases with visual examples. A snack should be provided for the invited people. These are the significant ways to attract invited people to come to the second and subsequent meetings. Date and place for the next meeting should be announced at the end of any meeting.

The second meeting should cover practical, healthy ways of dealing with animals and animal products. The teaching staff should show all the possible ways of disease transmission from animal to animal, animals to human, human to animals, via flies, ticks, and nonliving objects. The educators have to have videos, pictures, diagrams, and other effective teaching materials. Veterinary colleges should provide these materials for the project.

The second meeting should include all the possible ways of preventing the transmission of these diseases from animal to animal and animal to human or vice versa. The following are important points to be taught:

1. Use of separate clothes whenever they are working with animals.
2. Keeping children away from animals.
3. Keeping their food far from access by animals.
4. Having each species of animals separated.
5. Having separate equipment for each species of animal.
6. Separating sick animals from healthy animals.
7. Vaccinating their animals at the right time of the year.

8. Burying dead animals and not feeding them to the dogs or leaving them in the environment.
9. Prohibiting butchers from slaughtering sick animals in their village or on farms.

The third meeting should conclude all what they have taught in the last two meetings. At the end of the meeting the teachers should test participants by asking questions and acquiring their opinion. Interest and participation of the invited people and effect of the meetings should be reported to the provincial office. Provincial offices should review the reports and make even better plan for other provinces. Guidelines and posters that help people deal with animals daily should be circulated. VFUs should provide them with a contact phone number for help in emergency.

Surveillance

Food and Agriculture Organization of the United Nation (FAO) conducted a PPR survey in seventeen provinces in 2009¹². FAO probably conduct PPR survey in the remaining provinces in coming year as well³. Surveying different parts of the country in several years will not detect exact incidence and prevalence of PPR but it is good opportunity for the Ministry of Agriculture to coordinate with FAO and conduct country-wide surveillance. This project of country-wide surveillance of PPR should be conducted simultaneously with project of education which is described in the previous pages. Following are important steps to be taken conducting the project of country-wide surveillance of PPR.

➤ Having professional staff:

The structure of the education project which is described in previous pages is applicable here as well. One main office which will be staffed with one or two epidemiologist and a statistician and other necessary personnel should be in Kabul. One office which will be staffed with a provincial manager and other necessary personnel in each province or every five provinces is needed for the control and management of the project. The project should be conducted through VFUs. Veterinarians and paraveterinarians should be hired for this purpose in the provinces with insufficient or no VFUs. Ministry of Agriculture should be responsible for the salary and expenses of the employees. The project should be conducted in five provinces and should be completed in one month and then moved to the next five provinces. In this case, all the country can be covered in seven months.

➤ Have proper and sufficient equipment necessary for the survey:

The Ministry of Agriculture should provide the necessary equipment to each five provinces prior to conducting the survey. The Afghan reference laboratory is a well equipped laboratory which was established in 1996 in Islamabad and then moved to Kabul in 2002. It is supported by FAO and the International Atomic Energy Agency, Vienna. This lab has been using for the confirmation and investigation of the PPR outbreaks in Afghanistan¹¹. This lab could be used for this project as well. Provincial Reconstruction Team (PRT) attached to International Security Assistance Force (ISAF) and United State Department of Agriculture (USDA) has reconstructed provincial labs in Parwan and Kapisa

provinces. Japan reconstructed a provincial lab in Bamyan³. The Afghanistan Veterinary Association (AVA) and the Aga Khan Foundation (AKF) has some labs in some provinces that could be used in the survey. The Ministry of Agriculture should require use of the labs for the survey. Every province or every five provinces should have a well equipped lab with sufficient ability to run ELISA test and keep the samples refrigerated. Provinces with no electricity should be provided with a generator or solar energy to provide needed electricity for the lab.

All the necessary equipment such as needles, tubes, swab should be provided by Ministry of Agriculture. VFU staff is already having a motorbikes and refrigerators that they could use it in this project but the Ministry of Agriculture should provide gasoline for their motorbikes. Veterinarians, paraveterinarians and veterinary students who conduct the survey in the provinces should be provided with a motorbike and other necessary equipment for sample collection, storage, and transfer. Every provincial office should be provided with computers for data analysis and other office work. All necessary materials like paper, and forms, should be provided to every office.

➤ Install an effective surveillance procedure:

Veterinarians or paraveterinarian should consult the map of their covering area every day. Field veterinarians should talk with farmers and livestock owners about collecting samples from their animals (the project of educating farmers and livestock owners described in this chapter could assume this job too). Surviving animals should be given a specific tattoo, so that, they will not be surveyed again.

Veterinarians and paraveterinarians should group sheep and goats into three age groups: 1) younger than six months, 2) 6 month to one year old, 3) older than year. All age groups should be sampled (blood) randomly. At least a hundred samples should be collected from each age group from each province.

Collectively six hundred samples should be collected from a province and sent to the lab for ELISA test. ELISA test should be run in provincial lab, if provincial lab is not able to run the test sample should be sent to central lab to detect anti PPRV antibodies. Result of the test should be analyzed separately for each province and each species. To complete the survey, each province should determine incidence and prevalence of PPR so statistics for the whole country are possible.

Table 4.1: Necessary budget for surveillance and for educating livestock owners.

Project personnel	Number	Salary \$ per month	Months to serve	Total cost \$	
epidemiologists	2	800	7	11,200	
Statisticians	1	700	7	4,900	
Technicians	122	200	7	170,800	
Veterinarians and paraveterinarians	190	500	7	665,000	
Office staff	50	Ave 200	7	70,000	
Subtotal	365	2,400	7	921,900	
Equipments				500,000	
Total				1,421,900	

Long term recommendation

Plan for Eradication

Eradicating infectious and zoonotic diseases would be the second project after securing borders, conducting surveillance, and making farmers and livestock owners aware of infectious and contagious diseases. Worldwide eradication of PPR probably could be the next goal after eliminating recently eradicated rinderpest. Lessons learned from the eradication of rinderpest and other infectious diseases should be applied to PPR eradication¹³. PPR eradication from Afghanistan could be a part of worldwide eradication of PPR, but it is mostly the responsibility of the Afghan government and Afghans to eradicate PPR and other infectious and contagious diseases from Afghanistan. While it is not easy to accomplish, a strategic plan with animal owners' assistance could make it possible. Eradication of PPR should start in the places with low prevalence and incidence of the disease.

Following are important points regarding eradication of PPR from Afghanistan.

- The project should be conducted by Ministry of Agriculture or it should be involved in the project:

The president of animal health department of veterinary service should be the national director of the project, and all the central and provincial veterinary services and workers should be involved. Eradication of a disease needs effective planning, sufficient money and time, and coordination of different agencies and manpower. VFUs could play a significant role implementing this project as well. Farmers, livestock owners, and all Afghan people should be encouraged through

media and education project which is described previously in this chapter to play their role in the project.

➤ Possible sources of funding and assistance:

Ministry of Agriculture should provide all the necessary equipment (vehicles, equipment for carcass disposal, burying, or burning, and necessary equipment and places for quarantine) for implementing the project. The Ministry of Agriculture should encourage Non Governmental Organizations (NGOs) who are working for diseases eradication and elimination and other veterinary services throughout the world such as World Organization for Animal Health (OIE), FAO, USAID, and USDA to help the Ministry of Agriculture implementing this project. NGOs which are working in veterinary field only in Afghanistan such as Afghanistan Veterinary Association (AVA), Dutch Committee for Afghanistan (DCA) and others can also help this project. Ministry of Transportation should be encouraged to provide necessary trucks and vehicles for the project.

➤ Border security and control of animal movement to provinces should be ongoing after eradication or establishment of disease free provinces:

PPR is endemic in Afghanistan's neighboring countries like Pakistan, Iran, and Tajikistan. Since there is no strict control on animal movement, PPR and other infectious diseases can easily enter Afghanistan. Clearly, strict control on borders feasible to prevent unlawful importation of animals and animal products is necessary for a PPR eradication program. Every animal that enters Afghanistan would have to have valid identification (ID). This ID could be a tattoo, ear tag, or whatever is available and effective along with a health certificate or other

paperwork for a herd or single animal to show absence of the disease. Border's veterinary service should provide ID and certificate for healthy animals entering to Afghanistan but animal owner should be responsible for the expenses. Ports of entry should be separated for every animal species or should have different routes for every animal species at the same port. Also, ports of entry should be equipped with sufficient equipment like computers and single ID readers or mass animal ID readers, and equipment for testing to determine the PPR status of a herd or single animal. In addition, ports of entry should have separate quarantine areas. Suspected herds should be quarantined until required tests are completed which could take one or two days, and animal owners should be responsible for quarantine expenses. If the animal or its herd is healthy and seronegative for PPR, it would be allowed to enter the country; diseased or infected animals must be refused entry to the country.

- The Ministry of Agriculture should practice preeradication preparedness: The Ministry of Agriculture or whoever conducts the project should be completely prepared prior to conducting the project. For example, since the project will take at least five years or more to completely eradicate PPR from Afghanistan, having a budget for up to at least five years or more is necessary. Some of the equipment such as vehicles, carcass burners may be present in the ministry of agriculture or other related organizations, but some may have to be bought or rented. Identifying environmentally friendly places for burying, burning or disposing of animal carcasses and contaminated objects is also necessary prior

to conducting the project. Ministry of Mines and Collage of Geo-Science could help regarding this issue.

- The project should have a well defined implementation procedure:

Using the outcome of previously conducted surveillance, the eradication program should start in provinces with low incidence and prevalence of PPR. Movement of any PPR suspected or infected animal or animal herd would have to be prohibited to the provinces where the eradication work is in the place. The records of VFUs and veterinary clinics in the area, and required tests like PCR or ELISA should detect the diseased and seropositive animals. These animals should be killed in an environmentally safe and human maner, and the government should compensate animal owners based on their animal killed in this project. The carcass, food, wool, skin, feces have to be burned or buried in identified places. Vehicles and other moving objects to and from the area and all exposed facilities/equipment should be disposed of or disinfected. Barns, fences, and any other places where the infected animal lived should be disinfected using the following chemicals: sodium carbonate, sodium hydroxide, chloride and phenolic compounds.

- The project should offer a good post-eradication program:

Following the killing of all infected and suspected animals, the province should be surveyed again to make sure that no infected or seropositive animal or animal herd remained undetected. In case of finding any seropositive or infected case, all the previously described processes have to be applied to the suspected area. When no case of suspected or infected or seropositive animal remains, the eradication program should move to the next province, but complete preparedness for dealing

with reemergence of the disease should always be in place such as quarantine, testing and culling. Finally, movements of suspected or infected animals to disease-free provinces have to be banned.

The whole country or its provinces with no case of PPR up to three years after eradication should be declared disease-free. Every veterinarian and paraveterinarian working in the field should be required to report diagnosed and/or suspected cases of eradicated diseases to the Ministry of Agriculture. If any case of PPR emerges in any province the following steps must be taken:

1. Establishment of two areas around the infected area: 1) Restricted area (one or two mile) 2) Controlled area (two to three miles). Animal movement would be restricted to the restricted area and prohibited in the controlled area.
2. A preparedness plan engaged to block all the roads and routes to an infected area and offer necessities to serve people and animals of that infected area as long as quarantine is in place.
3. The process of eradication described in previous pages to be implemented again in the infected area.

Table 4.2: Budget needed for PPR eradication in five years.

Personnel/equipment	Number of people	Duration of employee/ year	Salary per month \$	Total \$
Experts of eradication	5	5	800	240,000
Veterinarians	100	5	500	3,000,000
Veterinary student/ paravet	100	5	200	1,200,000
Office personnel	20	5	200-500	360,000
Workers	500	5	100-200	4,500,000
Subtotal	725	5	1950	9,300,000
Equipment				10,000,000
Budget for animal owners compensation				60,000,000
Total				79,300,000

This is a rough estimate of eradication project expenses and it may change significantly regarding availability of equipment, and assistance of different agencies and people. Estimating cost of this project is not easy and could not be accurate because we don't know how many animals should be killed in those five or more years but

approximately a million sheep and goats will be affected and should be killed. Average cost of one sheep or goat is about three thousands Afghani which is equal to sixty dollars, collectively it will cost about sixty million dollars.

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