

## Challenges and Opportunities for Global Eradication of Paste des Petits Ruminants (PPR)

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### ABSTRACT

Sheep and goat provide valuable products such as meat, milk, particularly for women and children. Sheep and goat can be raised in arid and semi-arid and around the house, because of less investment and less feed required. Also, a high short period for output and income saving, On the other hand, diseases such as Paste Des Petits Ruminants (PPR) cause mortality and high economic loss in the world particularly in Asia and Africa that has a negative impact in many rural and urban lives. The disease caused many outbreaks in Asia and Africa, characterized by huge mortality and morbidity. Recently, the Food and Agricultural Organization (FAO) and the world animal health organization declared global eradication of paste des petits ruminants subsequently reduce poverty. This review dealt with challenges and opportunities that affect the global eradication of paste des petits ruminants. Information on its economic importance, the taxonomy of the virus, transmission and pathogenesis and methods of diagnosis are briefly dealt with.

**Keywords:** Paste des petits ruminants; Goat; Food and agricultural organization

**List of abbreviation:** APCs: Antigen Presenting Cells; CEMV: Cetacean Morbillivirus; FAO: Food Agricultural Organization; FMV: Feline Morbilli Virus; OIE: Organizational Des Epizooties; PBMCs: Peripheral Blood Mononuclear Cells; PCR: Polymerase Chain Reaction Paste Des Petits Ruminants-v: Pest Des Petits Ruminants Virus

### INTRODUCTION

According to the Food and Agriculture Organisation Statistics (FAOSTAT), the population of small ruminants globally is 2.1 billion heads, of which 59.7% are in Asia and 33.8% in Africa. It is the source of 300 million poor rural people around the globe. Poor people or landless villages include both pastoralists and agro-pastoralist who kept small ruminants to provide food, saving income and education. For food, small ruminants in other words sheep and goats play an important role in food security with components all parts of the nutritional content, high-quality protein, vitamins, minerals, for physical health and growth. They can be raised in arid and semi-arid environments in different production systems; extensive pastoralist and mixed flock [1].

The livestock sector in Ethiopia has been contributing to the economy of the country and also contributes to the development of the country and is the life of millions of people in Ethiopia

that's Ethiopia is the second-largest livestock population in East-Africa [2].

Though they have been livestock population that contributing their economic growth but the general economy of the country is still low economic in Africa [3]. Globally, economically important contagious diseases threaten the production of small ruminants: The Paste des Petits Ruminants (PPR) and Sheep/Goat Pox (SGP). Both paste des petits ruminants and SGP are transboundary animal diseases that include a list of animal diseases by the world organization of animal health [4,5].

Paste des petits ruminants are a high mortality disease in both domestic and wild small ruminants when associated with other diseases, morbidity rates can reach 100% accompanied by high mortality rates [6,7]. The risk factors the enhance the prevalence and incidence of infection rate of pest des petites ruminants are the variation sheep and goats' breeds, geographical distribution and variation, the topography of different areas across the globe,

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also the management of sheep and goats with husbandry practice in the farmers. However, variation in prevalence and severity of paste des petits ruminants' outbreaks can be seen due to variations in the sheep [8]. The disease occurred as an outbreak in new areas of the world with the loss of many valuable things such as production economic loss [9].

A recent report from Food and Agriculture Organization (FAO) announced that about 63% of small ruminants are South-Africa, South-East Asia Central and China, Turkey and Southern Europe are at risk of contracting paste des petits ruminant's infection [10].

Sub-Saharan Africa becomes endemic across global and part of the Middle East, and the Arabian Peninsula, Turkey, and Iran, Iraq, Pakistan, India, Bangladesh, Tajikistan and Kazakhstan in Central Asia [11]. China has also reported some strains of the virus in paste des petits ruminants [12].

Paste des petits ruminants are the major viral disease in sheep and goats and is a highly fatal disease of the animals in a different part of the world includes Asia, Africa and the Middle East. As part of the Sustainable Development Goals (SDGs), for poverty reduction, there is a global movement to eradicate paste des petits ruminants [1]. However, information on scientific thoughts whether this can be successful or challenged is scattered. Thus, this review dealt with opportunities and challenges that affect the global eradication of paste des petits ruminants.

## FOUNDING FACTS ABOUT PASTE DES PETITS RUMINANTS

The disease of paste des petits ruminants is a disease of small ruminants that have a negative impact on production and productivity and negatively influence the farmers' economy and their lives [13,14]. A report from the Food and Agriculture Organization (FAO) announced that about 63% of sheep and goats in South Africa, Central, and Southeast Asia, China, Turkey and Southern Europe are at risk of contracting paste des petits ruminant's infection. This viral disease of paste des petits ruminants increases the poverty alleviation and negative impact of one SDG [10,15]. In this chapter, a brief overview of the virus properties, pathology and economic significance is outlined below.

### Economic significance

Paste des petits ruminants causes huge losses of the economy and income of developing country; above 300 people there live in rural affecting livelihood, employment opportunities and food securities of poor families. On the other hand, production and productivity and international trade through Africa and the Middle East. This viral disease of paste des petits ruminants is considered to affect the export and trade of livestock of sheep and goats that create a shortage and alleviate poverty [1]. India has a small ruminant population of about 200 million. As a rough estimate, paste des petits ruminants causes economic losses of 1,800 million Indian rupees (US \$39 million) every year [13]. However, one-third (33% seroprevalence) of small ruminants in India tests are positive for antibodies against paste

des petits ruminants [16] Ethiopia has over 62 million paste des petits ruminants-susceptible sheep and goats. Paste des petits ruminants were first suspected in Ethiopia in 1977 following clinical observations consistent with infection of paste des petits ruminants [17].

Paste des petits ruminants has direct loss such as mortality and indirect loss such as cost of treatment and reduction of animal body condition, in contract of lack of or insufficient veterinary coverage and its veterinary labour, and reduce the value of the market value of small ruminant among trade market that is why have negative impact of export earnings [8].

Both direct loss and direct losses of the economy in the whole world are \$2,972.5/year during 2012-2017 in SAARC (South Asian Association for Regional Cooperation), among these regions, for example, India the loss would be \$2569.00 million/year [18].

A recent of Morocco there was an outbreak of paste des petits ruminants and spread in Morocco and East-Africa. This disease is a risk infection in the rest of the countries such as North Africa, Southern Europe, and Southern Africa, it is also important to take the step to prevent this wide impact of the small ruminants [19].

### Taxonomy and virus property

Paste des petits ruminants is a viral and transboundary animal disease particularly in small ruminants, it is also characterized by fever, erosive stomatitis, diarrhoea, gastroenteritis and conjunctiva, and is also caused highly acute mortality and contagious, an infectious viral disease. Paste des petits ruminants are originated from the French name and stands for the disastrous disease of sheep and goats. This disease is severely affected by sheep than goats [20]. There similar genetically both disease of rinderpest and paste des petits ruminants of cattle and sheep and goats respectively and others of large ruminants [21].

The *Paramyxoviridae* family is order of *Mononegaviral*, the paste des petits ruminants is a member of the genus *Morbillivirus*, the *paramyxovirinae*, genus *Morbillivirus* has several genetic similar makeups and consist seven known members of the genus *Morbillivirus* including (MeV), Rinderpest Virus (RPV), Canine Distemper Virus (CDV) paste des petits ruminants, Porcine Distemper Virus (PDV), Cetacean Morbillivirus (CeMV) and Feline Morbillivirus (FMV) [22].

The virus paste des petits ruminants have the shelf life or its half-life to decay in the environment is 2 hours at 37°C. will be die and become inactivated with 50°C within 60 minutes this virus is highly susceptible to the most disinfectants includes alcohol, ether, phenol and sodium hydroxide. But the virus able for living during a long period within chilled and frozen tissue [23,24].

The geographical distribution that was isolated from the paste des petits ruminants various the genetical relationship of the virus strains, thus classified into four linages were found genetic relationship between paste des petits ruminants' viruses isolated from different geographical regions [25,26]. These strains isolated in Africa in the 1970s and (Nigeria/1975/1, Nigeria/

1975/2, Nigeria/1975/3, Nigeria/1976/1 and Senegalese strain), is a representative of the virus in Lineage 1 [25,27]. The second deviation of the virus isolated in late 1980 in West Africa (Ivory Coast and Guinea). This virus becomes the only virus that did not cross and not found in the Red Sea and Asian countries. The Lineage tree found in Sudan [28], and Ethiopia [29]. Israel/1994, Iran/1994, Nepal/1995, Bangladesh/1993, and India these viruses isolated is Lineage 4 include Asian isolates [26]. The crossing virus from two continent such as Africa and Asia can accelerate the spread of disease through the trade into two Lineages from Africa and Asian Lineage from other [25,27,30].

The paste des petits ruminants have used mechanism to produce an antiviral state in the host by activation of a complex network of intracellular signalling pathways, that several cytokine genes to mediate transcription of the virus [31,32]. The virus shed in the host to resist host immune mechanisms such as Interferons (IFNs) are the main group of cytokines that induce mechanism virus escape from the immune host by modulating the adaptive immune response of the host. In addition, the virus paste des petits ruminants can cause infection in the goats after that, stimulate classic inflammatory response characterized by increased and suppression paste des petits ruminants cytokines such as IFN  $\beta$ , IFN  $\gamma$ , IL-4, IL-1  $\beta$ , IL-8, IL-10, IL-6 and IL-12 [33,34].

The *Morbillivirus* caused immunosuppression paste des petits ruminants by leading excessive damage of the lymphoid organs during process invasion of the host organs or tissue. This leads to inhibit the IFNs production and suppresses paste des petits ruminants the protection of the classic inflammatory response, facilitating the virus invades the host tissue and organs than creating the infection. Then the destruction of host immune mechanisms such leucocytes causing leukopenia, this is a result of inhibition of immunoglobulin synthesis due to loss of B cell or cell cycle arrest that is contact and invasion of the viral glycoprotein [35].

After, the virus caused extensive immunosuppression of paste des petits ruminants to lead severe of the pathological lesions of the host tissue and can infect the PBMCs: peripheral blood mononuclear cells that are the final stage the virus settles [36].

### Transmission, host, and pathogenesis

The paste des petits ruminant's virus can be transmitted and spread through close contact between infected animals; contaminated fomite is a source of the virus. In addition, inhalation through aerosols, sneezing coughing, milk feeding young [37].

Also, some report evidence that this virus isolated camels in Iran [38] similarly the other susceptible species include Dorcas Gazelle, Gamebok, Ibex and Thamsom's Gazelle [39,40]. In contrast, the disease can detect the virus without producing clinical signs are cattle and pigs called seroconvert upon contact with infected sheep and goats and the virus circulates within small ruminants and cattle, pigs. Cattle and pigs seroconvert upon contact with infected sheep [41,42] therefore, called as dead-end hosts [43]. Both domestic and wild small ruminant the

paste des petits ruminants affected [13,44,45] and camel [38,46]. The virus severely affected goats [47-49].

The process of the virus causes its pathogenesis is poorly understood in comparing another member of Morbillivirus such Canine Distemper Virus, Rinderpest, and Morbillivirus, they develop long-life immunity after recovered from infection of morbillivirus and immunosuppression paste des petits ruminants, to reinfection again the virus within the same host that recovered from infection [50].

When the virus of paste des petits ruminants invade the host tissue begin the attachment and infection, firstly the virus taken up by Antigen Presenting Cells (APCs) this antigen available in the intraepithelial space and lamina propria of the mucosa in the respiratory, (naso-pharyngeal/respiratory epithelium) [51,52], finally, the virus migrates in regional lymphoid tissue, this primary site of the virus settles and replicate takes place, after replication the virus caused damage lymphocytes than spread body through lymphatic and vascular systems of the body [7,53].

The virus of paste des petits ruminant has characterized both lympho-epithelia tropic infection and produce signs such as conjunctivitis, ulcerative stomatitis, gastroenteritis and pneumonia, rhinotracheitis. The virus-related cells, tissue, and organs finally, reached cells called piggy bagging on the PBMCs [54]. When the virus load is high related lung infection with paste des petits ruminants [7]. The virus variate to produce infection and depend on the number of strains, the immunological strength of the animal host, and the route of the infection, lastly the ability the virus stimulates, invade and generate infection within the host depend on to produce a final stage of clinical signs of the disease [55].

The virus preferred in the tissue of lymphoid and epithelial tissue and cause lymphotropic and epitheliotropic, of paste des petits ruminants and the similar way another member of morbillivirus. The main entry of the virus through the host is the respiratory route. When the virus enters the host and settle lymphoid organ in the respiratory tract, and colonizes localize tissue, begin first replicating in the pharyngeal and mandibular in the lymph nodes as well as tonsil. First clinical signs appear before 1-2 days infection also viremia may develop after 2-3 days, the virus dissemination of the virus to bone marrow, spleen, and mucosa of the gastrointestinal tract and the respiratory system result in viremia [56].

20 days can range incubation period in most cases clinical signs appear in 2-6 days [57]. Most 5-8 days before the animal either dies or begins. The characteristic of the signs begins with a clear discharge from the nose that becomes grey and sticky. The infection remains discharge from the nose may be mild or may progress to severe inflammation of the mucous membrane of the nose characterized by the presence of exudates that crust over, the virus erosion lesions developed the nasal mucous membranes, thus blocking the nostrils causing respiratory distress. The eyelids matted with congested may be conjunctiva. The mucous membranes in the mouth can also be eroded. Sheep and goats will be marked dehydration severe in the mouth, which may progress to emaciation. Difficult breathing and died within 5-10 days [58].

Necrotic stomatitis is common. It starts as small, roughened, red, necrotic foci on the gum below the incisor. Due to the lesion of the mouth and difficulty chewing of food in the animal leads diarrhoea, sometimes profuse but not haemorrhagic. Bronchopneumonia with coughing common late in the disease. The infection is also presented in pregnant ladies. The pathology damage of this virus by paste des petits ruminants is dominated by necrotic lesions in the mouth and the gastrointestinal tract. This viral disease is manifest erosive stomatitis emaciation, conjunctivitis, erosive stomatitis involving the inside of the lower lip and adjacent gum. Cheeks near the commissure's and the free portion of the tongue are frequent lesions. Lesion found on the hard palate; pharynx upper third of the oesophagus [59].

The lesions have affected rarely rumen, reticulum, and omasum. Erosions on the pillars of the rumen, also regularly caused erosion from the abomasum, blood [60]. The carcass is often emaciated and/or dehydrated and may have evidence of diarrhoea and serous or mucopurulent oculo-nasal discharges. Also, the eyes and nose produce profuse discharge and dried up discharge thus dried and blocked both eyes and nose. The eyeballs sunken, when animal show diarrhoea the hindquarters soiled with soft/watery faces. Lips become swollen and become erotic sometimes possibly become scabs or nodules in cases. The nasal cavity is congested (reddened) lining with clear or creamy yellow exudates and erosions [29].

The mortality is reached in 100% when there is an outbreak and there are preferred conditions among small ruminants affected populations. There is also a common morbidity rate 80%-90% and the case fatality rate was 50%-80%. The infection rate is high in goats particularly young at age 0 (4-8 months) more and severe both mortality and morbidity is higher [61].

### Diagnosis

The measuring mechanism that was diagnosis paste des petits ruminants, infected in small ruminants routinely diagnosed based on several combinations such as clinical examination, gross pathology, histological findings and laboratory confirmation to implement control measure is made rapid, specific and sensitive methods for diagnosis [62,63].

The differential diagnosis lists include rinderpest, contagious ecthyma, contagious caprine, bluetongue, pasteurilla, pleuropneumonia, foot and mouth disease, heartwater, coccidiosis, poisoning, nairobi sheep disease and mineral to differentiate some these diseases the case history, geographic location and the combination of clinical signs can help of laboratory analysis such as virus isolation, detection viral antigen, nucleic acid sequencing and detection specific antibody from serum gives a confirmation [64].

For paste des petits ruminant's diagnosis, the sample can be taken from swabs of the mucous membrane of the eye, nose and blood. Sample can be isolate from these organs such as large intestine, lungs and spleen. After isolation of these samples isolated should be transported within the cold chain and refrigeration. To detect paste des petits ruminants can be used for serological and molecular diagnostic tests [65]. Virus

isolation such as primary lamb cultures has also been used. Cultures are examined for Cytopathic Effect (CPE) [66]. Antibody detection like competitive ELISA (cELISA) and ELISA, Counter Immunoelectrophoretic (CIEP) [67] and molecular techniques are available [68].

### CONTROL PASTE DES PETITS RUMINANT

The structural composition of the virus paste des petits ruminants are surface glycoproteins hemagglutinin and fusion protein. This induces the immunity and morbilliviruses are highly immunogenic and produce protective immunity. The morbilliviruses are shared similar genetical composition particularly the virus strains of Rinderpest Virus (RPV) and paste des petits ruminants they have similar genetically and produce an antibody that against both viruses by cross-neutralizing and cross-protective immunity from the host of these two strains of virus [43]. When these viruses attack host, the immune response particularly cell-mediated induces immunity and is a crucial role in the protection of the host from these agents. The immunity of the goats can be used recombinant baculoviral expressing the hemagglutinin glycoprotein by creating the immunity of host in both humoral and cell-mediated immune responses from these viral agents [69].

Vaccination remains the most effective and viable tool for the prevention of paste des petits ruminant's infection, but the vaccines are relatively scarce [70]. The suitability to vaccinate the animal before starts the rainy season as well as annually endemic areas [6].

Were developed in live attenuated paste des petits ruminant vaccine for control of paste des petits ruminant in India, a homologous vero cell [71]. This vaccine had been found immunogenic, safe in non-pregnant and pregnant animals, and is in use throughout the country for protection and increase herd immunity of the sheep and goat, in contrast, there is a vaccine that available in Africa which was of a different Lineage (Lineage III) [72].

The vaccine manufacturing from Africa was Nigeria 75/1 was originated from Lineage 1, the virus isolated from dead goats that naturally infected of the virus of paste des petits ruminants, after that produce first homologous vaccine from this virus [42]. During processing, vaccine manufacturing was neutralizing to reduce the risk and severity of the virus was passage 63 in vero cell. When vaccine completed and immunize the animal the vaccine produces after 7 days of vaccination and enhance the immunity of the animal and provide long life immunity [71].

The Asian vaccination of the paste des petits ruminants was originated from Sungari/96 vaccine originated from Lineage 4 the virus was isolated from a goat at 1994 in India [73]. Arasur 87 and Coimbatore 97 are also another vaccine available immunity [74]. The cross-immunity and mutation of the virus is high suggested some scientific scenarios to use the vaccine were not designed for example Nigeria 75/1 vaccine can be used in Asian countries while the Asian vaccine Sungari/96 not used in Africa [75,76].

Veterinary authorities do not recommend the use of attenuated live-vaccine such as Europe, because these areas in non-endemic regions and not exist from these virus strains, the inactivated vaccine can be a viable alternative [77]. A number of recombinant antigens for vaccine and diagnosis were also experimentally evaluated [78-80].

The recombinant vaccine is the modern vaccine production this vaccine contains paste des petits ruminants virus vaccine, vaccine strain of Capri-pox viruses is the one affected and bring disease of sheep and goats' pox, in addition, this recombinant vaccine contains the Rinderpest vaccine, and a recumbent vaccine produces long life immunity from complex diseases. Also, this recombinant capri-pox, rinderpest vectored vaccine has three advantages, firstly, provide protection from the two other strains of the disease of rinderpest and Lump Skin Disease (LSD), because these viruses contain genetic relationship. Secondly provide long-lasting immunity for three years in cattle, thirdly; the similarity genetically of composition among the family of the Morbillivirus genus these vaccines can produce protective and long-lasting immunity of paste des petits ruminants in sheep and goats [81,82]. On the other sides, there is a disadvantage that affects the quality and intake of the vaccine in pre-existing antibodies against LSD Virus (LSDV) [83].

On the other methods for control and prevention, this virus recommended such as sanitary measure, testing and killing positive animal thus composition, destruction of the carcass in standard as well infected material, isolation and quarantine of infected and slaughter [84]. Similarly, infected fomites should be buried and banned, such as banes tools and other infected material that facilitates the risk of contamination and transmission of the virus by using disinfected with a common disinfectant such as sodium hydroxide 2%, alcohol, ether and phenol, detergents that recommended by OIE [6].

## GLOBAL PASTE DES PETITS RUMINANTS ERADICATION CAMPAIGNS

### General considerations

The paste des petits ruminant is a disease in alleviate poverty and make many losses in production and productivity of animal and interfere of rural poor family, the Office International des Epizootics (OIE) and Food and Agricultural Organisation (FAO) have targeted for next disease that controlled and eradicating globally by 2030 as priority [70,85].

Strategic control and eradication was set up to

- Reduce and prevent further spread of paste des petits ruminants and increase the health of the animals
- Control infected zones from paste des petits ruminants and prevention the spread of the disease from free zones
- Finally, to eradicate the virus from the countries by 2025 of paste des petits ruminants [86]

The lesson from the previous disease that eradicated from global such as Rinderpest have some understanding of the epidemiological distribution and biological paste des petits

ruminants, these some consideration to the reasons to control and eradicate.

There several factors to prefer for the eradication of paste des petits ruminants:

- This virus is existing only one serotype of Paste Des Petits Ruminant (PPRV), as well as provide cross protecting of different strains with different Lineage or different geographical areas
- The vaccine of this virus provides long-lasting immunity
- The animal cannot be carrier state of this virus
- The way this virus transmitted required close contact from infected animal and healthy animals
- The survival of the virus was weak and can be easily disseminated and destroy from sunlight and heal and cannot survive for a long period of time outside of the host
- Paste des petits ruminants the diagnostic tool for this disease is available and developed diagnostic tools are available
- In another word, when the vaccine is used and apply through a global to control the transmission of the virus in endemic areas. Since the disease have wasting public funds and losses many valuable things of this virus helping to eradicate from the world [87]

The following parameters should be considered before implementing a progressive control program of paste des petits ruminants in order to eradicate it [87]

- To increase herd immunity of the animal in (80%) and reduce the spread and transmission of the virus must implement mass vaccination available, also improve veterinary infrastructure to implement and cover whole livestock population in rural areas
- To implement mass vaccination with 3 years campaign for small ruminant population consideration with economic loss caused by paste des petits ruminants
- There is a several considerations factor consider before implementing the eradication of paste des petits ruminants include customs and cultural taboos prevalent in endemic countries with paste des petits ruminants, for instance, difficulty time to reach festivals because of restriction animal movement
- To increase herd immunity is an important factor to consider them annual turnover because sheep and goats have annual turnover is much higher than the cattle
- The lessons learned the eradicated Rinderpest is maintaining a paste des petits ruminants' cold chain of the vaccine in a similar manner is important to ensure the quality of vaccines in rural areas is a difficult task. Sharing a cold chain for both human and animal vaccine reduces risk and cost-minimizing of the problem of the vaccine that facilitates the control and eradication program of this disease
- The role of the other animal both domestic and wild ruminant in the virus of the paste des petits ruminant must be understood but is still not understood well
- The virus strains of the paste des petits ruminant invade the vaccine and become incomplete herd immunity [87]

### Challenges for the eradication campaign

The eradication of this disease by 2030 is a huge effort to the cost, government, and aid agencies are required to control and eradicate from global due destruction of the economy, production, the productivity of the animal and comprise the livelihood of the poor rural families. So that required large cooperation and quantification of the economy if disease. So important to study some important factor of this disease can spread such number of animal at risk, insufficient knowledge of ethics of the disease on damage of the livestock production, epidemiological distribution of both disease and animal, also difficulty in assessing the quantification of drivers of animal and their product in pastoral and mixed crop/livestock production. However still not investigate and not understanding the role of wildlife in the epizootiology of the paste des petits ruminants. Though there is the isolation of this virus from an outbreak in Indian buffalo, (*Bubalus bubalis*). These all are the challenges and other outbreaks that important into account to eradicate this viral disease from the global [88].

Single immunization can provide long-lasting immunity in an effective vaccine that followed by a single immunization for the existing live-attenuated paste des petits ruminants. As we mention some drawbacks, although we some vaccine has two main drawbacks, firstly the immune response that stimulates vaccine similar and identical to natural infection, therefore it is not possible to differentiate from naturally infected from the animal vaccinated DIVA [85].

So, there is a difficult way for the serological survey to determining by eliminated by the vaccination, secondly, whole investigation this viral disease from the epidemiological understanding their distribution the countries in well understood and have insufficient knowledge. The surveillance system when the disease to get adequate information in a different region for early detection and diagnosis of this disease, special for the farmers in animal health works is not familiar with the disease, illegal animal movements, seasonal occurrence of the disease are main drawbacks to control and eradication of this disease [63].

The cost of the paste des petits ruminants is major gab for easily control is lack economical assessment for strategy control. This would help such information for the use of veterinary services in convincing governments. As well as international to support and fund paste des petits ruminants, economic, and epidemiolocal models within small ruminants' population for framework disease control and eradication, thus allowing ex-ante economic assessment for the paste des petits ruminants [89].

The Asian and African countries that disease is endemic, is the hot and arid environment of both endemic and epidemic regions in both Asia and Africa which makes its cost and inconvenient affair, for good and paste des petits ruminants opriate requiring cold chain to deliver the vaccine into these areas. Also, important to build a thermo-labile vaccine to increase shell life and quality vaccine [85].

### Opportunities for the eradication campaign

The all know serotype and another member of the Morbillivirus have genetically similar and provide cross-protection for the immune host of the animal, thus the vaccine of paste des petits ruminants induce protective immunity and long-lasting immunity. In both natural infection or vaccination. The other opportunity that facilitates the eradication of this virus from global, this disease required close and direct contact from health animal and infected animals, though the virus cannot survive in the environment for long period. The infected can be infectious for a short period of time due to the high mortality of the disease. The important factor that can reduce the effect and impact of the viral disease is a safe and effective vaccine that developed with high diagnostic tools with its sensitivity and specificity are available that facilitate for eradication from this disease [90].

The eradication from a geographically defined area may require a sustained effort and regional cooperation. To reduce the problem of thermo-stability, vaccinations during the cold season is advocated. During the subsequent years, mass vaccination of target population (above 5 months), creation of immune belts at the borders, targeted sero-surveillance will be the required strategies to be employed before the final push for eradication [91,92].

Vaccination of small ruminants using a marker vaccine for Differentiation of Infected and Vaccinated Animals (DIVA) by use of a paste des petits ruminants operate the diagnostic tool. Further, the development of recombinant paste des petits ruminants vaccines and virus-like particles that are relatively more thermo-stable and have DIVA capability through the use of companion diagnostic tests to reduce cost and time for effective control and eradication of this disease eradication. The veterinary institutes/schools/universities and their faculties development vaccines and companion diagnostics [91,92].

### LESSONS THAT CAN BE LEARNED FROM GLOBAL ERADICATION OF RINDERPEST (GREP)

The main lesson from GREP is that understanding disease epidemiology is important factor its eradication [93]. Therefore, control programs, field data would be generated by its rigorous surveillance and its epidemiological understanding of the paste des petits ruminants, supported, and analysed risk and geographical distribution of the disease in small ruminants and large ruminant, also using mapping in geo-referenced mapping systems using GIS [94].

Production of a thermo-stable vaccine in the RP campaign was another important step [95]. Economic and political is a current issue impetus to drive the eradication campaign to complete eradication of the paste des petits ruminants by 2030 [96,97].

To eradication, the disease is important management herd practice is an important to factor, though a better knowledge of sheep and goat population dynamics in Asia and Africa, (including off-take rates) and animal movements (trade, transhumance) will important drive that facilitate the

eradication of the disease. Farmer management for the disease control of peste des petits ruminants based their community dynamic and customs, as well as strength animal health workers and veterinary professionals and services and capacity building research organization [98].

Innovative delivery mechanisms involving the community of livestock owners were helpful in meeting the challenge of how to get surveillance and vaccination services to the remote, often marginalized areas under the GREP. Peste des petits ruminant's eradication will similarly need to find innovative solutions [93].

They should receive attention and sustained resources and benefit from regional and international coordination. The big important to support to eradicate human and financial support animal health surveillance systems and strength veterinary services. For both international organizations to support funding and capacity building to create strategic planning from the global eradication of the peste des petits ruminants. This is to get the experience of rinderpest eradicated shown that strong coordination of all actors at international and regional levels to achieve good results for the eradication of the peste des petits ruminants from the global [89].

Eradicating a disease is not just about controlling epidemics. It must be clearly understood that certain combinations of husbandry and trade practices, such as social organization or remoteness from veterinary services, will lead to stable reservoirs of infection from which it is difficult, if not impossible, to remove the virus by standard disease control activities such as pulsed, mass vaccination campaigns [89].

As Rinderpest is subclinical or serovar in sheep and goats, this disease of peste des petits ruminants emerged after eradication of Rinderpest. In a similar way, the peste des petits ruminants are serovar in cattle. Cattle and buffaloes have shown of peste des petits ruminant's virus infection [46]. The upsurge of peste des petits ruminants has been considered, resulted mutation or discontinuation. For immunity Rinderpest vaccination after following its eradication. At the present time, there is a threat of emergence of the virulent bovine peste des petits virus in cattle. Developed a vaccine against peste des petits ruminants can be self-transmitting of the peste des petits ruminants, albeit to a lesser extent to self-immunized, in contact susceptible animals including cattle [99].

## CONCLUSION AND RECOMMENDATION

Many emerging and re-emerging diseases that affect small ruminants caused the loss of production parameters and reduced economy. Peste des petits ruminants-v causes high mortality and mass destruction of the economy of international and regional countries. Peste des petits ruminants are endemic in many countries of Asia and Africa. Understanding epidemiological distribution and development of a peste des petits ruminants opriate diagnostic test to differentiate natural and vaccinated animals is important. Successful implementation of control measures for peste des petits ruminants requires rapid, specific and sensitive methods for diagnosis. Based on the above conclusion the following recommendations are forwarded:

- Development of a peste des petits ruminants-v antigen that can differentiate natural infections from vaccinated animals is necessary
- Design and production of a thermostable vaccine should be supported,
- Frequent epidemiological surveillance is necessary
- A targeted and strategic framework to eradicate the disease, and get a peste des petits ruminants opriate facilities such financial support, communication and coordination is paramount importance

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