



## Peste des petits ruminants (PPR) in Morocco

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PPR (also called “goat plague”) has appeared for the first time and spread over the course of a few weeks throughout Morocco. Two outbreaks were detected in mid-July in the central part of the country and officially reported by the Moroccan veterinary services to the World Organization for animal Health (OIE). The disease has spread quickly from the index flocks to the rest of the country, currently affecting the most southern and northeastern areas of the country. As of 14 August 2008, there have been seven outbreaks reported close to the Algerian border.

PPR is a disease that is endemic to several African sub-Saharan countries, but the disease had never been reported in the northern part of the continent, aside from Egypt.

This emerging situation should be of great concern for neighboring countries, especially for Algeria with approximately 19 million sheep and 3 million goats. The risk is also high for southern European countries that have historically maintained intense commercial interests with Morocco. Of these countries, Spain seems to be particularly exposed, given its geographic proximity and the importance of its vulnerable livestock (with more than 23 million sheep and almost 3 million goats).

PPR is characterized by morbidity and mortality rates that can approach 80% in some cases, and the disease can lead to important direct economic losses, aggravated by the sanitary measures imposed by authorities in controlling animal movement and trade restrictions on their by-products.

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Figure 1. PPR outbreaks in 2008 in Morocco



Retrospectively it is believed that the first outbreak occurred on 12 June 2008 in the rural village of Ain Chkef, Moulay Yacoub, not far from Fès. PPR was confirmed by laboratory tests on 18 July and reported to the World Organization for Animal Health (OIE) on 23 July, 2008. In the aftermath of its initial detection, the disease has spread quickly such that by 4 August, 92 outbreaks had been identified by the Moroccan veterinary services, of which 25 have been reported in the previous five days.

In all of these field outbreaks, 2 833 sick animals have been identified, with case fatality rates approaching 50%. Of the infected animals, 96% are sheep.

The origin of the PPR outbreaks in Morocco is unknown. It is however believed that it might have been introduced to Morocco through the movement of live but infected animals. For the North African countries, the control of transnational animal movements over the border is difficult, especially in the southern part of the region where intense migratory movements of Saharan nomadic populations live.

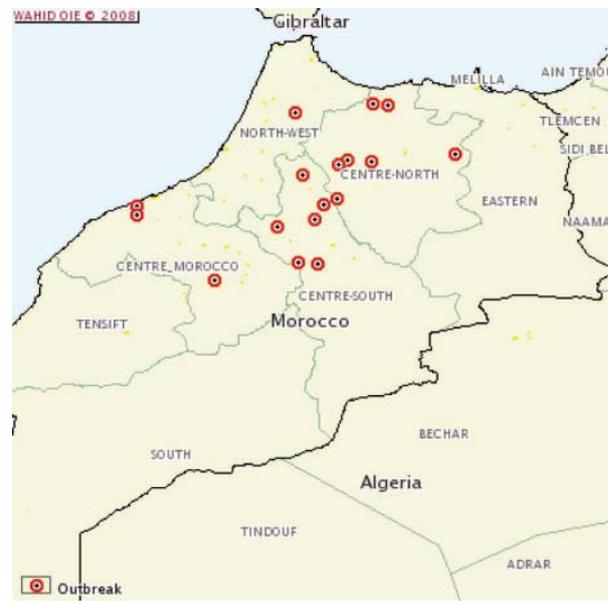
With the holy month of Ramadan (beginning in early September), and the Eid El Kebir celebration (December), the commerce of sheep will increase in all Muslim countries, including Morocco. Without proper control mechanisms, these animal movements could contribute to and accelerate the spread of the virus regionally.

At the request of Morocco’s Agriculture and Fishing Ministry’s Director of Farming, the Crisis Management Centre-Animal Health (CMC-AH) has sent to Morocco a Rapid deployment Team (RDT) made up of 2 experts to help with the establishment of urgent measures to control and limit the spread of the disease.

Figure 2. Evolution of PPR (June – August 2008)



June 12th and June 26th: 2 epidemic field outbreaks reported in 15 days



June 30th - July 19th: 24 epidemic field outbreaks in 20 days



July 20th - July 31st: 41 epidemic field outbreaks in 12 days.



July 31st - August 4th: 25 epidemic field outbreaks in 5 days

Source WAHID OIE

## 1. PESTE DES PETITS RUMINANTS (PPR)

PPR is a very contagious infectious disease of viral origin. Though PPR is principally a sheep and goat disease, it can affect wild ruminants as well. Other animal species, like cattle, buffalos, and dromedaries, though less vulnerable to the PPR virus, can also be infected. Up to now, no swine disease has been attributed to the PPR virus.

The agent responsible for PPR is a virus from the morbillivirus group, of the Paramyxoviridae family. It is related to cattle plague (rinderpest) and to measles in humans. The genetic characterization of PPR viruses

has allowed classification into four groups: one in Asia and three in Africa (West Africa, West and Central Africa, East Africa). In the Middle East, the Asian group is more prevalent, but the East African strains also are known to occur.

The typical clinical form of PPR infection is that of acute manifestations characterized by a sudden and quick appearance of respiratory distress, fever, depression, diarrhea and death. The ocular and nasal mucous membranes are congested with ocular and nasal discharge that appears serous at first, leading to a muco-purulent character later in the course of disease. Erosive stomatitis gives the animal a fetid breath. These

signs are accompanied by pneumonia (respiratory difficulties and coughing) and diarrhea. The mortality rates can reach 80% in acute cases.

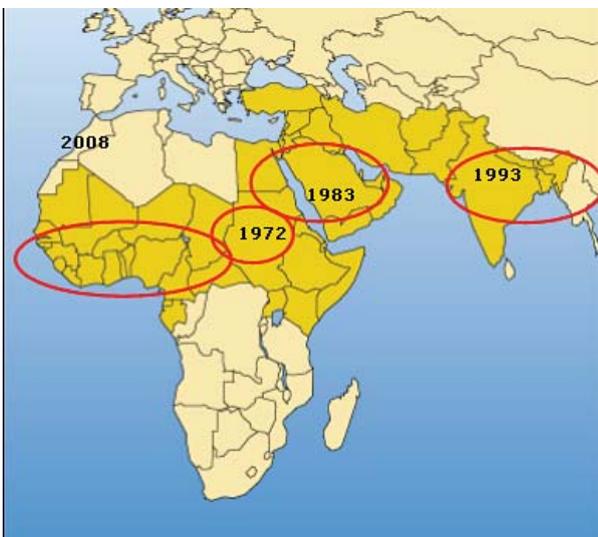
There are two other forms of PPR. The per-acute form is mainly seen among animals 3 months of age and younger. In 100% of these cases, the animals die within 5 days of the first appearance of the disease, even before the appearance of signs of bronco-pneumonia and necrotizing erosive lesions in the mouth or digestive track in older stock. Conversely, in the sub-acute form, the clinical signs are slightly marked or even inexistent in some cases. In these latter cases, the infection can go undetected or mistaken for contagious ecthyma due to the presence of black scabs around the mouth of the infected animal. Affected animals will usually recover from the sub-acute form.

**2. GEOGRAPHIC DISTRIBUTION AND RECENT SPREAD OF THE DISEASE**

Discovered for the first time in the Ivory Coast in 1942, PPR has oftentimes been associated with the Western African countries. 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 (with an apparent barrier in northern Kenya) nor the Eastern part of Northern Africa (apart from Egypt) had been infected with the disease. The disease can also be found in Middle and Far Eastern countries and in the Indian sub-continent (Pakistan, India, Bangladesh, and Nepal).

Since the middle of the 1980's, the development of new tools for diagnosis, allowing for a specific identification of the virus, has helped in determining the area of distribution of PPR. From West Africa, PPR quickly spread to include the Central African countries, East Africa, the countries of the Middle and Far East, and several Asian countries like China, which has reported

Figure 3. Geographic distribution

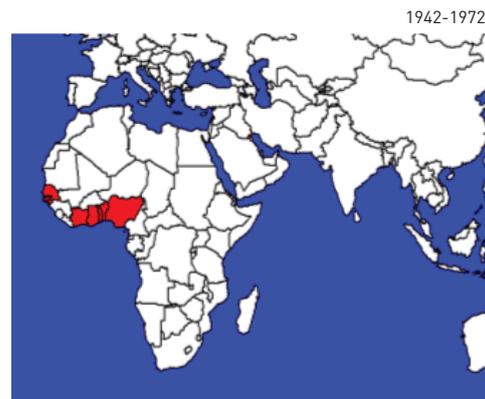


its first case of PPR in Tibet and in Nepal in 2007. In the last 5 years, the spread has been confirmed in Asia, and also into the Central Asia (Tajikistan). By reaching Gabon, the Congo, Uganda and Kenya, the PPR is spreading now to the South of the continent beyond the Equator.

The evolution of the spread of the disease does not necessarily mean that the origin of the disease is in West Africa. It is very probable that the disease had existed long before its first observation and official identification. Indeed it could have been mistaken either for rinderpest (due to the identical erosive mucous lesions and the presence of diarrhea), or pasteurellosis (as bronchopneumonia signs are manifested). In fact the PPR virus fosters a favorable environment for secondary infections by bacteria like Pasteurella. Pasteurellosis is the most frequent bacterial complication of the viral infection.

The recent spread of PPR can be correlated with the increase of animal movement for commercial and trade purposes (e.g. the massive imports of small ruminants to the Middle East), transhumance and nomadic customs and the extensive farming practices in the Saharan regions.

Figure 4. Extent of the disease



Source: Official OIE reports. The existence of the clinical disease has not been reported by all countries; for some reports there is only serologic evidence of infection.

|             |              | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|-------------|--------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| ASIA        | Bahrain      |      |      |      |      |      |      |      |      |      |      |      |      | ?    |      |      |      |      |      |      |      |
|             | Oman         |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|             | UAE          |      | ?    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|             | Yemen        |      |      |      |      |      |      |      |      |      | ?    |      |      |      |      |      |      |      |      |      |      |
|             | Jordan       |      | ?    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|             | Lebanon      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|             | Kuwait       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|             | India        |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|             | Israel       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|             | Saudi Arabia |      |      |      |      |      |      | !!   |      |      |      |      |      |      |      |      |      |      |      |      |      |
|             | Iran         |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|             | Nepal        |      |      |      |      |      |      |      |      | !!   |      |      |      |      |      |      |      |      |      |      |      |
|             | Bangladesh   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|             | Palestina    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|             | Pakistan     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|             | Iraq         |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Afghanistan |              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Turkey      |              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Tajikistan  |              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |

Source: FAO registry, WHO, OIE animal health 1988- 1995, WAHID OIE, 1995-2005 and 2005 -2007, DEFRA

|           |                          | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|-----------|--------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| AFRICA    | Benin                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Burkina Faso             |      |      |      |      |      |      |      |      |      | ?    |      |      | ?    |      |      |      |      |      |      |      |
|           | Cameroon                 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Cote D'Ivoire            |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Gambia                   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Ghana                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Mali                     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Mauritania               |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Niger                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Nigeria                  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Senegal                  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Sudan                    |      |      |      | ?    |      |      |      |      |      |      |      |      |      |      |      | ?    |      |      |      |      |
|           | Togo                     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Guinea Bissau            |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Siera Leone              |      | ?    | ?    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Egypt                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Ethiopia                 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Liberia                  |      |      |      | ?    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Guinea                   |      |      | !!   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Central African Republic |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Chad                     |      |      |      | ?    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Equatorial Guinea        |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Kenia                    |      |      |      |      | ?    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Eritrea                  |      |      |      |      |      | !!   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Gabon                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Somalia                  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|           | Uganda                   |      |      |      |      |      |      |      |      |      |      |      |      |      | ?    | ?    | ?    | ?    |      |      |      |
| Congo RDC |                          |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Congo     |                          |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |

Source: FAO registry, OIE animal health 1988- 1995, WAHID OIE 2005 -2007

|    |   |
|----|---|
|    | <b>Not reported</b>                               |
|    | Not reported (after being present in the country) |
|    | information                                       |
|    | Disease presence                                  |
| !! | Detected for the first time in the country        |
| ?  | Suspicion but no confirmation                     |

### 3. DIFFICULTY OF THE DIFFERENTIAL DIAGNOSIS

This disease may be undetected or misdiagnosed as it spreads to other countries because small ruminant respiratory diseases have a multitude of causes. The main differential diagnoses for PPR include:

- **Oral lesions:** rinderpest, foot-and-mouth disease, bluetongue, and contagious ecthyma.
- **Respiratory insufficiency:** Pasteurellosis, sheep pox, contagious caprine pleuropneumonia (CCPP)
- **Diarrhoea:** Coccidiosis, gastro-intestinal parasitic infections.

### 4. TRANSMISSION AND SPREAD OF THE DISEASE

In the zones where the PPR is enzootic, the most severely affected animals are those from 4 to 18-24 months of age. The infected animals excrete large quantities of virus through nasal fluids, tears, saliva and feces. Coughing and sneezing contributes to viral spread. The animals in the immediate surrounding environment contract the virus through respiratory channels. Water, food, mangers, watering holes, and areas soiled by the viral materials represent other sources for viral contamination, even though the virus will not persist for a lengthy period of time in an exposed environment.

The clinical appearance of PPR can be associated with:

- Recent movements and gatherings of sheep and goats of different ages;
- A recent introduction of new animals or the return to the village of animals that were not sold in the market; gathering and interaction of animals of different origins.
- Contact with foreign animals (animals being transported to markets, animals from nomadic or pastoralist people) sharing the same food, water sources, or shelters.
- Stress related to changes in the farming procedures (change of diet, habitat, and intensification of farming) or climate change (beginning of the rainy season, Harmattan winds from West Africa, for example).

### 5. DISEASE DIAGNOSIS

A tentative diagnosis of PPR can be made with thorough epidemiological investigations and clinical information: the viral infection is characterized by ocular and nasal discharges and diarrhea associated with respiratory problems and high mortality rates among sheep and/or goats, but with no effect on the cattle that are in direct contact with them. During post-mortem examinations, the presence of congestive and erosive lesions of different mucosal tissues and bronco-pneumonic lesions can reinforce the diagnosis. The diagnosis should be confirmed through laboratory tests that make it possible to detect the presence of the virus or its genetic material (antigen capture ELISA or PCR) or of specific antibodies (competitive ELISA)

The samples required for laboratory analysis, and the handling instructions are as follows:

- **Tears:** scrape the conjunctival mucosa with a cotton swab to draw some tears. Place the end of the swab into a tube containing 150 µl of sterile phosphate buffered saline (PBS, pH: 7.2 to 7.6), and place the tube on ice.
- **Epithelial tissues (gingival):** this sample can be drawn by using a spatula or a finger covered with rubber, and by rubbing the mucous membranes of the gums or the lips. The sample should then be placed in a separate tube with 150µl of PBS, and placed on ice.
- **Organs:** It is recommended during the post-mortem examination that samples be taken of lymph nodes, portions of the spleen and lungs. These samples can be placed in sterile plastic bags or jars and placed on ice.
- **Whole blood with anti-coagulant** (heparin or EDTA) for the separation of white blood cells for



PHOTO: FAO/P. ROEDER

*Discharge and purulent tearing in a case of advanced PPR*

eventual attempts at virus isolation or detection. [Note - Heparin can interfere with PCR testing]

- **Blood taken in clot-tubes** for eventual harvesting of serum and detection of specific antibodies.

### 6. RECOMMENDATIONS

The prevention and control measures applied include animal movement control, institution of quarantine on affected or suspect farms, and medical prophylaxis (vaccination around field outbreaks and in high risk areas). These measures are essential for control of PPR. In the present context it is recommended that the countries at risk :

- Review and revise animal disease emergency and contingency plans.
- Raise awareness and inform veterinarians, producers and the different governmental services about PPR, its risks, and clinical signs.
- Promote the prompt reporting of suspected cases to the authorities
- Reinforce epidemiological surveillance in the zones of high risk
- Improve inspection of sheep and goat flocks and

| Producer  | Countries where products are sold  | Type                   |
|---|--|------------------------|
| Jordanian Vaccine Company (JOVAC)<br>Product PESTEVAC | Afghanistan, Albania, Bahrein, Ethiopia, Irak, Jordan, Kuwait, Lebanon, Malaysia, Oman, Pakistan, Syria, Emirates Arabes Unis, Yemen | virus PPR Nigeria 75/1 |
| Botswana Vaccine Institute                            | Botswana   | virus PPR Nigeria 75/1 |
| Veterinary Serum and Vaccine Research Institute       | Egypt  | Egypt 87               |
| National Research Development Corporation             | India  | Not Available          |
| Biological Products Division                          | Nepal  | virus PPR Nigeria 75/1 |
| National Veterinary Research Institute                | Nigeria  | virus PPR Nigeria 75/1 |
| Vetal Company   | Turkey   | Not Available          |
| Veterinary Control and Research Institute             | Turkey   | virus PPR Nigeria 75/1 |
| Laboratoire Central Vétérinaire                       | Mali   | virus PPR Nigeria 75/1 |
| LABOVET de Garoua                                     | Cameroon   | virus PPR Nigeria 75/1 |
| Laboratoire Vétérinaire de Dakar Hann                 | Senegal  | virus PPR Nigeria 75/1 |
| National Veterinary Institute                         | Ethiopia   | virus PPR Nigeria 75/1 |

[\*]FAO is not able to guarantee the effectiveness of these vaccines

institute animal movement control procedures. The control and management of livestock markets and the surveillance of suspected cases are of paramount importance to contain the spread of the disease. The increase in livestock movements during the holy month celebrations of Ramadan and Eid El Kebir can negatively affect the containment of the disease.

- If medical prophylaxis actions are taken to control PPR, it is recommended that vaccines should meet international standards in terms of efficacy, potency and sterility. The use of homologous vaccines (i.e. attenuated PPR viruses) should be considered. The use of rinderpest vaccines or those for distemper is not recommended.

The above list summarizes the vaccine producers and the countries where the vaccines are produced.

## 7. SHEEP AND GOAT LIVESTOCK POPULATIONS AROUND THE MEDITERRANEAN

The commerce of small ruminants is the most likely reason for the spread of PPR across borders. The consumption and importance of these products in Muslim countries reaches its peak during religious festivities which encourage trade and commerce of the animals in the region. Such movements for trade or to meet grazing and watering needs are poorly regulated.

Even though the countries of North Africa are net importers of live sheep and goat, there remains an informal trade pattern across the borders that may, at a given point, favor the spread of PPR (or other transboundary animal diseases) to other countries of the region or to countries of southern Europe.

The map shows the census of sheep and goat in the North African countries, notably Morocco and Algeria (with more than 22 million sheep and goats each), as well as the composition of the livestock of northern

Mediterranean countries. The large population of sheep and goats around the Mediterranean is an important factor that should be taken into consideration, given the grave economic impact that this disease represents.

## 8. FOR MORE INFORMATION

FAO 1999. Recognizing peste des petits ruminants - A field manual. FAO Animal Health Manual No. 5. Also available at: <http://www.fao.org/DOCREP/003/X1703E/X1703E00.HTM>  
 FAO. 1999/1. PPR ruminants - Petits ruminants - Pequeños ruminantes. World animal review - Revue mondiale de zootechnie - Revista mundial de zootecnia. Also available at: <http://www.fao.org/DOCREP/T8600T/t8600T00.htm>

Figure 5. Sheep and goat livestock populations

