



Food and Agriculture
Organization of the
United Nations

Oie
WORLD ORGANISATION
FOR ANIMAL HEALTH

GLOBAL STRATEGY FOR THE **CONTROL** AND **ERADICATION** OF **PPR**



The designations and denominations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the OIE or of FAO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers and boundaries.

The views expressed in this information product are those of the author(s) and do not necessarily reflect the views of OIE or of FAO.

OIE ISBN 978-92-9044-989-8

FAO ISBN 978-92-5-108733-6

This publication is protected by copyright. Extracts may be copied, reproduced, translated, adapted or published in journals, documents, books, electronic media and any other medium destined for the public, for information, educational or commercial purposes, provided prior written permission has been granted by the copyright holders.

© OIE and FAO 2015

CONTENTS

FOREWORD	3
EXECUTIVE SUMMARY	4
CONTENT	5
LIST OF ACRONYMS	9
INTRODUCTION	11
PART A. GENERAL PRINCIPLES AND TOOLS	13
1. Rationale for the eradication of PPR	13
1.1. PPR situation in the world	13
1.2. Rationale	14
1.3. General principles and SWOT analysis	17
2. Regional situations	21
3. Reasons why there are three well-integrated components	24
4. Tools	25
4.1. Information Systems	25
4.2. PPR Monitoring and Assessment Tool (PMAT)	26
4.3. Post vaccination evaluation (PVE)	26
4.4. Vaccines	27
4.5. Surveillance	27
4.6. Laboratory diagnostics	28
4.7. Regional and international laboratory networks	29
4.8. Regional and international epidemiology networks	29
4.9. Global Research and Expertise Network on PPR (PPR-GREN)	30
4.10. OIE Standards and the Performance of Veterinary Services (PVS) Pathway	30
4.11. Other tools that can be used for PPR and other diseases	31
5. Research needs	32
PART B. THE STRATEGY	33
1. Objectives and expected results	33
1.1. Overall and specific objectives, Purpose	33
1.2. Expected results	34

2. The strategy at national level	35
2.1. Major features	35
2.2. Vaccination	40
2.3. Description of the PPR Control and Eradication Step wise Approach	42
2.3.1. Stages 1	42
2.3.2. Stage 2	47
2.3.3. Stage 3	53
2.3.4. Stage 4	58
3. The strategy at regional level	63
3.1. <i>Peste des petits ruminants</i>	63
3.2. Strengthening Veterinary Services	65
3.3. Combining with other diseases	65
4. The strategy at international level	66
4.1. <i>Peste des petits ruminants</i>	66
4.2. Veterinary Services	67
4.3. Combining with other diseases	67
PART C. GOVERNANCE AND MONITORING, TIMELINES AND COSTING	69
1. Governance	69
2. Monitoring and evaluation	70
2.1. <i>Peste des petits ruminants</i>	70
2.2. Veterinary Services	72
2.3. Other diseases of small ruminants	72
3. Timelines	73
3.1. PPR at national, regional and international levels	70
3.2. Veterinary Services	72
3.3. Combining PPR control activities with other diseases at national, regional and international levels	72
4. Costing	77
REFERENCES	79
ANNEXES	83

FOREWORD

Peste des petits ruminants (PPR) can severely affect small ruminants in almost 70 countries in Africa, the Middle East and parts of Asia. It is a highly contagious disease that causes USD 1.5 to 2 billion in losses each year in regions that are home to over 80% of the world's sheep and goats and to more than 330 million of the world's poorest people, many of whom depend on them for their livelihoods. The disease threatens food security and the livelihoods of smallholders and prevents animal husbandry sectors from achieving their economic potential. Reducing the number of PPR-endemic countries is therefore a shared interest and should be considered a Global Public Good.

PPR, as one of the most damaging of all animal diseases, is among the priority diseases indicated in the FAO-OIE Global Framework for the Progressive Control of Transboundary Animal Diseases (GF-TADs) 5 Year Action Plan. In response to recommendations of GF-TADs, a resolution by the World Assembly of Delegates of the OIE and recommendations of the Committee on Agriculture (COAG) and the Council of FAO, the GF-TADs Working group has developed the PPR Global Control and Eradication Strategy (hereinafter the 'Global Strategy'), which is being presented at the FAO and OIE International Conference for the Control and Eradication of *peste des petits ruminants* to be held in Abidjan (Côte d'Ivoire), from 31 March to 2 April 2015.

The Global Strategy described in this document is not a 'stand-alone' activity designed for PPR control and eradication only. It will allow progress to be made in other fields, with the strengthening of Veterinary Services as a cornerstone of the strategy which will provide the necessary enabling environment to control other animal diseases through a cost-effective combination of activities against several major diseases of small ruminants.

The lessons learned from rinderpest eradication and from a number of regions' experiences have been used thanks to the contribution, throughout the Global Strategy development process, of key selected experts, national and regional authorities, policy-makers, development partners and private industry. We wish to thank the members of the GF-TADs FMD Working Group and all those who have contributed to this Global Strategy for their excellent work.

Today, there is an increased interest in investing in animal disease control and PPR is one of the targeted diseases for many governments and their development partners. We are convinced that the joint FAO/OIE Global Strategy offers a framework with the necessary tools, methods and strategies to implement a well structured global control and eradication programme.

Bernard Vallat

Director General
World Organisation for Animal Health (OIE)

Dr Ren Wang

Assistant Director-General
Food and Agriculture Organization
of the United Nations (FAO)
Agriculture and Consumer Protection Department

ACKNOWLEDGEMENTS

The Global Strategy for the Control and Eradication of PPR has been prepared by the FAO-OIE GF-TADs Working Group (WG), composed of two the Co-chairs Joseph Domenech (OIE) and successively Vincent Martin and Eran Raizman (FAO), and the other members of the WG, Nadège Leboucq and Susanne Münstermann from the OIE and Adama Diallo (Joint Division FAO-AIEA), Giancarlo Ferrari and Felix Njeumi from FAO.

The preparation of the Global Strategy has benefited from the assistance and support of many experts and representatives of key countries, regional organisations and specialised bodies, including the following:

1. The participants in an expert meeting on PPR that was held in Rome, Italy (8-10 October 2014) to discuss the first draft of the Global Strategy: experts and professionals from individual countries, regional and international organisations, NGOs and private industry, OIE and FAO Reference Laboratories/Centres, various bodies in charge of implementing regional programmes and experts from OIE and FAO regional representations;
2. The participants in an e-Conference organised by the GF-TADs PPR WG (from 3 February to 7 March 2014) to prepare the establishment of the PPR Global Research and Expert Network (PPR-GREN);
3. The members of the OIE Scientific Commission for Animal Diseases (SCAD);
4. The authors and contributors to specific paragraphs or Annexes to the Global Strategy, including Jonathan Rushton (RVC, London, UK, Socio-economics and costing of the Global Strategy), Renaud Lancelot (CIRAD, Montpellier, France, epidemiology, Post-Vaccination Evaluation tool, costing of the Global Strategy), Marisa Peyre and Fanny Bouyer (CIRAD, Montpellier, Sociology, Post-Vaccination Evaluation tool), Nick Lyons, João Afonso and Alana Boulton (RVC, London, UK, Costing of the Global Strategy), Gregorio Torres (OIE, Paris; Post Vaccination Evaluation tool) and Tabitha Kimani (FAO, socio-economics);
5. The peer reviewer group who reviewed the Global Strategy document (Alf Fuessel, EC DG Santé, Brussels, Belgium, Franck Berthe, EFSA, Parma, Italy, Kris Declercq, SCAD, OIE, Philippe Dubourget, independent expert, Stephan Forman, WB Nairobi, Kenya, William Amanfu, independent expert, Bandyopadhyay Santanu Kumar, New Delhi, India, Georges Khoury, Veterinary Services, Syria, and Hameed Nuru, GALVmed, Gaborone, Botswana).

EXECUTIVE SUMMARY

Peste des petits ruminants (PPR) is a highly contagious disease of sheep and goats caused by a *Morbillivirus* closely related to rinderpest virus and is considered to be one of the most damaging livestock diseases in Africa, the Middle East and Asia. Bearing in mind the strong negative impact that PPR can have on food security and the livelihoods of poor farmers, the main keepers of sheep and goats, the Global Framework for the Progressive Control of Transboundary Animal Diseases (GF-TADs) Global Steering Committee in 2012, the Food and Agriculture Organization of the United Nations' (FAO) Council and the Committee on Agriculture (COAG) and the World Organisation for Animal Health (OIE), in the form of a Resolution of the World Assembly of Delegates of the OIE in 2014, have all recommended the development of a PPR Global Control and Eradication Strategy (hereinafter named 'Global Strategy') and expressed a strong willingness to address the animal health problems in a systematic way, dealing with horizontal as well as more disease-specific (vertical) issues.

PART A of the Global Strategy describes the rationale for controlling and eradicating PPR and other major small ruminant diseases, the general principles and the tools to be used.

It is estimated that 330 million of the poorest people in Africa, the Middle East and Asia keep livestock, including small ruminants. Sheep and goats play an important role in the livelihoods and food security of poor families and contribute to national economic development. Identified for the first time in the early 1940s in Côte d'Ivoire, PPR has steadily expanded over the years, particularly in the last 15 years, and now affects large parts of Africa, the Middle East, Central Asia, South Asia and the People's Republic of China (China).

In the worst situations, PPR-related morbidity is as high as 100%, with a mortality rate that can reach 90%. In areas where the disease is endemic, the mortality rate may be lower, but the disease has a more insidious impact on flock productivity. Each year, PPR causes economic losses worth an estimated USD 1.2 to 1.7 billion, due to animal deaths, reduced production and the cost of fighting the disease. Approximately a third of the financial impact occurs in Africa and a quarter in South Asia. This large impact could be eliminated and it is expected that the control and eradication of PPR will improve incomes from small ruminant husbandry systems and lead to their improved profitability and productivity.

The current PPR situation is that around 70 countries have either reported infection to the OIE or are suspected of being infected. Of these, more than 60% are in Africa (including North Africa) the other infected countries being in Asia (South-East Asia, China, South Asia and Central Asia/West Eurasia including Turkey) and the Middle East. Another 50 countries are considered to be at risk for PPR. As of May 2014, 48 countries in the world were officially recognised by the OIE as PPR free.

The Global Strategy has three integrated components. While eradication of PPR (Component 1) is the ultimate goal of the Global Strategy, to be attained after a period of 15 years, the PPR Strategy cannot be a 'stand-alone' activity. The Strategy recognises that good quality Veterinary Services (VS) are indispensable for the successful and sustainable implementation of PPR (and other major transboundary disease) prevention and control activities worldwide. Therefore, strengthening the VS as a country moves towards PPR eradication will be the objective of Component 2 of the Strategy and this will in turn create more cost effective opportunities to control other priority diseases, which is the objective of Component 3.

The Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis has identified numerous favourable factors for PPR control and eradication. Examples include the availability of very efficient and safe live attenuated vaccines giving inoculated animals life-long immunity and specific and highly sensitive diagnostic assays (both types of tools to be used according to the OIE international standards specified in the *OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals*), favourable epidemiological features (absence of long-term carrier state in animals and no known reservoir in wildlife or in domestic animals other than small ruminants) and growing political support for the control and eradication of PPR, following on from the successful completion of the Global Rinderpest Eradication Programme (GREP) and benefiting from the lessons learnt. In favour of the Global Strategy are:

- a) the potential for achieving economies of scale and a subsequent relative reduction of programme costs by combining PPR control with activities against other major diseases of small ruminants, and
- b) the incentives provided by the prospect of gaining official OIE recognition of PPR free status or endorsement of national PPR control programmes.

Unfortunately, there are numerous negative factors that can hamper effective control and eradication of PPR, such as the insufficient control of live small ruminant movements, poor information on the size of their populations and the absence of identification of animals in most developing countries. Vaccine delivery systems are often not very effective in reaching all small ruminant holders in certain types of production system and the VS can face numerous logistical problems, such as insufficiently developed private-public partnerships.

The required tools: in addition to the PPR vaccine and specific diagnostic assays that are already available, the following very important tools will also be used during implementation of the Global Strategy. The OIE PVS Pathway will serve to evaluate VS compliance with OIE standards, to identify the cost of the gaps to be addressed for compliance and to address other issues such as veterinary laboratories, relevant legislation and education. The PPR Monitoring and Assessment Tool (PMAT) and the Post-Vaccination Evaluation tool (PVE) have been specifically developed. The aim of the PMAT is to categorise countries according to the four different stages identified in the Global Strategy. The PVE tool will enable the effectiveness of the vaccination campaign to be evaluated, using various methods such as passive and active surveillance, including participatory disease search, serological surveys, flock productivity surveys and sociological surveys to assess livestock owners' perception of vaccination success. The Global Strategy will also establish a Global Research and Expertise Network on PPR (PPR-GREN) to build strong partnerships between researchers, technical bodies, regional organisations, well-recognised experts and development partners and to act as a forum for scientific and technical consultation and discussion.

PART B describes the successive elements of the strategy and the four main stages. The overall objective is a small ruminant sector contributing to global food security and nutrition, human health and economic growth, particularly in developing countries, thereby alleviating poverty, increasing income generation and improving the livelihoods of smallholder farmers and general human wellbeing. The specific objectives of the Global Strategy are the eradication of PPR by 2030, while at the same time, through reinforcing VS, improving animal health globally by reducing the impact of other major infectious diseases.

The expected results are described in a series of tables presenting the percentage of countries reaching the successive stages after 5 years and after 10 years, leading ultimately to global eradication of PPR after 15 years. Regarding the VS, the level of advancement for selected PVS Tool Critical Competencies (CCs) at relevant PPR stages will have been reached by countries that were not previously compliant with OIE standards on quality of VS. Lastly, the incidence of other priority small ruminant diseases will have been significantly reduced.

At national level, the strategic approach is based on four stages, corresponding to a combination of decreasing levels of epidemiological risk and increasing levels of prevention and control capabilities. The stages range from Stage 1, when the epidemiological situation is being assessed, to Stage 4, when the country can provide evidence that there is

no virus circulation either at zonal or national level, and is ready to apply for official OIE recognition of PPR freedom. The strategy recognises that situations and contexts can be very different between and even within countries. Consequently, the proposal is to begin by controlling the disease in areas where it is highly endemic and then to consolidate these control efforts by concentrating on areas where a low endemic level has been reached and where eradication is a feasible objective or is already underway. For countries already free of PPR, the Global Strategy is designed to maintain this status. The duration of each stage is variable and will depend on the context. The strategy recommends a minimum of 12 months and a maximum of three years for Stage 1, three years (from two to five years) for Stage 2 and Stage 3, and one to three years for Stage 4. For each stage, the Global Strategy describes the minimum requirements to enter the stage, the epidemiological and context (environment) situation assessments, the stage focus and specific objectives and outcomes for each of the five technical elements and the activities to be implemented. The five technical elements that characterise each stage are related to PPR diagnosis, surveillance and prevention and control systems, the legal framework in place and stakeholder involvement. The implementation of activities, in particular vaccination which is the key tool of the Global Strategy, will be regularly monitored and evaluated by the PMAT, the PVE and the OIE PVS Follow-up to ensure that efforts are achieving the expected outputs.

At regional level, the focus is on the need for regional coordination and harmonisation of national strategies and activities and on the development of strong partnerships. The regional networks, particularly for laboratories and epidemiology teams/centres, are tools of paramount importance, as clearly demonstrated during the GREP. The GF-TADs Regional Animal Health Centres (RAHCs), where regional multidisciplinary expertise would be located, can play an important role in implementing the Global Strategy at regional level, in close association with the relevant regional economic communities (RECs) or other relevant regional organisations such as the African Union – Inter-African Bureau for Animal Resources (AU-IBAR) in Africa, which are members of the GF-TADs Regional Steering Committees.

At global level, the GF-TADs governing bodies (Global Steering Committee and Global Secretariat, Management Committee) will be maintained and a new Global Secretariat for the implementation of the Global PPR Control and Eradication Programme (PPR-GCEP) will be established. The maintenance and roles of the specialised GF-TADs Working Group on PPR will be reconsidered while establishing the GCEP. The OIE and FAO PPR Reference Laboratories/Centres and the OIE and FAO Epidemiology Collaborating Centres will establish two global networks and the PPR-GREN platform will be set up. The joint FAO/IAEA Division is to play an important role in supporting laboratories at national and regional levels.

PART C explains how the GF-TADs principles and mechanisms will be used to provide coordination at both the global level (and the regional level (particularly the Regional Steering Committees in association with relevant regional organisations). A global control and eradication programme to implement the Global Strategy will be launched and a joint FAO-OIE Global Secretariat will be established to implement this programme. Monitoring and evaluation are key elements of the Global Strategy implementation and the PPR Monitoring and Assessment Tool (PMAT) will be used for that purpose. Countries will participate in (sub)regional PPR Roadmaps during which the stage ranking assessments will be agreed through an ‘acceptance process’.

The timelines of the PPR Global Strategy foresee three 5-year phases. The PMAT and the PVE (when vaccinations have been carried out) will be used on a yearly basis to monitor progress at national level and a precise evaluation of the results will be undertaken in 2020 in order to provide guidance on the continuation of the activities. The timelines for the expected results are presented globally and for each region. Regarding the VS, a table shows the number of relevant CCs and the expected compliance level for each PPR Stage.

Regarding the cost of the PPR Global Strategy, it is important to note that the costs of Component 2 (strengthening Veterinary Services) and Component 3 (combining with other diseases) have not been included in this exercise. The support to Veterinary Services is the object of specific investments after countries have evaluated their needs, particularly through the use on voluntary basis of the PVS Gap Analysis tool. The cost of combating other diseases

in combination with PPR control and eradication activities is extremely difficult to estimate since the list of priority diseases to be addressed will be defined after discussions to be held during regional and national workshops and subsequent definition of specific control strategies against other diseases. But it is also worth highlighting that the investments in supporting activities against PPR will have benefits for Veterinary Services' activities (e.g. surveillance systems) and finally for animal health improvement in all targeted countries.

The undiscounted costs for a fifteen-year Global Strategy are between USD 7.6 and 9.1 billion, with the first five years costing between USD 2.5 and 3.1 billion. The lower range is 16.5% less and would be expected in the event of a rapid decrease in PPR incidence in countries employing an effective vaccination strategy. In all the scenarios tested there are significant vaccination campaigns that could well be reduced by strong targeting of at-risk populations through careful epidemiological and economic analysis. These costs include a realistic figure for vaccine dose costs and an amount to cover vaccine delivery costs in the different scenarios. Overall, it is estimated that annual costs during the initial 5-year period will be in region of USD 0.5 billion. The PPR current annual direct impact alone is between USD 1.2 to 1.7 billion per year, and with a successful eradication programme this impact would be reduced to zero. It is important to recognise that without the strategy anything between USD 4.0 and 5.5 billion would be spent over a 15 year period on poorly targeted vaccination campaigns that are unlikely to lead to eradication.

LIST OF ACRONYMS

ARAHIS:	ASEAN Regional Animal Health Information System
ARIS:	Animal Resources Information System
ASEAN:	Association of South-East Asian Nations
ASF:	African swine fever
AU-IBAR:	African Union – Inter-African Bureau for Animal Resources
AU-PANVAC:	Pan African Veterinary Vaccine Centre
CAHWs:	Community animal health workers
CMC-AH:	Crisis Management Centre – Animal Health
CCs:	Critical Competencies (OIE PVS)
CCPP:	Contagious caprine pleuropneumonia
CEBEVIRHA:	<i>Commission Economique du Bétail, de la Viande et des Ressources Halieutiques</i>
CEMAC:	Central African Economic and Monetary Community
COAG:	FAO Committee on Agriculture
DIVA:	Differentiation between infected and vaccinated animals
ECOWAS:	Economic Community of West African States
EFSA:	European Food Safety Authority
EMPRES:	Emergency Prevention System (FAO)
EMPRES-i:	EMPRES Global Animal Disease Information System (FAO)
FAO:	Food and Agriculture Organization of the United Nations
GF-TADs:	Global Framework for the Progressive Control of Transboundary Animal Diseases
GCC:	Gulf Cooperation Council
GLEWS:	Global Early Warning System (FAO/OIE/WHO)
GREP:	Global Rinderpest Eradication Programme
GCES:	Global Control and Eradication Strategy
HPAI:	Highly pathogenic avian influenza
IAEA:	International Atomic Energy Agency
ICT:	Information and communication technologies
LIMS:	Livestock Information Management System (SADC)
NGOs:	Non-Governmental Organisations
OIE:	World Organisation for Animal Health (Office International des Epizooties)
PANVAC:	Pan African Veterinary Vaccine Centre of the African Union
PDS:	Participatory disease surveillance
PMAT:	PPR Monitoring and Assessment Tool
PPP:	Public–private partnership

PPR:	<i>Peste des petits ruminants</i>
PPRV:	<i>Peste des petits ruminants virus</i>
PPR-GCEP:	Global PPR Control and Eradication Programme
PPR-GREN:	PPR-Global Research and Expertise Network
PVE:	Post-Vaccination Evaluation tool
PVS Pathway:	Performance of Veterinary Services Pathway (OIE)
RAHCs:	Regional Animal Health Centres
RECs:	Regional Economic Communities
REMESA:	<i>Réseau Méditerranéen de Santé Animale</i> (Mediterranean Animal Health Network)
RLEC:	Regional Leading Epidemiology Centre
RLLs:	Regional Leading Laboratories
RP:	Rinderpest
RVF:	Rift Valley fever
SAARC:	South Asian Association for Regional Cooperation
SADC:	Southern African Development Community
SWOT:	Strengths-Weaknesses-Opportunities-Threats
TAD:	Transboundary animal disease
VPH:	Veterinary public health
VS:	Veterinary Services
WAEMU:	West African Economic and Monetary Union
WAHID:	World Animal Health Information Database (OIE)
WAHIS:	World Animal Health Information System (OIE)
WTO:	World Trade Organization

INTRODUCTION

Peste des petits ruminants (PPR) is a widespread, virulent and devastating disease of small ruminants. It has a significant economic impact on food security and livelihoods. PPR is therefore considered one of the most damaging of all animal diseases in Africa, the Middle East and Asia, and it is also one of the priority diseases indicated in the FAO-OIE Global Framework for the Progressive Control of Transboundary Animal Diseases (GF-TADs¹) Global level 5–Year Action Plan² (2013-2017) (17).

In October 2012 the GF-TADs Global Steering Committee requested that the activities of the Global GF-TADs Working Group be extended to include PPR with the task of developing a PPR Global Control Strategy and organising an international conference to launch a PPR eradication programme. This recommendation was further supported by a Resolution of the World Assembly of Delegates of the OIE, adopted in May 2014, and by the recommendations of the Committee on Agriculture (COAG) and the Council of FAO, in October and December 2014, respectively.

In 2013, the OIE and FAO jointly decided to embark upon the control of PPR on a global scale and develop a ‘PPR Global Control and Eradication Strategy’, (hereinafter named ‘Global Strategy’) with a strong willingness to address the animal health problems in a systematic way through approaching horizontal as well as more disease-specific (vertical) issues.

The task of eradicating PPR can benefit from a series of favourable elements, including the experience gained from eradicating rinderpest (RP), several favourable technical aspects (such as a battery of diagnostic and surveillance tools, effective and inexpensive vaccines that covers all known strains/lineages of the virus, no long-term virus carriers and no significant role of wildlife), the new OIE *Terrestrial Animal Health Code* chapter adopted in 2014 (with PPR becoming a disease with an official status (official recognition of PPR free status) and with the possibility of OIE endorsement of national control programmes), the direct economic impact for the owner of the animals as well as a growing political commitment from various decision-makers at national, regional and global levels to invest in a control and eradication strategy for PPR.

The underlying objective of this strategy is that through the control and eradication of PPR and other major diseases and through reinforced Veterinary Services (VS) and global animal health systems, the improvement of animal health will reduce the impact of these diseases and in so doing strengthen the contribution made by the small ruminant sector to global food security and economic growth while at the same time improving the livelihoods of smallholders and poor farmers.

¹ Global Framework for the Progressive Control of Transboundary Animal Diseases, an FAO/OIE initiative launched in 2004

² The Global Action Plan is based on the conclusions and recommendations of the meetings of the GF-TADs Global and Regional Steering Committees, the five GF-TADs Regional Action Plans and the conclusions and recommendations of key meetings that recommended the use of the GF-TADs mechanism to influence and/or implement activities

PART A. GENERAL PRINCIPLES AND TOOLS

1. RATIONALE FOR THE ERADICATION OF PPR

1.1. PPR situation in the world

Since its first identification in the early 1940s in Côte d'Ivoire, PPR has steadily expanded its geographical distribution beyond its original endemic region in Western Africa. Indeed a significant and dramatic geographical expansion of the disease has occurred over the last 15 years resulting in large parts of Central Asia, South Asia and East Asia now being endemic for PPR (Fig. 1). Currently around 70 countries have reported infection to the OIE or are suspected to be infected and another 50 are considered at risk for PPR. Out of these infected countries, more than 60% are in Africa (including North Africa) the other infected countries being in Asia (South East Asia, China, South Asia and Central Asia/ West Eurasia including Turkey) and the Middle East. As of May 2014, 48 countries were recognised as PPR free by the OIE. While these countries are historically free areas in the Americas and Europe, the OIE has established an international recognition process (as was the case with rinderpest) for other countries to follow.

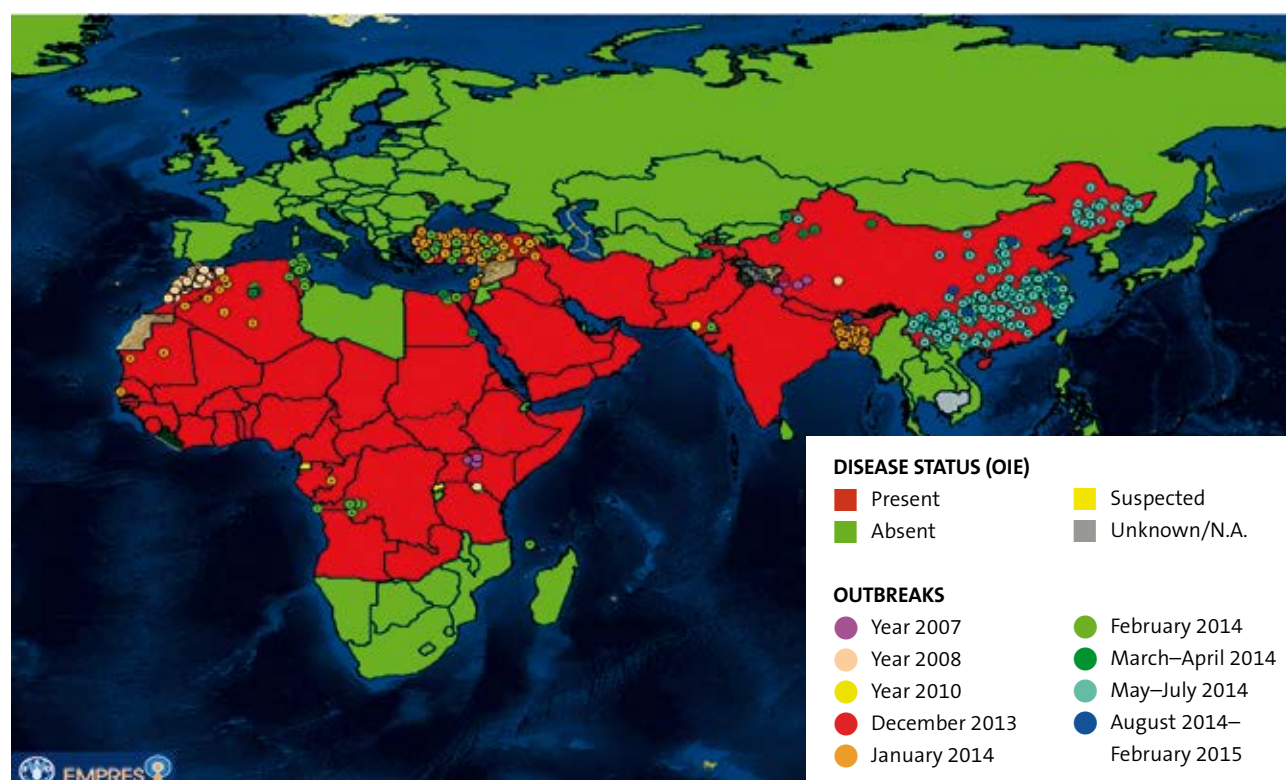


Fig. 1
Current global PPR situation and occurrence of outbreaks between 2007 and 2014
Source: OIE WAHIS and FAO EMPRES-i (12, 29)

Until 2007, the countries in Africa that were officially recognised as infected with PPR were those, apart from Egypt, lying in the belt between the Sahara and the Equator. In 2007, however, PPR caused heavy losses in the Republic of the Congo, Uganda and Kenya. From that year onwards, the disease steadily expanded southwards to cover the Democratic Republic of the Congo, Tanzania, Zambia, Angola and Comoros. In North Africa, it affected successively Morocco, Tunisia and Algeria.

1.2. Rationale

1.2.1. For *peste des petits ruminants* (PPR) (7, 10, 13, 21, 22, 23)³

■ People and small ruminants

It is estimated that 330 million poor people across Africa, the Middle East and Asia keep livestock. Small ruminants, mainly sheep and goats, play an important role in the livelihoods and food security of poor families. Small ruminants are important to those who own and manage them, providing a source of milk, meat, milk and meat products, fibre and wool. Keeping small ruminants is a way of generating cash for expenditure such as school fees as well as providing a store of wealth, rather like a mobile bank. In addition, these small ruminants have a role in returning nutrients to the soil through the production of manure for use in cropping systems.

In many systems, particularly smallholder systems, women are very important in small ruminant production, and the gender dimension needs to be taken into account.

Sheep and goats also play a critical role in the livelihoods of the traders who buy the animals and bring them to urban centres. Trade involves the use of transport and is a source of additional employment. People are also involved in running businesses to slaughter animals, dress carcasses and cure skins. In the case of Kenya, for example, the trade in small ruminants is geographically dispersed, with sheep and goats being brought into the city of Nairobi from Somalia, Ethiopia and Sudan. In Somalia, Djibouti and Ethiopia, the trade of live animals also extends into the Middle East and Arabian Peninsula, with between 3 and 4 million live sheep and goats being exported every year. Similar extensive trading systems for sheep and goats exist across other areas of the Middle East and Asia.

The largest category of beneficiaries of sheep and goat production and value chains consists of consumers, both rural and urban. There are some 5.4 billion consumers in the regions affected by PPR. Consumer demand is currently changing, with a trend towards urbanised living and increasing wealth. These consumers benefit from access to high quality food products such as milk, dairy products and meat, leather from the skins of the animals and wool and fibre for clothing. As demand rises, there is a need for improved production and supply systems to maintain reasonable prices. Fluctuations in the supply of sheep and goat products can have an impact across society and at specific times can affect the diets of many consumers.

In summary, the scale of the production, trade, processing and consumption of sheep and goats means that many people are involved and these small ruminants are important for their livelihood. In the production systems and their associated value chains, millions of people depend on small ruminants to generate revenue for their businesses and families. These people are generally poor relative to other groups in society, and are vulnerable to small changes in the production of sheep and goats.

³ These publications can be found in the list of references

■ *Peste des petits ruminants (PPR) and people*

Some 5.4 billion people live in the areas affected by PPR. In rural areas, many of them rely on sheep and goats. PPR can have dramatic impacts, not only on the families who manage and produce sheep and goats but also along well defined and complex value chains supplied by these production systems. The development of sheep and goat production and value chains requires stability. Therefore, the elimination of animal diseases in general and transboundary diseases such as PPR in particular should be a priority for decision-makers interested in making food value chains less risky for the people involved and the consumers they supply. Measures such as the control and eradication of PPR will not only improve the income from small ruminant husbandry systems, it will also reduce costs and thus will lead to improved profitability and productivity. This in turn will allow the small ruminant economy to contribute to the overall economic development of the national economy.

In rural areas many of these people either have sheep and goats or are affected by the economies these species generate in their local environments. A disease such as PPR causes direct losses in production when it occurs and costs in terms of surveillance, control and prevention. More difficult to estimate is the impact on trade: the presence of a contagious disease will quickly change the pattern of local trade and often lead to international trade embargos. These risks are difficult to quantify and even more difficult to manage, leading to underinvestment in sheep and goat production systems and, equally important, a lack of development of the trade, slaughter and processing infrastructure.

Peste des petits ruminants is a severe viral disease of small ruminants caused by a *Morbillivirus* closely related to rinderpest virus (2, 6, 19). In the worst situations, PPR-related morbidity is 100%, with up to 90% mortality. In areas where the disease is endemic, the mortality rate may be lower; yet the disease has an insidious impact, hampering the development of lambs and kids and compromising the immune defence of adult animals against other, bacterial diseases. Overall, PPR is a limiting factor to the development of healthy and thriving flocks⁴.

It is estimated that direct annual losses due to PPR are between USD 1.2 and 1.7 billion. The estimated current expenditure on PPR vaccination ranges between USD 270 and 380 million. The annual impact of PPR alone may be valued at between USD 1.45 and 2.1 billion per year. Approximately a third of the global financial burden of PPR is borne by Africa, with a further quarter borne by South Asia (Fig. 2). This burden will be removed with the successful eradication of PPR. A control and eradication programme at an estimated cost of USD 2.5 billion (undiscounted costs) over an initial 5-year period (i.e. approximately USD 0.5 billion per year) appears small in comparison. A reduction of 42% in the impact of PPR would justify the annual expenditure alone.

All the socio economic dimensions are discussed in Annex 1

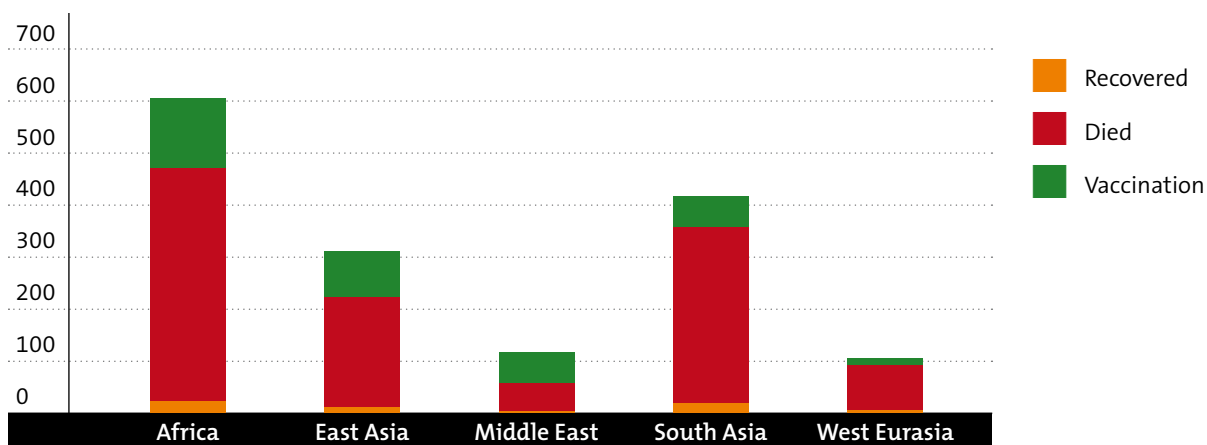


Fig. 2
Impact of PPR (USD million)

⁴ 'Flock' is used for sheep and 'herd' for goats but for the purposes of the Global Strategy, the term flock means any group of small ruminants.

1.2.2. Strengthening Veterinary Services (VS)

The OIE devotes two chapters of the OIE *Terrestrial Animal Health Code* (the *Terrestrial Code*) to the Quality of VS. The VS, as defined in the OIE *Terrestrial Code*, are comprised of public and private sector veterinarians and veterinary para-professionals (28).

Compliance with these standards on quality provides a foundation for implementing all of the other provisions of the OIE *Terrestrial Code*. This will for example increase the credibility of VS' certification for international trade. On a more general note, the quality and good governance of VS create an 'enabling environment' for improving animal and public health and enhancing compliance with SPS standards, at the national, regional and international level.

The quality of the VS depends on a set of factors, which include fundamental principles of an ethical, organisational, legislative, regulatory and technical nature. Some of them are directly related to good governance of the VS, which is a necessary condition for sustainable economic development as it promotes the effective delivery of services and improves the overall performance of animal health systems. Ultimately, the missions of the VS, insofar as they relate to the control and eradication of animal diseases and support economic development, are considered a public good, and are clearly linked to the global goal of reducing poverty and ensuring food security, thereby helping to achieving the Post 2015 Sustainable Development Goals and the UN's Zero Hunger Challenge

1.2.3. Prevention and control of other major diseases of small ruminants

There are several good reasons to combine PPR control programmes with control measures for other diseases, the principal one being the economies of scale that will be obtained through such an association of activities. The opportunities are related to the global increased perception that combating major animal diseases is a good investment for food production and increased revenues. For example, a major cost of the PPR control programme will be in transport and the time taken by technical staff to reach the target population, including smallholders, herders and pastoralists, in order to deliver the PPR vaccine and also to investigate possible PPR outbreaks. This creates an opportunity for the programme in terms of delivery of information and technologies to manage other animal health problems, particularly with regard to combined vaccinations (either multivalent vaccine or several monovalent vaccinations at the same time).

Regarding the list of diseases that could be combined with PPR, several exercises have already been carried out, such as those undertaken to define the priority diseases of the 5-Year Action Plans of the GF-TADs Regional and Global Steering Committees. Some viral and bacterial diseases are good candidates, such as sheep and goat pox, pasteurellosis and brucellosis. Combining control measures for PPR with control measures for other diseases may have particular economic significance in certain regions and farming systems. Possible examples include Rift Valley fever (RVF) or contagious caprine pleuropneumonia (CCPP) in Africa and FMD in Central Asia. It would also be worthwhile exploring whether less contagious infectious diseases that may nevertheless cause significant economic losses, such as internal and external parasites (e.g. trypanosomosis in Africa), enterotoxaemia or anthrax, should be included in combined control measures.

It is important to note, however, that combining activities to control and eradicate PPR with activities against other diseases could be considered counterproductive because they could dilute the focus on PPR eradication. When defining Component 3 of the Global Strategy, it will be necessary to consider this risk very carefully and maintain a good balance between the possible positive and negative consequences of such approaches. The regional and national analysis will be the only way to confirm the extent to which addressing several diseases together is appropriate to the local contexts.

1.3. General principles and SWOT analysis

1.3.1. General principles

The Global Strategy⁵ will operate according to the following underlying principles⁶:

- **To address the disease at source:** Since PPR may also be introduced into countries that are currently PPR-free and have a significant population of small ruminants, it is likely to be a win-win situation if control measures targeted at the source of the problem are supported by countries at risk.
- **To adopt a progressive risk-based approach:** This approach has to be flexible enough to adapt the strategy to national and regional circumstances, particularly with regard to the socio-economic contexts.
- **Focus on pastoral and agro-pastoral production systems:** PPR is more widespread in pastoral and agro-pastoral production systems than in production systems with a predominance of crop agriculture in dry sub-humid and humid regions. Moreover PPR is regularly being introduced or re-introduced into these mixed crop-livestock farming systems from pastoral and agro-pastoral systems. For these two reasons, the control programmes will be focused on the latter.
- **Global political support** from national governments and regional and international communities as well as financial investment from governments and their development partners are key elements for the success for implementation of the Global Strategy.
- **All stakeholders to be involved:** Another condition is to ensure full engagement of all stakeholders (livestock producers and owners, traders, civil society, etc.) in the design and implementation of disease surveillance and reporting as well as of disease control, including biosecurity measures. In addition to Veterinary Services and farmers, the role of NGOs should be taken into consideration.
- **Communication is key:** To obtain strong effective involvement of farmers and other actors, communication campaigns will have to be designed and implemented.
- **A delivery system capable of reaching all producers:** The chances of PPR eradication success are related to the possibility of reaching the vast majority of small ruminants, particularly for vaccination, and this can be a challenge in smallholder village production systems in crop-based humid zones (because of the low density of small ruminants) or in very remote or insecure areas. The quality and adaptability of the delivery systems will be a key element of strategy implementation and all possibilities should be considered, including the use of veterinary paraprofessionals and community-based animal health workers, provided that appropriate legislation and veterinary supervision are in place.

⁵ It is important to note that there is no opposition between the words 'control' and 'eradication'. Control means progressive fight against the disease in certain areas/production systems within a country and, where the control methods are implemented, the expected result is to eliminate (i.e. eradicate) the virus from the targeted small ruminant populations. The word eradication is used when implementing control measures with the expected result being the elimination of the virus from an entire country or region (i.e. several countries).

⁶ The underlying principles can be either principles that FAO and the OIE decide to follow when defining the Global Strategy (e.g. addressing the disease at source or using a risk-based approach, focusing on pastoral and agro-pastoral systems, using rinderpest experience, country centred strategy, etc.) or external conditions that will be essential for the successful implementation of the Strategy (political commitment, financial support from governments and donors, etc.).

- **Improving animal health is a global public good** and all countries need to contribute to the control of highly contagious diseases such as PPR, since if a single country is incapable of controlling an animal health crisis it endangers animal lives and human livelihoods throughout the world.
- **The costs of control and eradication activities are to be shared** according to the situation along the control and eradication pathway. Costs are essentially borne by the owners during the control stages (Stage 2, no eradication objective, 'private good' approach) but the activities become highly subsidised during Stage 3, when vaccination for example becomes compulsory (eradication objective, 'public good' approach).
- **An appropriate institutional environment through good governance of VS and the use of OIE standards:** On the governance and institutional aspects, an appropriate environment for animal disease control through the use of OIE standards is an important requirement. This applies to the VS (use of the PVS Pathway to guide countries) and to more technical issues such as surveillance and the quality of vaccines and diagnostic tests. **It also applies to the import and exports of animals;** countries should not introduce small ruminants without strictly observing the relevant OIE *Terrestrial Code* standards, in order to avoid introducing the disease, even to countries that are not PPR-free.
- **The lessons learnt from rinderpest eradication,** particularly with regard to the regional and international coordination dimensions (8, 25) and from past or on-going PPR control programmes in certain countries or regions, must all be taken into account. Some lessons could also be taken from the response to avian influenza H5N1 crises.
- **Use of existing international and regional organisations and development of partnerships for implementing the Global Strategy at all levels:** The governance and implementation of the Global Strategy is to be built on existing international (OIE, FAO, GF-TADs, IAEA) agencies and relevant regional organisations (RECs) instead of creating new structures. Other partnerships, such as with existing subregional projects, donors, civil society and the private sector (vaccine production firms, international unions of private veterinarians, etc.) will be established or strengthened.
- **Use of incentives to promote PPR control and eradication:** The use of incentives to support the Global Strategy and to encourage livestock-keeper participation can be based on several elements, such as the combination of PPR vaccinations and other field activities with control activities against other small ruminant diseases of importance to animal keepers. This is one of the reasons why a specific component on this type of combination is included in the Global Strategy, with the expectations of a broad benefit against other infectious diseases of small ruminants. Achieving official OIE recognition of PPR free status or endorsement of national PPR control programmes is also a powerful incentive particularly for the National VS and to some extent for export-oriented farms and traders.
- **A country-centred strategy:** Even if a regional approach with co-ordination at the global level are indispensable, it is worth recalling that most activities will be carried out at the national level.
- **Capacity building** at national, regional and global levels has to be a major element of the Strategy.
- **More advocacy through socio-economic analyses:** Advocacy for increased investment in PPR control should be primarily based on cost-effectiveness analyses of the control programmes, to assess their impact, especially for smallholder farmers and for rural development.
- **Monitoring and evaluation activities are indispensable** to assess the Global Strategy implementation achievements and to adjust or update the control methods and strategies accordingly, to ensure optimal performance.

1.3.2. SWOT analysis

STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Component 1 – PPR control and eradication			
<ul style="list-style-type: none"> - Very effective and safe live attenuated vaccines - Effective diagnostic tests, which are already available - Absence of carrier state in animals - No known reservoir in wildlife or in domestic animals other than small ruminants (i.e. that could play a significant role in the epidemiology of the disease) - Available OIE international standards to be used in support of the PPR strategy 	<ul style="list-style-type: none"> - Increasing mobility of live small ruminants for trade - Lack of reliable information on size of small ruminant populations; need to carry out regular census - Lack of individual identification of small ruminants in most countries - Vaccine delivery systems often not very effective to reach small ruminant holders in certain production systems* - Difficult to sustain flock immunity due to high turnover in a given sub-population - Requirement of cold-chain for vaccine not always in place - Absence of DIVA (differentiation between infected and vaccinated animals) vaccines and companion diagnostic assays - Lack of private and non-governmental stakeholder involvement e.g. private veterinarians, community animal health workers - Vaccine delivery hampered by insufficiently developed private-public partnerships (PPP) - Insufficient understanding by livestock owners of the benefits of preventing and controlling animal diseases - Limited preparedness of owners to pay for health services due to limited individual economic value of sheep and goats as compared to cattle 	<ul style="list-style-type: none"> - Growing political support for control and eradication of PPR - Use of rinderpest eradication experience - Possibilities for economies of scale and subsequent relative reduction of the programme costs through combination of PPR prevention and control with activities against other major diseases of small ruminants - Possible incentives through official OIE recognition of PPR free status and endorsement of national control programmes - Increasing role of NGOs in certain countries for animal production development 	<ul style="list-style-type: none"> - Political instability and security problems. An infected country under crisis constitutes a permanent threats to neighbouring countries (current cases in Middle East, North Africa and surrounding regions) - Lack of transparency by some countries regarding their PPR situation

* e.g. in marginalised extensive production systems and/or smallholder systems with limited access to public or private services and with limited political influence, or in some cases in nomadic systems

STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Component 2 – Strengthening Veterinary Services (VS)			
<ul style="list-style-type: none"> - Experience gained from recent crises, e.g. highly pathogenic avian influenza (HPAI) H5N1 or FMD in Europe - Recognition of the role of VS - OIE standards on the quality of VS - Availability of a well-recognised pre-operational tool (PVS Pathway), already implemented in many countries to guide investments for VS reinforcement - Political willingness to strengthen VS - GF-TADs mechanism existing at global and regional level - Improved access to ICT 	<ul style="list-style-type: none"> - Prevalence and incidence of animal diseases - Weak VS in some countries - Other priorities than animal health and veterinary public health in some countries' political agenda - Weak role of consumer stakeholders - Weak network of private practitioners - Lack of professional organisations (producers and consumers, notably) - Lack of appropriate marketing systems and poor internal economic linkages between the agricultural and industrial sectors 	<ul style="list-style-type: none"> - VS are a global public good, eligible for public investment and international aid - Growing global demand for animal protein - Important livestock development potential - Strong potential for extensive livestock breeding - Possible access to higher value markets - World Trade Organization (WTO) accession by an increased number of countries - Donor interest in strengthening VS - Private investments in animal health and food safety - Possibilities to develop PPPs by using para-professionals and community animal health workers (CAHWs) in some specific contexts under veterinary supervision 	<ul style="list-style-type: none"> - Impact of governance on the delivery of VS in the development context - Long land borders (risk of TAD incursion), particularly with countries at risk - Possible lack of transparency - Vulnerability of herders in the pastoral sector
Component 3 – Prevention and control of other major diseases of small ruminants			
<ul style="list-style-type: none"> - Some already mentioned for PPR and VS e.g. experience gained from previous crises, recognition of the role of VS, PVS Pathway available, GF-TADs mechanism in place at global and regional levels - Political willingness to control diseases - Vaccines available for certain diseases - Improved access to ICT - OIE standards for many animal diseases 	<ul style="list-style-type: none"> - Some already mentioned for PPR and VS, e.g. VS to be improved, lack of appropriate delivery systems and PPP, other priorities than animal health and veterinary public health (VPH), weak roles of some stakeholders (producers and consumers, private veterinarians, etc.) - lack of sufficiently effective vaccines for some diseases - No multivalent vaccines available to allow combined vaccination against several diseases in one inoculation of the animal at the same body site. - NB: this could be seen as an opportunity for vaccine producers and researchers to develop new products) 	<ul style="list-style-type: none"> - Some already mentioned for PPR and VS, e.g. growing global demand for animal protein, livestock development potential, possible access to higher value markets, donor interest in animal production and improved control of animal diseases, PPP for improvement of the efficacy of animal health systems, etc. 	<ul style="list-style-type: none"> - Some already mentioned for PPR and VS, e.g. good governance of VS, lack of border controls (particularly with countries at risk), vulnerability of pastoral herders - Some small ruminant diseases are not considered priorities for control - It may sometimes be considered that the other diseases to be included could compromise the progressive control of PPR** - Lack of transparency by some countries regarding their animal disease situation - Emergence of new diseases due to climate change, ecosystem modification, etc.

** risk of losing the focus on PPR control and eradication and thus being less effective, or problems due to different vaccination protocols according to each disease, which could lead to confusion among the owners

2. REGIONAL SITUATIONS^{7,8}

East Asia, South-East Asia, China and Mongolia

The first incursion of PPR into China occurred in 2007. Since the end of 2013, 22 of the 31 provinces in China have been infected. Culling and vaccination (300 million doses) have been conducted in 27 provinces and this has significantly reduced the number of outbreaks.

The Association of South-East Asian Nations (ASEAN) member countries of the South-East Asia region and Mongolia are not infected.

South Asia

In South Asia, a regional roadmap was formulated in 2011 by the SAARC member countries. Almost all the SAARC countries have reported PPR infection. Vaccination campaigns are implemented in high-risk areas. Some countries, such as Afghanistan and Pakistan, benefit from strong FAO technical support.

Central Asia

In Central Asia⁹ few countries are or have been infected but the exact situation is not always well known. Vaccination has been used in several countries and there is a need for greater harmonisation and coordination of all PPR control and eradication programmes.

Turkey is heavily infected. Vaccination is being implemented and one of the major challenges is to prevent any disease incursion into Europe, a region that is totally PPR free at present.

Middle East

The PPR situation in this region is favourable but some countries are infected and the precise situation in some others should be better assessed. Surveillance is ongoing in all countries and awareness is increasing. Nevertheless, during an FAO-OIE GF-TADs workshop held in 2014 a number of limiting factors were identified, such as the lack of regional epidemiosurveillance and laboratory networks, inadequate control of small ruminant movements and insufficient communication. A PPR regional strategy will be formulated and the Gulf Cooperation Council (GCC) Secretariat is currently developing a specific GCC PPR control strategy.

In three countries of the Middle East (Iraq, Syria and Yemen) with large small ruminant populations, the current political disturbances are hindering the surveillance and control programmes for PPR as well as for other major diseases. This represents a major risk to neighbouring countries.

⁷ More details are given in Annex 2

⁸ The list of countries in each of the regions or sub-regions is largely based on the membership of the Regional Commissions of FAO and OIE and that of the relevant Regional Economic Communities. The lists and maps are shown in Part C, Paragraph 2.

⁹ This region groups together Turkmenistan, Kazakhstan, Uzbekistan, Kyrgyzstan, Tajikistan and Caucasus countries (Georgia, Azerbaijan and Armenia). For epidemiological reasons, some countries in the Middle East (Syria, Iran) and South Asia (Afghanistan, Pakistan) regions as well as Turkey are linked to Central Asian countries and are consequently invited to participate in 'West Eurasia' regional meetings.

■ Europe¹⁰

There is no circulation of PPR virus in Europe and 29 countries in the region have an OIE-recognised official free status. Due to the increased risks of introduction related to the expansion of PPR in neighbouring regions in recent years, such as in North Africa and Turkey, the European Food Safety Authority (EFSA) has published a report in 2015 (5) assessing the risk of introduction of PPR into the European Union.

■ North Africa

PPR is currently present in some countries in the North Africa region, where the situation has evolved in recent years. The disease occurred for the first time in Morocco in 2008, with a virus belonging to lineage IV (a virus present notably in South Asia and the Middle East) and the same lineage IV is also present in Tunisia and Algeria and is widespread in Egypt. According to serological surveys it is suspected but not officially reported in Libya. In Mauritania, PPR is due to virus lineage II.

Morocco started implementing a mass vaccination campaign in 2008 and this continued in 2010-2011. The results demonstrated that PPR can be controlled through mass vaccination campaigns. Designing and implementing a regional PPR control strategy in North Africa is of crucial importance and regional policies and activities in the field of animal health are coordinated by the Mediterranean Animal Health Network (REMESA: *Réseau Méditerranéen de Santé Animale*) platform.

■ Eastern Africa

In Eastern Africa all countries are infected and a regional strategy has been developed. Currently, vaccination campaigns are mostly conducted in response to disease outbreaks but wider campaigns have been conducted in several countries such as Kenya and Somalia with the active support of FAO, AU-IBAR and the relevant regional organisations.

■ Southern Africa

Most countries in Southern Africa are currently free from PPR. Following the introduction of PPR in a few countries, the Southern African Development Community (SADC) developed a regional PPR control strategy in 2010 in order to immediately contain/control PPR virus circulation in these countries, to prevent the disease from spreading to adjoining countries and ultimately to achieve the eradication of PPR from the SADC region. South Africa is officially recognised by the OIE as PPR free.

■ Central Africa and West Africa

All countries in Central and West Africa are infected and they are facing multiple constraints in controlling and eradicating PPR. At a regional level, the relevant RECs (Economic Community of West African States [ECOWAS], Central African Economic and Monetary Community [CEMAC], Commission Economique du Bétail, de la Viande et des Ressources Halieutiques [CEBEVIRHA], Western African Economic and Monetary Union [WAEMU], etc.) and other regional organisations need to increase their political commitment as well as their financial and technical support together with their development partners. FAO has implemented several national projects supporting activities relating to laboratory diagnosis (together with AIEA), surveillance and other field operations, vaccine production (together with AU-PANVAC: Pan African Veterinary Vaccine Centre) and formulation of national strategic plans. A pilot field project funded by the Bill & Melinda Gates Foundation was carried out by the OIE in Ghana and

¹⁰ Geographical Europe (and not countries belonging to the FAO or OIE Regional Commissions for Europe).

Burkina Faso to identify the major constraints hampering successful implementation of vaccination programmes, to improve the production and availability of quality control vaccines (with AU-PANVAC) and to establish a regional vaccine bank. The lessons learned have contributed to the definition of this Global Strategy.

In Africa, the support of AU-IBAR is crucial and in 2014 the AU adopted a continental strategy for PPR control (1, 3).

At the global, regional and national levels, FAO and the OIE support regional organisations and member countries, in association with IAEA with regard to laboratory matters. The OIE's adoption of new articles relevant to PPR for the *Terrestrial Code* means that it is now possible for a country to apply for official OIE recognition of freedom from PPR or for OIE endorsement of its national control programme. FAO has published a 'Position paper' in 2014 (11) and has implemented various national development projects. At regional and international level the two organisations are working together within the framework of the GF-TADs initiative to advocate and provide the appropriate expertise in support of their members.

3. REASONS WHY THERE ARE THREE WELL-INTEGRATED COMPONENTS

Eradication of PPR is the ultimate goal of this Global Strategy, to be attained after a period of 15 years.

The PPR strategy cannot, however, be a ‘stand-alone’ activity. The PPR Global Strategy recognises that good quality VS are indispensable for the successful and sustainable implementation of PPR (and other major TADs) prevention and control activities, in addition to their other mandates and activities such as food safety, prevention of antimicrobial resistance or animal welfare. Effective VS are the cornerstone of the PPR ‘enabling environment’. Therefore, VS capacity must be strengthened as a country moves towards eradication and this will be the objective of Component 2 of the Global Strategy. This in turn will create more cost-effective opportunities to control other priority diseases, which is the objective of Component 3. This will be attained through appropriate combinations of activities such as vaccinations against other major diseases, epidemiological investigations, diagnostic activities and treatments.

Strengthening the VS and controlling PPR and priority diseases come together with reciprocal, spin-off benefits, and therefore the Global Strategy includes these three components:

1. PPR control and eradication,
2. Strengthening Veterinary Services,
3. Improving the prevention and control of other major diseases of small ruminants.

4. TOOLS

4.1. Information systems

■ OIE WAHIS-WAHID (29)

The World Animal Health Information System (WAHIS) is an internet-based computer system that processes official data on animal diseases in real-time and then informs the international community. Access to this secure site is only available to authorised users, namely the Delegates of OIE Member Countries and their authorised representatives, who use WAHIS to notify the OIE of relevant animal disease information. The system has two components:

- an early warning system to inform the international community, by means of ‘alert messages’, of relevant epidemiological events that have occurred in OIE Member Countries, and
- a monitoring system in order to monitor OIE-Listed diseases (presence or absence) over time.

The WAHID Interface provides access to all data held within the OIE’s WAHIS. A comprehensive range of information is available from (i) immediate notification and follow-up reports submitted by countries notifying and providing updates on exceptional epidemiological events occurring in their territory; (ii) six-monthly reports indicating the health status of OIE-Listed diseases in each country/territory; (iii) annual reports providing health information and information on a country’s veterinary personnel, laboratories, vaccines, etc.

■ FAO EMPRES-I (12)

The FAO Emergency Prevention System (EMPRES) Global Animal Disease Information System (EMPRES-i) is a web-based application designed to support Veterinary Services by facilitating regional and global disease information.

EMPRES-i aims to clarify disease events worldwide that FAO receives information on from a wide variety of sources. For verification purposes, EMPRES as well as the FAO/OIE/WHO Global Early Warning System (GLEWS) use not just official but also unofficial sources of information. This information is used to generate and disseminate early warning messages. It is also fed into the EMPRES-i database and presented (after validation) in a structured and digested format to the public: disease events database, mapping/graphing tools.

EMPRES-i provides updated information on global animal disease distribution and current threats at national, regional and global levels. It also provides access to pathogen genetic information as well as publications, manuals and other resources, such as lists of reference laboratories and contact details of Chief Veterinary Officers (CVOs).

Under the Disease Events tab, EMPRES-i enables users to access and retrieve information easily on animal disease outbreaks/cases throughout the world according to user-defined search criteria (disease, date, species, location, etc.). Data can then be easily exported in the two available formats (PDF and Excel) for further analysis.

In addition to these international tools there are information systems in place at regional level (e.g. the ARIS: Animal Resources Information System (ARIS) in Africa, the Livestock Information Management System (LIMS) in the SADC region, and the ASEAN Regional Animal Health Information System (ARAHIS) in South East Asia), and some new methods are being developed such as mobile phone application technologies (e.g. SMS, ‘EpiCollect’) and social media, etc., which will ultimately play a critical role in sensitisation, reporting and data collection.

4.2. PPR Monitoring and Assessment Tool (PMAT)

The PPR Monitoring and Assessment Tool (PMAT) is a companion tool to the Global Strategy.

The aim of the PMAT is to categorise countries according to the four different stages (Assessment Stage; Control Stage; Eradication Stage; Post-Eradication Stage) identified in the Global Strategy, which correspond to a combination of decreasing levels of epidemiological risk and increasing levels of prevention and control.

The PMAT also guides and facilitates the efforts of countries that have embarked on prevention and control activities for PPR. Notably, it gives PPR-endemic countries guidance and milestones based on epidemiological and activity-based evidence.

The PMAT can be used either for self-assessment by the country or for external independent assessment by external experts (country visits) at the request of the country. The results of the assessments (using the PMAT) are reviewed and discussed during the annual regional GF-TADs PPR regional roadmap meetings and serve to establish the country's GF-TADs PPR Stage.

A full description of the PMAT is provided in Annex 3.3.

4.3. Post-Vaccination Evaluation (PVE)

Vaccination is the key to preventing and controlling PPR in high risk or endemic areas. In order to evaluate the effectiveness of the vaccination campaign, several approaches can be used, details of which are described in Annex 3.4. Participatory techniques to assess livestock owners' perception of vaccination success and other parameters as well as serological surveys at a defined time period after vaccination can be used for this purpose.

If sero-monitoring is chosen as a method to assess the effectiveness of vaccination, the objectives can vary, depending on a country's epidemiological situation, budget and needs. More details are given in the Annex with the description of different protocols to assess the following objectives or a combination thereof:

- immune response to vaccination
- population immunity at a given point in time
- changes in population immunity over time where PVE is implemented over a sequence of vaccination campaigns.

Just as for the vaccination campaign itself, conducive preconditions such as stakeholder sensitisation need to be put in place before vaccination and PVE.

An appropriate disease surveillance system to detect virus incursion or virus circulation, particularly in unvaccinated parts of the national flock, should be in place to adequately interpret the PVE results. Different surveillance strategies can be used according to particular epidemiological circumstances.

4.4. Vaccines

One of the key conditions for the success of the global rinderpest eradication programme was the use of a rinderpest vaccine that was highly efficacious in protecting animals against all rinderpest virus strains. A similar tool also exists for the prevention and control of PPR. Indeed, efficient live attenuated PPR vaccines are available that can induce lifelong protective immunity in vaccinated animals (see Annex 3.2).

Currently, more than 20 manufacturers produce PPR vaccine. Therefore, it will be of the utmost importance for the products of all these manufacturers, before their use in the field, to be certified as meeting OIE vaccine quality standards (24) to ensure their efficacy. In that regard, the certification body should be an independent institution such as the African Union Pan-African Veterinary Vaccine Centre (AU-PANVAC), which ensures the quality control of various veterinary vaccines, including PPR vaccine, in Africa. PANVAC is an OIE and FAO Collaborating/Reference Centre for quality control of veterinary vaccines.

Current PPR virus (PPRV) attenuated vaccines are thermolabile and to avoid their thermal inactivation they require uninterrupted maintenance of the cold chain until their application to the animal. The currently commercially available vaccines are in freeze-dried form and they are stable for at least two years at 2°C to 8°C and for several years at -20°C. Once the vaccine is reconstituted, it needs to be utilised as soon as possible, but not later than 30 minutes after dilution. Most of the PPR-endemic regions have a hot climate and they usually have poor infrastructure to maintain the cold chain needed to preserve vaccine potency and efficacy. To address this constraint, many research laboratories have succeeded in improving the freeze-drying conditions in the presence of cryoprotectants to obtain a thermostable PPR vaccine product. It is expected that the continued transfer of these newer technologies to vaccine manufacturers will improve the quality of the final products delivered in the field.

Consideration should be given to the constitution of regional vaccine banks to ensure vaccine availability in case of emergencies. The OIE has established vaccine banks using the concept of virtual rolling stocks (32): the supplier (vaccine production companies selected through calls for tender based on international standards) produces the vaccines when needed or a limited physical stock of vaccines remains with the supplier and is renewed on a rolling basis under terms and conditions contractually defined with the OIE. This concept enables the rapid supply of an emergency stock of vaccines to infected countries in order to vaccinate animal populations at risk and to progressively achieve eradication wherever possible. The concept can also serve the purpose of delivering quality vaccine for the annual control programmes, in a non-emergency situation.

The vaccination protocols and delivery systems to be used in this Global Strategy are presented below (see Part B).

4.5. Surveillance

The primary objective in carrying out surveillance is to understand the epidemiological situation in a country or zone and to help define its current PPR stage. Establishing and/or strengthening surveillance for PPR is therefore an absolute priority to achieve the following objectives:

- early detection of the appearance of the disease or virus incursion
- demonstration of the absence of clinical disease or infection with PPRV
- determination and monitoring of the prevalence, distribution and occurrence of the disease or infection

Passive surveillance is the most likely way in which an introduction of the disease might be detected. However, it is advisable also to incorporate active surveillance elements (e.g. structured non-random surveillance, including targeted or risk-based surveillance) in the national control programme. Methods other than sero-surveillance, such as syndromic surveillance, participatory disease search (20), a sentinel system and wildlife and abattoir surveillance, should also be considered (27).

Should serological surveillance be employed, a description of the different protocols for the detection of virus incursion and/or demonstration of absence of disease or infection, as well as the application of different surveillance methods in different situations, is given in Annex 3.5.

Surveillance as well as PVE programmes need to be coordinated with diagnostic services in order to guarantee smooth delivery of field samples to the laboratories, use of validated or at least proficiency-tested tests of known sensitivity and specificity and quick turn-around time for reporting of results to epidemiologists and veterinary administrations. Strong links between the epidemiology teams and field staff and with the laboratories involved in diagnosis need to be established at national level.

4.6. Laboratory diagnostics

As with many diseases, the primary diagnosis of PPR is made by field animal health workers (veterinarian, technician, etc.). It is therefore of the utmost importance that the necessary steps are taken to inform them about PPR clinical and pathological findings and differential diagnosis with similar diseases. However, PPR clinical diagnosis should be always considered as provisional until laboratory confirmation. Since the mid-1980s, the diagnosis of PPR has constantly been improved by benefiting from advances in biotechnology, bioinformatics and miniaturisation of electronic devices. Tools are now available for rapid and specific diagnosis of PPR at different skill levels of the diagnostician and depending on the equipment available in the test laboratory:

- pen-side tests for diagnosis in the field by specialised and non-specialised diagnosticians
- serum-based tests (ELISA) for the detection of antibody or the virus
- PPR virus identification by nucleic acid amplification (RT-PCR)
- virus isolation and genotyping at a well-equipped laboratory or at FAO and OIE reference or collaborating laboratories.

Given that a programme must be cost-effective, control of other priority diseases of small ruminants should be included and the diagnostic laboratories need to be strengthened not only for diagnosis of PPR but also for those diseases simultaneously. The *OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* provides (26) internationally agreed diagnostic laboratory methods (prescribed and alternative diagnostic tests). (A more detailed description of the laboratory diagnostic tools is provided in Annex 3.1.)

4.7. Regional and international laboratory networks

Considering the transboundary nature of PPR, its control requires a regional strategy. This will imply close collaboration and coordination of activities between countries in a given region. To achieve this objective, regional networks are the best structure for diagnostic laboratories and should include regular exchange of information, meetings and workshops to harmonise techniques and to evaluate the result of proficiency testing (quality control of the diagnostic work being undertaken in the national laboratories members of the network). In each regional network at least one national laboratory will be designated by the members of the network as the lead regional laboratory with agreed mandates and missions to coordinate with other national laboratories in the region. The networks will be supported by the Joint FAO/IAEA Division, an OIE Collaborating Centre for animal disease diagnosis, in close liaison with OIE and FAO PPR reference laboratories/centres to ensure that validation and transfer of appropriate technologies, training, virus characterisation, organisation of proficiency testing, etc. are properly implemented.

The OIE and FAO reference laboratories/centres¹¹ will establish an international network in the field of PPR and other diseases of small ruminants in order to support the regional and national networks.

4.8. Regional and international epidemiology networks

At regional level, epidemio-surveillance centres and networks play an important role in monitoring the regional situation and conducting disease intelligence studies on PPR and other realms regarding small ruminant health of regional concern.

The aim of establishing regional epidemiology networks is to share information and strengthen collaboration on different aspects of surveillance (i.e. early detection, early warning and rapid response) and to support national epidemiology teams and networks. To achieve this aim, specific regional meetings will be conducted periodically, at least once a year, to enhance personal and technical relationships. These meetings will also provide training and expertise, harmonise methods and support coordination of strategies and activities. More specifically, whether on a daily basis or during regional meetings, information sharing will include:

1. Early detection of the appearance of the disease.
2. Methods for assessing the health status of a population.
3. Definition of the priority geographical areas for disease control and prevention activities, including vaccination strategies and risk assessment.
4. Mapping small ruminant value/market chain for targeted surveillance and intervention activities.
5. Provision of information to plan, prioritise and conduct research.

¹¹ The OIE recognises Reference Centres which are either 'OIE Reference Laboratories', whose principal mandate is to function as a world reference centre of expertise on designated pathogens or diseases, and 'OIE Collaborating Centres', whose principal mandate is to function as a world centre of research, expertise, standardisation of techniques and dissemination of knowledge on a given specialty. Similarly, FAO recognises Reference Centres, which can be reference laboratories or specialised centres on specific specialities. The FAO Reference Centres recognise 18 technical areas for which FAO requires appropriate expertise. In 2014, the OIE recognised three PPR Reference Laboratories and FAO recognises two of these as Reference Centres on PPR laboratory diagnostic and research.

At international level the OIE Collaborating Centres and the FAO Reference Centres on epidemiology¹² will establish an international network in the field of PPR and other diseases of small ruminants in order to support the regional and national networks and centres/teams.

4.9. Global Research and Expertise Network on PPR (PPR-GREN)

Excellent tools exist such as vaccines and diagnostic tools but the global strategy supports research particularly to increase vaccine thermotolerance, to develop DIVA vaccines and their accompanying diagnostic assays or combined vaccines against several diseases. More research is also needed in the fields of epidemiology, socio-economics and delivery systems. More details are given in Annex 4.

At global level, FAO and the OIE are establishing the Global Research and Expertise Network on PPR (PPR-GREN) which will build strong partnerships between researchers and technical bodies, regional organisations and well-recognised experts and development partners. It will also play an important advocacy role with policy-makers at national, regional and international levels. To prepare this PPR platform, an electronic conference involving 307 subscribers was held in 2014. The concept of including other important diseases of small ruminants was largely supported as well as establishing a strong research group as a major component of the platform. PPR-GREN will operate under the FAO/OIE GF-TADs PPR Working Group and will be primarily a forum for scientific and technical consultation and discussion.

4.10. OIE Standards and the Performance of Veterinary Services (PVS) Pathway

The OIE's standards specific to PPR are contained in the current Chapter 14.7. of the OIE *Terrestrial Animal Health Code* (28) and Chapter 2.7.11. of the OIE *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* (26). PPR is a disease for which countries can apply to the OIE for official recognition of their PPR free status and for endorsement of their national PPR control programmes. In addition to PPR-specific standards, there are a number of horizontal chapters which are applicable to PPR and other highly contagious infectious diseases. For example, there are chapters related to surveillance and notification, risk analysis and the quality of VS, as well as other general recommendations. There are also chapters or individual articles relating to disease prevention and control, trade measures, import/export procedures and veterinary certification, VPH and the legal framework (veterinary legislation). More information on the relevant articles is given in Annex 3.6.

During the years 2006 to 2010, the OIE progressively developed a global programme for the sustainable improvement of a country's VS' compliance with OIE international standards, namely the OIE PVS Pathway¹³ (30, 31). This is a voluntary, comprehensive and multi-staged process (to be embarked upon at the country's request) which involves:

¹² See footnote No. 11

¹³ A detailed presentation of the PVS Pathway can be found in the 'Global Foot and Mouth Disease Control Strategy – Strengthening animal health systems through improved control of major diseases' (Component 2), published in 2012 (14)

the systematic evaluation of VS with regard to international standards (initial OIE PVS Evaluation). The important steps in the process are five-year costed investment plans based on integrating the OIE PVS Evaluation findings with national priorities (PVS Gap Analysis); assistance in the development and/or modernisation of national veterinary legislation (OIE PVS Veterinary Legislation Support Programme); review and improvement of the Veterinary Laboratory network (OIE PVS Pathway Laboratory mission) and capacity (OIE Laboratory Twinning Projects); strengthening and harmonising veterinary education establishments to align them with the corresponding OIE guidelines (OIE Veterinary Education Establishment Twinning Projects); ensuring excellence of the veterinary profession in the private sector by setting standards and establishing measures regarding education and licensing (OIE Veterinary Statutory Body Twinning Projects); and, lastly, a consistent mechanism for the monitoring and evaluation of progress of all components (regular OIE PVS Evaluation Follow-up missions).

The outputs of the various steps in the OIE PVS Pathway are key development instruments for the preparation of national, sub-regional/regional and global programmes aimed at strengthening the VS.

4.11. Other tools that can be used for PPR and other diseases

Several other tools can be used for PPR and other diseases, such as the FAO-OIE Crisis Management Centre – Animal Health (CMC-AH) (16) to undertake emergency response country activities to assist the VS, Ministries of Agriculture/Livestock or, in the case of zoonoses, enabling the coordinated response between relevant health agencies as well as the FAO-OIE-WHO Global Early Warning System (GLEWS) (15) platform to carry out disease intelligence work.

The specific tools to be used for diseases other than PPR will be defined at the regional and country levels after the countries and regions have decided on priority diseases to be addressed.

Candidate small ruminant diseases to be combined with PPR interventions, such as sheep and goat pox, brucellosis, FMD, pasteurellosis, Rift Valley fever (RVF) or contagious caprine pleuropneumonia (CCPP), have their own specific tools relating to their control, such as the relevant OIE standards in the *Terrestrial Manual* and the *Terrestrial Code*, diagnostic assays (diagnostic laboratories), surveillance with specific protocols (sampling methods, etc.), vaccines and legislation.

Specific monitoring and/or evaluation tools, including post-vaccination monitoring (PVM) or Post Vaccination Evaluation Tool (PVE), could be developed for diseases other than PPR (monitoring and evaluation tools already exist for FMD, the Progressive Control Pathway [PCP] (18), and a PVM system is being prepared).

5. RESEARCH NEEDS

While very effective tools already exist for the control of PPR, investment in further research will be invaluable to facilitate the campaign and speed up the course of the programme (see also Annex 4).

The attenuated vaccines currently in use do not enable the differentiation between vaccinated and infected animals. Thus, research should be carried out to develop a vaccine that would make differentiation possible. This would be particularly useful at stages of the campaign where disease surveillance will be implemented simultaneously with vaccination. Another PPR area of research is the development of a multi-disease discriminatory assay and non-infectious diagnostic reagents. As it is planned in the PPR Strategy to encourage vaccination against other small ruminant diseases along with PPR, it is important that diagnostics for the simultaneous surveillance of PPR with those diseases be made available. A multi-disease diagnostic assay will also be needed during the final stages of the eradication programme when PPR-like disease clinical syndromes will have to be investigated to confirm the presence or absence of PPR and to give the owners correct diagnostic results and advice on curative or prophylactic treatments.

To finalise the development of a thermotolerant vaccine, some urgent applied research and transfer of technologies should be undertaken. Oral, aerosolisation or eye drop vaccine administration should also be investigated.

There is also a need to undertake research on the issues regarding the necessary level of immunity to break the PPR virus transmission cycles. Classically this level is considered to be 80% but this percentage appears to be very difficult to obtain and some recent field experiences have shown that 70% could be satisfactory. A precise knowledge of the level of immunity needed to break the PPR virus cycle should be included in the list of research priorities.

Another research area to be encouraged is in the epidemiology field, in order to better assess the potential epidemiological role of other domestic animals or wildlife species. Research should also address the socioeconomics of PPR, in particular in the delivery systems domain, and the impact of the disease and the cost-benefit ratio of control and eradication programmes. Generally speaking, an evaluation of the results of the various approaches and models that will be used during implementation of the Global Strategy would provide a wealth of information for the overall improvement of small ruminant health and intervention measures for other diseases.

PART B. **THE STRATEGY**

1. OBJECTIVES AND EXPECTED RESULTS

1.1. Overall and specific objectives, purpose

The overall objective is a small ruminant sector contributing to global food security and nutrition, human health and economic growth, particularly in developing countries, thereby alleviating poverty, increasing income generation and improving the livelihoods of smallholder farmers and general human wellbeing.

The specific objectives of the Global Strategy are:

a) the eradication of PPR by 2030, which requires:

- in infected countries, achieving a progressive reduction of the incidence and spread, leading to final eradication of PPR;
- in non-infected countries, maintaining the officially recognised PPR free status.

While at the same time:

b) reinforcing Veterinary Services

c) improving animal health globally by reducing the impact of other major infectious diseases.

The purpose is to establish the capacity of stakeholders and VS to control and eradicate PPR and control other small ruminant diseases.

1.2. Expected results

Three types of results (corresponding to the three components) are expected:

a) On PPR

- Effective specific surveillance systems are in place in affected countries and countries at immediate risk (and more general surveillance in all countries)
- Laboratory capacity for PPR diagnosis is established
- Effective vaccination systems are used, with outreach to all livestock holders
- Eradication of PPR worldwide in 15 years. It is expected that after five years around 60% countries have reached Stage 3 or 4, almost all the others (around 40%) are implementing a control programme and less than 5% are still at Stage 1. After 10 years more than 90% of countries are at Stage 3 or 4 which means that in these countries cessation of PPRV circulation is almost achieved.

b) On Veterinary Services

- A minimum of 'level of advancement 3' for selected Critical Competencies (CCs; CC levels are from 1 to 5; see below) in relevant PPR stages has been reached by countries that were not compliant with OIE standards on quality of VS
- OIE standards on quality of VS are at least maintained at the same level by countries that were already compliant with OIE standards on quality of VS.

c) On other small ruminant diseases

- The incidence of other priority small ruminant diseases¹⁴ is reduced significantly.

¹⁴ The identification of diseases will be done at regional and national level at a later stage.

2. THE STRATEGY AT NATIONAL LEVEL

2.1. Major features

- 1. The strategy addresses endemic and free countries at risk:** the Global Strategy recognises that differences in risk of disease or infection occur between (and within) countries, and that, within a region, countries are at different stages in managing risk of infection. As a result, the Global Strategy proposes to first control the disease in highly endemic areas and then to consolidate these control efforts where a low endemic level has been reached and where eradication is feasible or already effective. For countries already free of PPR, the Global Strategy proposes to maintain this status through the tripod 'early detection – early warning – rapid response' and a robust risk analysis to understand the potential pathways for the (re)introduction of the disease.
- 2. Planning for emergency.** If there is inadequate advance planning, national VS will face a disease emergency with insufficient capabilities to respond immediately. Preparedness programmes for animal disease emergencies, such as the incursion of PPR, are the key to mounting early effective action in the face of an emergency. Defining a preparedness programme is an important core function of public VS.

Preparedness planning, including the development and approval of contingency plans for identified highthreat diseases, enables VS to be far better technically equipped to cope with a disease emergency, to take decisions and to release government funds more quickly and to obtain the effective cooperation of farming communities since they will have been involved during the planning preparation. In this regard, it is important that the national authorities establish a forum of all relevant stakeholders where plans and concerns are addressed: i.e., a National PPR Committee.

Contingency plans will address specific diseases that are considered to represent the greatest threat but also unanticipated disease occurrences or unknown new emerging diseases (9).

- 3. The Strategic Approach of the Global Strategy** is based on four different Stages: The four stages correspond to a combination of decreasing levels of epidemiological risk and increasing levels of prevention and control. The Stages range from Stage 1 – where the epidemiological situation is being assessed, to Stage 4 – when the country can provide evidence that there is no virus circulation either at zonal or national level, and is ready to apply for the OIE official country status of PPR freedom (Fig. 3). On the contrary:
 - A country where there are insufficient and unstructured data to understand the true risk for PPR and where no appropriate epidemiological investigations are undertaken and where no prevention and control programme is present, cannot be categorised in any of the four stages (i.e. is 'below Stage 1').
 - A country with an official OIE PPR status cannot be categorised either in any of the four stages (i.e. is 'beyond Stage 4'). A country is entitled to apply to the OIE for official recognition of PPR free status at the end of Stage 4.

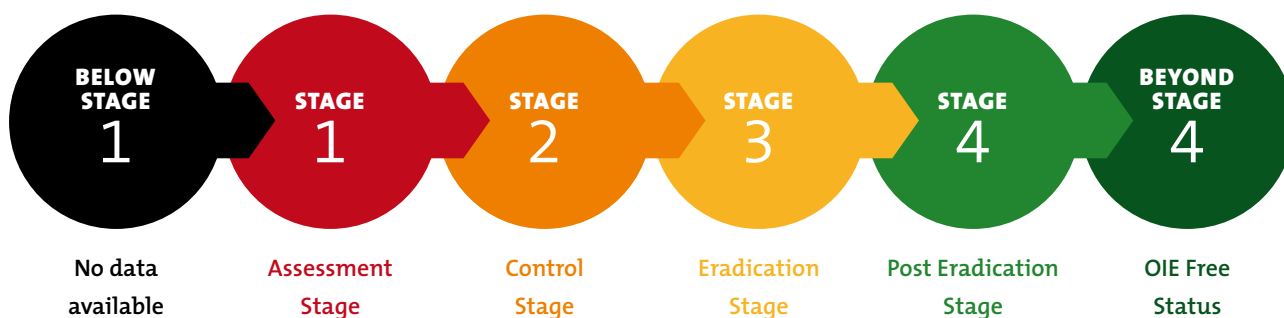


Fig. 3
The Progressive Step-wise Approach for the prevention and control of PPR

4. A regular step-wise approach but fast-track procedures allowed: the usual progression is to move from one Stage (n) to the Stage immediately after (n+1); this will be the case for most countries where PPR is endemic, notably in developing countries which may not have the resources to tackle the disease straightaway on a national scale. However, for countries willing to eradicate PPR more rapidly, there is a fast-track procedure allowing them to move from Stage 1 to Stage 3, Stage 2 to Stage 4 and Stage 1 to Stage 4 (Fig. 4). Whatever the path, Stage 1 is unavoidable to understand the situation and decide the relevant steps forward towards eradication.

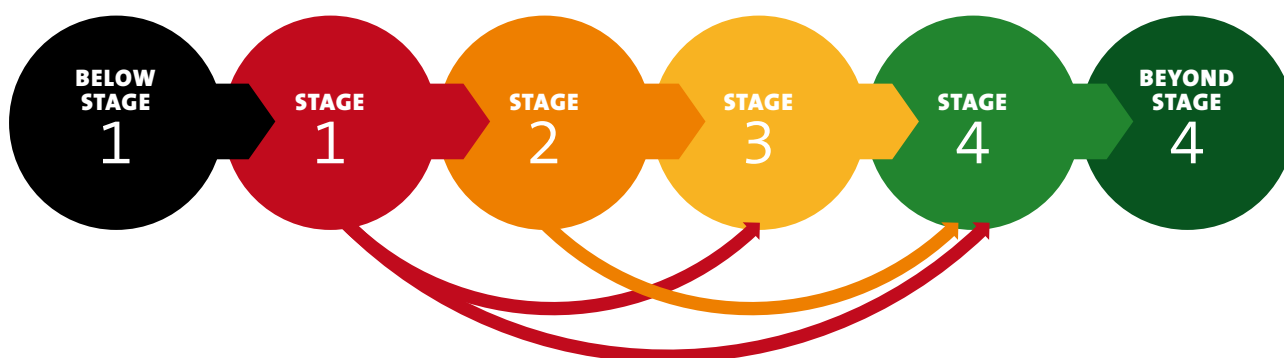


Fig. 4
Fast-track procedure

The diagram shows the progression across the four Stages and illustrates the possibility, when appropriate investment is made, to move directly forward two or even three Stages.

5. Compliance with a higher stage (n+1) supposes compliance with the preceding stage (n) requirements; for countries using the fast-track procedure, the compliance with the preceding Stage (n+1 or n+2, respectively) remains fully valid except for some prevention and control measures, the application of which is likely to be related to the presence or absence of the virus as determined in Stage 1.

6. Stage durations are variable and depend on the context: the speed of progression is according to each country's decision and possibilities, depending on the epidemiological situation, the capacity of the VS and the political commitment with appropriate investments. However, the Global Strategy foresees the following duration for each Stage:

- Stage 1 → minimum 12 months and up to 3 years
- Stage 2 → 3 years (from 2 to 5 years)
- Stage 3 → 3 years (from 2 to 5 years)
- Stage 4 → 24 months and up to 3 years.

- 7. Five technical elements characterise each stage:** categorising a given country at a given Stage (= to a specific level of risk) is the result of a combination of the five technical elements described below:



PPR Diagnostic system(s) – effective control of PPR requires that basic reliable laboratory diagnostic services are operational within individual countries (preferred option) or are outsourced. The capability of field veterinarians and their skill in recognising PPR and initiating a differential diagnostic procedure should be part of the overall diagnostic system.



PPR Surveillance system(s) – surveillance is key to understand PPR epidemiology in a country as well as to monitor progress in the control and eradication efforts. Along the Stages of PPR efforts to control and eradicate the disease, the surveillance system is likely to become more and more complex. In any case, comprehensive surveillance activities imply a thorough understanding of the production and trading systems (value chain).



PPR Prevention and control system(s) – PPR prevention and control measures are a combination of different tools, which can include vaccination, improved biosecurity, animal identification, movement control, quarantine and stamping out. These individual tools are likely to be applied at different levels of intensity while an individual country is moving along the pathway.



Legal framework in place for PPR prevention and control – PPR legislation is the cornerstone that provides the Veterinary Services with the necessary authority and capability to implement PPR surveillance, prevention and control activities. For each Stage it should be guaranteed that the legislation framework in place is consistent with the types of activities due to be carried out.



Stakeholders' involvement on PPR – true progress in PPR prevention, control and eventually eradication cannot be achieved without serious involvement of relevant stakeholders in all sectors (private and public veterinarians, para-professionals, livestock keepers and their community-based animal health workers, traders, NGOs and other development partners). This implies defining their roles and responsibilities at each Stage – the control efforts are likely to be a combination of public and private contributions. This also implies strong awareness and communication strategies directed to all these different actors.

- 8. Vaccination is a key tool to control and eradicate PPR in endemic countries** (or smaller geographical areas or farming systems). The principles to reach appropriate immunity, the vaccination protocols and the delivery systems are presented in the paragraph 2.2 below.
- 9. The implementation of activities** and their impacts are measurable: the set of activities to be implemented in each Stage relates to these five main elements listed above. Activities in each Stage are appropriate to mitigate the risk in accordance with the evidence provided in the preceding Stage or to new evidence provided by the continuous monitoring of the epidemiological situation and progress achieved. Activities and their impacts are indeed measurable in each Stage (PMAT). The implementation of all activities should enable countries to achieve the progressive decrease in the incidence of PPR to the point at which the disease can be eliminated from the domestic animal populations (and wildlife if relevant). Control/eradication activities are regularly monitored to ensure that efforts are providing the expected outputs.
- 10. Vaccination and other control and eradication measures are implemented following combined public good and private good approaches:** the public good nature of the activities implemented increases as the countries move along the stages towards eradication, particularly with regard to vaccination.

- In Stage 1, no official control activities are foreseen by the official public services. Nevertheless, a private owner who wants to protect his/her flock, particularly in endemic regions, should not be prevented. In this case it will be done on a purely private good basis, without any public subsidies. The VS will be involved in controlling that the vaccine and the delivery system (private veterinarians or technicians) are complying with the OIE quality standards. The epidemiological investigations and surveillance are an official public VS responsibility and are public goods.
- In Stage 2, the control activities, particularly vaccination, will be implemented or overseen by the VS in the targeted geographical areas or production systems. This will be done via a public-private partnership and in line with the methods defined in the national control plan. Nevertheless, in the nontargeted areas and production systems, a private owner can implement vaccination on a purely voluntary and private basis, with the same conditions as described above for Stage 1 (more precise information on the vaccination protocols is given below).
- In Stages 3 and 4, all PPR activities are led by the Veterinary Services (with the exception of biosecurity measures at farm level) and are considered to be public goods. Identification of flocks and gradually of individual animals will be implemented in Stages 3 and 4.

11. The public-private good dimension; the costs of implementing the Strategy are shared, the biggest share, however, being supported by public funds: when the vaccinations are not compulsory but decided on a voluntary private basis (private good), the cost is supported by the owner. However, when it becomes compulsory, the public good dimension implies that the costs are shared and that a certain level of public subsidies is considered. The percentages of cost sharing between the owners and the public budget will depend on the epidemiological and economic situations and a precise study will have to be undertaken while preparing the national control and eradication plans. Certain control, eradication and preventive measures, such as surveillance, have to be subsidised and compensation will be paid to the owners in the case of animal culling for disease control purposes. Public funds may not be easily available and buy-in and commitment at country level accompanied by advocacy from the start is critical.

12. Efficient animal health systems, and in particular VS, are indispensable to achieve PPR eradication: efficient VS are indispensable for the successful and sustainable implementation of PPR (and other major TADs) prevention and control activities. Therefore, VS capacity must be reinforced as the country moves along the PPR Stages ('progressive institutionalisation of PPR prevention and control'). Regarding other stakeholders who are not strictly speaking included in the VS¹⁵, including in particular the owners' associations and traders, their partnership with the VS and their involvement in control activities will increase along the PPR Stages. Some development partners such as NGOs can play an important role in the field in certain countries.

The OIE PVS Evaluation tool will be used to assess the level of VS compliance with OIE standards on the quality of VS (initial PVS), and at a second stage, to assess the progress made over time (PVS Follow-Up). Out of the 47 existing Critical Competencies (CCs) of the OIE PVS evaluation tool¹⁶, 33 are clearly

¹⁵ Veterinary Services are defined in the OIE *Code Glossary* (28). They are composed of the governmental and non-governmental organisations that implement animal health and welfare measures and other standards and recommendations in the *Terrestrial Code* and the OIE *Aquatic Animal Health Code* in the territory. The Veterinary Services are under the overall control and direction of the Veterinary Authority. Private sector organisations, veterinarians, veterinary professionals or aquatic animal health professionals are normally accredited or approved by the Veterinary Authority to deliver the delegated functions. The Animal Health Systems can be composed, in addition to the Veterinary Services described above, of other owners associations and traders and of representatives of producers and farmers communities (animal health workers).

¹⁶ Edition 2013

linked to the prevention and control of PPR at national level (hereafter named ‘PPR relevant CCs’)¹⁷. Besides, these CCs are particularly relevant to achieving the outcomes of a specific PPR Stage and therefore the reinforcement of the VS is sequenced and tailored to the relevant PPR Stage needs and timeframe.

For each of these PPR-relevant CCs, five levels of compliance with the OIE standards on quality of VS are established, ranging from no compliance at all (level 1) to full compliance (= level 5). In most cases, level 3 qualifies the country as having sufficient compliance with OIE standards and this level will be the one targeted for most PPR relevant CCs; for a few of them, however, targeting level 2 or level 4 may be more appropriate. A basic principle is that once a level is reached for a given CC, it cannot regress, regardless of the relevance of the CC in further PPR Stages.

13. Strategy implementation will be evaluated/monitored using the two previously mentioned tools, the OIE PVS Evaluation tool and the PPR Monitoring and Assessment tool (PMAT): the evaluation/monitoring of the progressive reinforcement of the VS and of the control and eradication of PPR are carried out using these two distinct tools. While it is not deemed relevant to merge the two tools, the evaluation/monitoring of the VS and of PPR control activities are worth conducting in parallel, the levels of advancement of the OIE PVS CC being considered as relevant and important conditions to move along the PPR Stages¹⁸. The required level of advancement of each of the CCs specific to a given PPR Stage should be met as early as possible in the Stage, if possible at the very beginning though this is not a requirement to enter the Stage.

14. Final considerations: as a result of these different points, each Stage is described in the next Section by the boxes illustrated in Fig. 5, keeping in mind that a country is categorised in a given Stage according to the five technical elements listed in point 6. It is also important to note that for each Stage, the three components forming the basis of the Strategy are presented in an integrated manner, namely Component 1 on PPR specific activities; Component 2 on strengthening Veterinary Services (‘enabling environment’); and Component 3 on the combined control for other diseases of local priority.

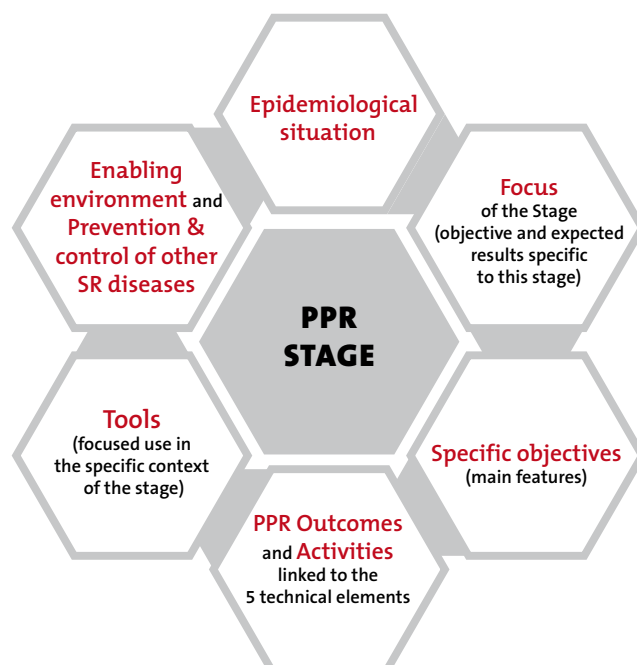


Fig. 5
Sections for each PPR stage

¹⁷ *Caveat:* despite the selection of these 33 PPR relevant CCs, when a country decides to have an OIE PVS Evaluation, the exercise is conducted in full, using all 47 CCs. The focus is, however, placed on the results of the PPR-relevant CCs for a country engaged in the eradication of PPR.

¹⁸ This will be defined in Volume 1 of the GF-TADs global control strategy against major TADs (to be published in 2015).

2.2. Vaccination

2.2.1. Vaccination protocols for PPR

Regarding vaccination protocols, theoretically 100% of the small ruminant populations above three months old should be vaccinated and the vaccination protocols will take into account the type of production systems (in addition to population dynamics and movement patterns).

To facilitate the calculation of the number and cost of vaccination programmes, over ten classical production systems described in several documents (Ref. International Livestock Research Institute (ILRI), FAO 1996) have been merged to form three major systems for small ruminants: the pastoral and agro-pastoral systems in hyper-arid, arid, and semi-arid zones and the mixed crop-livestock farming systems with a predominance of agriculture in dry sub-humid and humid zones.

The following principles will be applied:

- the vaccination will be implemented during two successive years followed by the vaccination of new born animals during one or two successive years;
- in hyper-arid, arid, and semi-arid pastoral and agro-pastoral systems (marked parturition season determined by the availability of forage resources in natural rangelands), a single vaccination campaign should be implemented each year, i.e. at the beginning of the dry season, just before the parturition peak;
- in dry sub-humid and humid mixed crop-livestock farming systems (in which livestock farming is not a major production activity and forage resources and agricultural by-products are more abundant, leading to the absence of a marked parturition season), two vaccination campaigns should be implemented each year to maintain high immunity coverage in small ruminant flocks. The period of vaccination has to be adapted according to the agricultural calendar and, consequently, availability of the farmers;
- in peri-urban production systems, a single vaccination campaign or two campaigns should be implemented each year according to the animal turnover in the flock.

Maintenance of an overall 80% of protection in the targeted population will require a thorough understanding of the population dynamics (i.e. rate of yearly restocking) and may, in turn, dictate the vaccination schedule to be adopted.

The objectives of vaccination campaigns for diseases such as PPR are classically to reach a postvaccination 80% immunity at flock, geographical area or farming system level in order to break the epidemiological virus maintenance and spread cycle. To obtain such a percentage the vaccination coverage should be almost 100% of small ruminant populations above three months old. These assumptions are in fact based on rinderpest experiences and publications but there have been multiple examples of rinderpest virus elimination without reaching such high immunity levels. Besides, very few scientific publications provide evidence to suggest that such levels of immunity are needed to stop PPR virus maintenance and spread. Moreover, the recent experience of Morocco with PPR eradication has shown that 70% immunity was sufficient to eliminate virus circulation in the country (ref). Also, several field experiences and epidemiological research (4) have shown that 80% protection might not always be reached under actual field conditions, even when the vaccination campaign has been correctly implemented. Therefore, while considering that 80% protection remains the option of the Global Control and Eradication Strategy, the design of the PostVaccination Evaluation (PVE see Annex 3.4.) methodology for serological surveys (e.g. sample size) and for the interpretation of the results will be based on a 70% level of immunity.

2.2.2. Vaccine delivery systems

In order to deliver a sufficient quantity of good quality vaccine to the field, several factors need to be considered:

- › the quality of the vaccines received at the national point of entry;
- › the cold chain that needs to be maintained throughout the different vaccine delivery stages, from central purchase point to distribution centres and to the vaccinators in the field;
- › the size of vaccine vials to reduce cost and wastage (smaller vials for smallholder production systems and larger vials for large flocks);
- › a realistic estimation of the required vaccine quantity, in order to provide vaccinators with a sufficient quantity to achieve the desired vaccine coverage;
- › the organisation of delivery to the vaccinator teams and to the flock level.

Implementation of mass vaccination is a major challenge in most developing countries, particularly in remote areas and in village smallholder husbandry systems. Furthermore, recent animal censuses are often not available and the official size of the small ruminant population may be very different from the true figure.

Vaccination will be supervised and often carried out by the public VS. The partnership with private veterinarians holding a 'sanitary mandate' or 'accreditation' (i.e., a contract between the official VS and the private veterinarians who are accredited or approved by the veterinary authority to deliver the delegated functions) is to be developed or is already a common practice in many developed countries and in some intransition countries. The participation of private veterinary para-professionals and of representatives of producers and farmers communities (animal health workers) can be a very effective means of reaching small ruminants in some difficult areas (e.g. remote or insecure areas), when the density of animals is very low such as in smallholder village production systems in crop-based humid zones and/or to facilitate revaccination of young stock when required. This partnership needs appropriate legislation and veterinary supervision to be in place.

Depending on the stage of a given country, vaccination can be a private or a public initiative, targeted at high risk areas or covering the entire population.

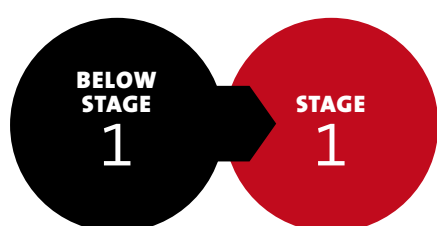
Regardless of the approach, the goal should be to reach the maximum vaccination coverage in the shortest possible time.

For this purpose, the vaccination campaigns need to be carefully planned and executed. Training of teams and logistics, including the cold chain, are essential. Communication is also very important, not only at a national level or using the official channels, but also in identifying the local communication networks (radio programmes, production of TV ads, sponsoring public relation activities, religious or celebratory gatherings). Ignoring them might result in frustration and the dissemination of negative information with respect to vaccination campaigns or other activities. Furthermore, a major challenge is to correctly identify relevant socio-technical networks to be considered for animal health and the delivery of animal health care. When the public VS or private veterinarians are not present to meet the animal health needs of the farmers in remote, insecure or low animal density areas, local stakeholders often take over (e.g. community animal health workers, pharmacies, traders, NGOs, development projects, etc.). Their use for communication and implementation of the PPR vaccination campaigns would be possible under veterinary supervision since these stakeholders can disseminate the right messages regarding the reliability/safety of the PPR vaccine. Furthermore, farmers will fully participate in the vaccination campaigns if they get full support of their usual providers of animal care.

Therefore, vaccination campaigns should be preceded by a very thorough preparatory stage encompassing all these issues and using a participatory approach with the farmers, animal-health stakeholders and local authorities. The participation of communication specialists working with sociologists with a good knowledge of local actors is a key condition during this stage. Post-vaccination evaluations will consider these aspects in order to identify the critical points of the vaccination campaigns in order to take corrective actions to improve subsequent campaigns.

2.3. Description of the PPR Control and Eradication Step-wise Approach

2.3.1. Entering the strategy channel – Stage 1



Minimum requirements:

1. **An Assessment Plan is available and endorsed by the Veterinary Authorities** to gain a better epidemiological understanding of the presence, distribution and (possibly) main risk factors associated with PPR in the country. The objectives, outputs and activities of the Assessment Plan can be derived directly from the outcomes that need to be fulfilled in Stage 1 in order to move to a higher Stage.
2. **The country commits to joining the (sub)regional PPR Roadmap**

■ **STAGE 1**) Epidemiological and context (environment) situation assessments

■ Stage 1 epidemiological situation

For countries entering the PPR control and eradication step-wise approach, at the beginning of Stage 1 the precise epidemiological situation is unknown or poorly known. PPR is most likely to be present, but due to poor surveillance and weak laboratory diagnostic capacity, it has not been reported. In this situation, there is no structured information available on the presence and distribution of PPR that would possibly lead to the formulation of effective control activity¹⁹.

The proposed duration of Stage 1 is one to three years. It should be a relatively short period (one year) to allow control activities to start as soon as possible, but long enough to obtain a proper assessment, which will be the basis for the control Strategy.

At the end of Stage 1 the epidemiological situation will be known based on *(i)* the occurrence or not of the disease expressed through clinical manifestations and *(ii)* the identification or not of the presence of infection using diagnostic tests, and will allow the conclusion to be drawn that:

- The country appears to be free of PPR, meeting or not the criteria of ‘historically free’ (see Article 1.4.6. of the OIE *Terrestrial Code*); or
- PPR is present in the country (epizootically and enzootically).

¹⁹ When a country is supposed or known to be free, even without specific PPR epidemiological surveillance programmes in place, it is ranked in stage 3 or 4 and the objective will be to document the freedom and to submit a dossier to the OIE for possible official recognition of PPR free status, following the provisions of Chapters 1.6. and 14.7. of the OIE *Terrestrial Code* (see below). The countries that are in a position to apply for PPR free status on a historical basis, according to *Terrestrial Code* Article 1.4.6., need to fulfil the OIE relevant criteria but without PPR-specific surveillance.

■ Stage 1 focus

To gain a better epidemiological understanding of the presence of PPR

In Stage 1, the main objective is to acquire elements for a better understanding of the presence (or possibly the absence) of PPR in the country, its distribution among the different farming systems and, ultimately, its impact on these systems. The generation of this information is an essential pre-requisite in order to reach a decision on what next needs to be done: it is important to distinguish whether the country will adopt the decision to implement activities with the initial aim to eradicate PPR only in specific sectors or geographical zones, recognising that the virus may still be circulating in other sectors/areas (Stage 2), or to eradicate PPR in the entire territory (Stage 3). The assessment phase may also demonstrate the absence of PPR, and in this case the country can directly move to Stage 4, applying for an OIE official free status.

Recommended Stage 1 duration: from one year up to three years.

■ Stage 1 specific objectives (Component 1)

Diagnostics	To establish laboratory diagnostic capacity mainly based on ELISA methods
Surveillance	To implement monitoring activities and evaluate socio-economic impacts
Prevention and control	To lay the ground for the implementation of prevention and control activities
Legal framework	To assess the animal health legal framework with a focus on PPR
Stakeholder involvement	To engage stakeholders for their agreement and concurrence on the PPR control and eradication objectives (notably in terms of transparency)

■ Stage 1 PPR outcomes and activities (Component 1)

Outcome 1 (diagnostic System) The laboratory diagnostic capacity of the country is established (activities will largely depend on the status of the laboratory facilities, equipment and expertise already available in the country). A – in-country laboratory diagnostic capacity is established	A1.1 (A)	Assess throughout the country existing laboratory facilities candidates to be designated as the National Laboratory that will be responsible for testing field samples. This process should lead to identify at least one laboratory that will act as leading laboratory for PPR
	A1.2 (A)	Assess throughout the country existing laboratory facilities to be designated as peripheral units to receive and prepare samples before they are sent to the designated leading laboratory/ies
	A1.3 (A)	Establish (or review) ELISA diagnostic procedures for antigen and antibody detection
	A1.4 (A)	Train peripheral units' staff to manipulate PPR samples before they are sent to the leading laboratory for testing
	A1.5 (A)	Test samples (using basic ELISA techniques) and document them (if the laboratory has just started its activities)
	A1.6 (A)	Design a Laboratory Information and Management System (LIMS) if not already existing (no specific indicators are built for this activity)

B – laboratory diagnosis is outsourced internationally	A1.1 (B)	Formulate Standard Operating Procedures on how to handle field samples (if not already existing)
	A1.2 (B)	Train all staff involved in the reception of field samples to receive, record, manipulate, package and ship the field samples received
	A1.3 (B)	Collect and ship samples to an OIE or FAO reference laboratory
Outcome 2 (Surveillance System) A surveillance system is progressively established; however, at this stage, active surveillance should be fully operational allowing an understanding of how PPR may be introduced and/or maintained and what its impact is. The monitoring/surveillance system will include implementation of specific field surveys based on serology and/or participatory disease surveillance (PDS) or some other approaches. The case definition for a possible and likely case of PPR is developed (to serve as basis for building the reporting system and for delivering training to field veterinarians).	A2.1	Formulate/design and implement an overall monitoring/surveillance system (with its active and passive components)
	A2.2	Develop related Procedures for each component (continuing vs. <i>ad hoc</i> surveys) of the surveillance system, as well as Forms to register data
	A2.3	Implement a post-assessment evaluation Form to quantify the clinical and (possibly) the socio-economic impact at this Stage. Visit confirmed clinical outbreaks for such purposes
	A2.4	Design (and possibly implement already at this Stage) an information system in support of surveillance activities (each component and sub-component of the system should be managed through an information system)
	A2.5	Train veterinary officers from central and peripheral level on value chain and risk analysis
	A2.6	(VS) Identify risk hotspots and transmission pathways using the value chains and risk analysis principles
Outcome 3 (Surveillance Systems) The ability of field veterinarians to relate health events to PPR is improved. Organisation of a well-distributed Field Veterinary Network throughout the territory as well as the education of field veterinarians to recognise PPR and make a differential diagnosis are essential aspects in order to capture clinical events that may match the case definition of a possible case of PPR and ensure that such cases are adequately further investigated.	A3.1	Train field veterinarians to increase their awareness about PPR and its differential diagnosis (training should also address collection, storage and submission to the closest delivery place in proper condition and to avoid potential spoiling of test results).
	A3.2	Provide incentives for the installation of private veterinarians in remote areas to capture PPR clinical events
Outcome 4 (Prevention and Control system) A national PPR Committee is established to coordinate all activities related to PPR prevention and control measures. The Committee should be headed by the Central Veterinary Services and include representatives of other ministries / agencies involved in PPR control (Environment; Interior; etc.) as well as private veterinarians (Veterinary Statutory Bodies and Veterinary Association) and all actors involved in small ruminant production. No official prevention activity is foreseen in Stage 1	A4.1	Define the modus operandi and tasks of the National PPR Committee
	A4.2	Organise meetings of the PPR Committee and prepare meeting reports
	A4.3	Formulate/design and implement a Standard Operating Procedure for a response mechanism (appropriate to this Stage) in case of a suspected/confirmed outbreak <i>(In order for such procedures to be fully implemented, it is necessary that awareness material be prepared and distributed to livestock keepers (see Stage 1 Outcome 6).</i>

Outcome 5 (Legal Framework) The legal framework is improved during this Stage to ensure that the Veterinary Services have the authority to take actions that may be needed in the following Stages; in particular, PPR is a notifiable disease in the domestic animal population and suspected/confirmed cases in the wild animal population are also notified to the Veterinary Authorities.	A5.1	(National PPR Committee) Establish specific Working Groups (involving competent authorities, legal experts and relevant stakeholders) to evaluate gaps in the veterinary legislation with regard to PPR that may need to be addressed
	A5.2	(WGs). Propose concrete amendments to update the legal framework conducive to efficient PPR prevention and control

Outcome 6 (Stakeholders' involvement in PPR control) A communication campaign is organised to inform all stakeholders on the vision and on the required actions and why they are put in place. The objectives of the campaign are to promote, stimulate and provide incentives for PPR control measures. Field veterinarians may serve as the means for disseminating the campaign material as well as some other development partners such as NGOs.	A6.1	Prepare/develop communication material to inform stakeholders on PPR control and ultimately the eradication Vision
	A6.2	Disseminate the material to all stakeholders involved in PPR prevention and control activities

■ Stage 1 specific use of tools²⁰ (Component 1)

› Surveillance (→ focused on active surveillance)

The surveillance in Stage 1 has three objectives:

1. to assess the health status of the small ruminant population, including collection of baseline data
2. to define the priority areas for PPR control and prevention activities
3. to determine the prevalence, distribution and occurrence of PPR (disease and infection).

The reporting system – based only on passive surveillance – is likely to be too weak in Stage 1 to collate the required information and this is why an active component must be designed in the Assessment Plan and implemented in Stage 1. A better epidemiological understanding of PPR (and of its impact) can be reached through different methodologies:

- a) participatory disease surveillance (PDS);
- b) serology;
- c) a combination of PDS and serology (valuable for retrospective studies);
- d) post-assessment visits to confirmed PPR outbreaks to evaluate its impact, are all to be seen as components of the overall monitoring/surveillance system to be implemented in Stage 1.

²⁰ In this section, only those tools whose utilisation varies in the different Stages are mentioned; this concerns namely: (i) surveillance; (ii) vaccination, including post-vaccination monitoring; and (iii) OIE standards relevant to PPR. All the other tools referred to in Part A Paragraph 4 are used in the same way regardless of the Stage.

In order to formulate the working hypothesis on how PPR virus is introduced/maintained, it is relevant at this Stage that information generated through the surveillance system is complemented with information generated through a combination of value chain and risk analysis to better identify and characterise hotspots and transmission pathways for PPR virus (it is likely that these activities will need to be introduced and external support may be required).

› (no vaccination)

It is in fact assumed that before entering Stage 1 and during Stage 1, the country does not have any structured response mechanism in place. Emergency vaccination and stamping out may not be considered among the appropriate options. However, control activities can be implemented on a voluntary private basis and may be limited to biosecurity and vaccination measures at the level of individual farms, particularly in the case of commercial farms surrounded by endemic areas.

■ Stage 1 enabling environment (Component 2)

In Stage 1, the VS must have the necessary authority to comprehensively assess the PPR epidemiological situation – in domestic animals and in some circumstances wildlife – throughout the national territory as well as to identify the main risk factors for its introduction, maintenance and spread. Twelve Critical Competencies are relevant to support the PPR-specific activities of Stage 1. The most important competencies to acquire and/or implement for Stage 1 are therefore the capacity linked to active surveillance (CC II.5.B) and risk analysis (CC II.3). The VS should demonstrate an up-to-date knowledge in these fields (CC I.3). Consultations with stakeholders to support national PPR control and eradication efforts are also essential in the early steps of the eradication process. For all Stage 1 PPR-relevant CCs, the level of advancement to target is level 3, except for the competence related to access to veterinary laboratory diagnosis (CC II.1.A), where level 2 suffices as PPR is to be included among the major diseases of national economic importance. The countries will most likely have recourse to private veterinarians (in particular for vaccination activities foreseen in Stage 2) under official delegation (CC III.4) and therefore their licensing and registration is an important pre-requisite (CC III.5.A and B). At this Stage, a National PPR Committee should be established and it may appoint specific Working Groups to follow the different components of the Global Strategy. This National PPR Committee will address specific requests from stakeholders.

OIE PVS CRITICAL COMPETENCIES		TARGETED OIE PVS LEVEL OF ADVANCEMENT	
CC I.2.A	Professional competencies of veterinarians	3	The veterinarians' practices, knowledge and attitudes usually allow undertaking all professional/technical activities of the VS (e.g. epidemiological surveillance, early warning, public health, etc.).
CC I.3	Continuing education (CE)	3	The VS have access to CE that is reviewed annually and updated as necessary, but it is implemented only for some categories of the relevant personnel.
CC II.1.A	Veterinary laboratory diagnosis – Access to veterinary laboratory diagnosis	2	For major zoonoses and diseases of national economic importance, the VS have access to and use a laboratory to obtain a correct diagnosis.
CC II.1.B	Veterinary laboratory diagnosis – Suitability of national laboratory infrastructures	3	The national laboratory infrastructure generally meets the needs of the VS. Resources and organisation appear to be managed effectively and efficiently, but their regular funding is inadequate to support a sustainable and regularly maintained infrastructure.
CC II.3	Risk analysis	3	The VS compile and maintain data and have the capability to carry out risk analysis. The majority of risk management measures are based on risk assessment.
CC II.5.B	Epidemiological surveillance and early detection – Active epidemiological surveillance	3	The VS conduct active surveillance in compliance with scientific principles and OIE standards for some relevant diseases, apply it to all susceptible populations, update it regularly and report the results systematically.
CC III.2	Consultation with interested parties	3	The VS maintain a formal consultation mechanism with interested parties.
CC III.3	Official representation	3	The VS actively participate in the majority of relevant meetings.
CC III.4	Accreditation / authorisation / delegation	3	The public sector of the VS develops accreditation/authorisation /delegation programmes for certain tasks, but these are not routinely reviewed

OIE PVS CRITICAL COMPETENCIES		TARGETED OIE PVS LEVEL OF ADVANCEMENT	
CCIII.5.A	Veterinary Statutory Body – authority	3	The VSB regulates veterinarians in all relevant sectors of the veterinary profession and applies disciplinary measures
CCIII.5.B	Veterinary Statutory Body – capacity	3	The VSB is an independent representative organisation with the functional capacity to implement all of its objectives
CC IV.1	Preparation of legislation and regulations	3	The VS have the authority and the capability to participate in the preparation of national legislation and regulations, with adequate internal and external quality in some fields of activity, but lack the formal methodology to develop adequate national legislation and regulations regularly in all domains.

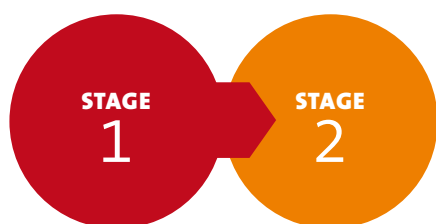
■ Stage 1 Combining control activities with other diseases (Component 3)

The implementation of field activities aimed at building information on PPR can offer a unique opportunity also to investigate other diseases of small ruminants (and possibly other species). If, for example, serum samples are collected as part of the PPR activities, those sera could also be tested for other diseases.

Besides, some activities implemented in Stage 1 are actually not PPR specific and can serve the purpose of any other prevention and control programmes:

- outcome 1.A → activity 1.1; 1.2; 1.6
- outcome 1.B → activity 1.1; 1.2
- outcome 2 → activity 1.1; 1.2
- outcome 3 → activity 2.5; 3.2.

2.3.2. Moving from STAGE 1 to STAGE 2



Minimum requirements:

1. All activities of Stage 1 are successfully completed
2. A comprehensive Report is produced capturing the findings of Stage 1 and should include:
 - (i) the identification of specific ‘hotspots’ defined by the combination of high PPR impact, high risk of spread to other areas or of regular (re)introduction of new infected animals and their mapping in the country;
 - (ii) risk factors for the presence of PPRV and subsequent risk pathways;
 - (iii) a detailed value chain analysis of the small ruminant sector.
3. A comprehensive risk-based Control Strategy (CS1) is developed based on the outcomes of activities carried out in Stage 1 and includes Components 1, 2 and 3 of the Global Strategy.

STAGE 2 Control Stage

Stage 2 epidemiological situation

All activities carried out while in Stage 1 have led to its being established that PPR is widespread/endemic in the country, where the virus is continually circulating. However, the results of the epidemiological investigations will also have shown that the prevalence, incidence and socio-economic impacts of PPR differ from one area or production system to another and that high-risk areas ('hotspots') may exist in the country. In some cases, the production and marketing profiles could identify areas or production systems where, even if PPR is not important, prevention and control measures are needed. This information will allow the identification of areas and/or production systems where control activities should take place in priority.

Stage 2 focus

To control both PPR clinical disease and infection in a specific area or production system

A risk-based Control Strategy has been formulated and will be implemented during Stage 2 in areas or production systems identified based on the outcomes of the activities carried out in Stage 1. However, if any new PPR epidemiological event appears in the non-targeted areas or production system, the control activities of Stage 2 will be extended to include them as well.

The control phase will be mainly based on a targeted vaccination programme aimed at controlling the disease, which means that the virus may be eradicated from the targeted small ruminant populations but without the aim of eradicating the disease nation-wide, foreseen in Stage 3.

Recommended Stage 2 duration: average three years (from two to five years).

Stage 2 specific objectives (Component 1)

DIAGNOSTICS	To strengthen the laboratory capacity through the introduction of bio-molecular methods for a better characterisation of field strains
SURVEILLANCE	To implement surveillance incorporating a response mechanism and risk mitigation measures
PREVENTION AND CONTROL	To implement targeted vaccination campaigns – on an area or production system basis – and thereby, manage secondary prevention in the whole country
LEGAL FRAMEWORK	To improve the legal framework to support the implementation of control activities in targeted sectors
STAKEHOLDER INVOLVEMENT	To actively involve stakeholders in increased reporting and in targeted sectors in the implementation of vaccination campaigns

Stage 2 PPR outcomes and activities (Component 1)

<p>Outcome 1 (Diagnostic system) The laboratory diagnostic system works with a higher level of efficiency than in Stage 1 as possible shortcomings identified are now being solved; in addition, the system is further improved by introducing the use of bio-molecular techniques to obtain a characterisation of field virus isolates.</p> <p>The assumption used is that molecular epidemiology may provide additional insights into PPR distribution and dissemination pathways.</p> <p>Should this not be a feasible option, a link with an international reference laboratory is established to which representative samples can be sent.</p> <p>Characterisation of field virus isolates – and more generally the upgrading of laboratory capacity – is facilitated by the involvement of one or several national laboratories in the Regional Laboratory Network (when existing).</p>	A1.1	Train laboratory staff in bio-molecular testing methods and equip at least one laboratory, if the use of biomolecular testing is an option
	A1.2	Establish and regularly update Standard Operating Procedures for biomolecular testing
	A1.3	Establish written protocols to define criteria to select samples eligible for being processed using biomolecular techniques
	A1.4	Test all submitted samples meeting the eligible criteria for bio-molecular testing
	A1.5	Participate in international proficiency test led by either an International Reference Laboratory or a Regional laboratory designated as leading laboratory in the regional network
<p>Outcome 2 (Surveillance System) The surveillance system is further strengthened:</p> <p>– notably in its passive surveillance component</p> <p>– to capture any possible event linked to PPR.</p> <p>New components are now added into the system, namely: (i) passive surveillance in slaughterhouses and markets; (ii) passive surveillance in wildlife through functional external coordination with the Ministry in charge of wildlife/environment/hunters' organisations (some wild animals may act as sentinels, indicating any spill-over of PPR virus from domestic small ruminants); and (iii) involvement in the (sub-)Regional Epidemio-surveillance Network (when existing).</p>	A2.1	Train inspectors in slaughterhouses to increase their awareness of PPR and its differential diagnosis (training should also address sample collection, storage and submission to the closest delivery place in proper condition and to avoid potential spoiling of test results)
	A2.2	Design a procedure to improve external coordination with MoE and other organisations involved in wildlife management (notably for improved reporting of PPR cases in wildlife)
	A2.3	Organise an awareness campaign on PPR for hunters
	A2.4	Participate in Regional Epidemio-surveillance Network activities (when existing); feed the Network with appropriate sets of data
<p>Outcome 3 (Prevention and control system) A targeted vaccination campaign is implemented.</p> <p>The government has decided to allocate some financial resources to the PPR vaccination programme in the targeted area or sub-population (vaccination in other zones may remain a private initiative). The targeted vaccination zone or subpopulation may evolve during Stage 2, notably upon detection of clinical outbreaks outside the initial targeted zone and constantly taking into account the results of the monitoring system in place.</p>	A3.1	Formulate/design field vaccination Procedures (according to the strategy adopted by the country) for this purpose, the National PPR Committee appoints a specific Working Group
	A3.2	Train field vaccination teams
	A3.3	Implement field vaccination (according to the strategy adopted by the country)
	A3.4	Conduct PPVE with collection of data for evaluating the results of the vaccination programme and monitor the whole vaccination chain accordingly

<p>Outcome 4 (Prevention and control system) Additional measures are put in place to ensure the success of the vaccination campaign.</p> <p>In particular, <i>(i)</i> all outbreaks are investigated to <i>(a)</i> clearly understand why clinical outbreaks may be observed in the sectors/zones covered by the vaccination, and <i>(b)</i> assist in deciding if the vaccination sectors/zones needs to be extended or not (in this case, it will remain limited to what is indicated in Stage 1); and <i>(ii)</i> animal movements (within the country at this Stage) are controlled to ensure that the 2 sub-populations with a different health status as a result of the vaccination campaign remain separate; however, some countries may not be in a position to efficiently regulate animal movement. In such a case, it could be feasible to manage the obligation of introducing only vaccinated animals (or animals to be vaccinated) in those sectors/areas where targeted vaccination is on-going.</p>	A4.1	Design an outbreak investigation Form to collate the following information: <i>(i)</i> possible date of introduction of the virus into the infected premises; <i>(ii)</i> possible means of introduction; and <i>(iii)</i> potential spreading
	A4.2	Conduct investigations for all detected/reported outbreaks, whether in or outside the vaccination sectors/zones
	A4.2	Implement movement controls between the vaccinated/non-vaccinated sectors/zones, in close collaboration with other Services involved (police notably)

<p>Outcome 5 (Legal framework) The legal framework is enforced to fully support the prevention and control activities foreseen in Stage 2.</p>	A5.1	Organise meetings of specific working groups (mixed VS, other authorities, and stakeholders) to better understand the impact of control measures (including financial aspects) on stakeholders and upgrade the legislation framework to support field control activities
	A5.2	Propose concrete amendments to update the legal framework conducive to efficient PPR prevention and control

<p>Outcome 6 (Stakeholder involvement) The Stakeholders fully contribute to the control efforts foreseen in Stage 2.</p> <p>This notably implies that the stakeholders <i>(i)</i> facilitate the vaccination operations in the field – for instance by gathering the animals and handling them; <i>(ii)</i> respect the movement restrictions within the country; and <i>(iii)</i> ensure the early reporting of suspected clinical outbreaks to the VS; at this Stage, early reporting of suspected clinical outbreaks – in particular in the targeted vaccination areas/ production systems – is critical to adjust the control measures already put in place.</p> <p>Awareness and communication are key.</p>	A6.1	Prepare and disseminate informative material to increase awareness among livestock keepers and thereby facilitate reports of suspected cases.
	A6.2	Prepare communication material to explain and convince (advocacy) all stakeholders particularly farmer that control of PPR is needed
	A6.3	Organise meetings with the livestock keepers and their partners active in the field (NGOs, etc.)
	A6.4	Should wildlife be identified among the issues to be addressed, organise meetings involving wildlife specialists and other stakeholders (such as hunters)

■ Stage 2 specific use of the tools²¹ (Component 1)

】 Surveillance (→ mostly passive surveillance)

The surveillance in Stage 2 has two objectives:

1. to provide early detection of PPR appearance;
2. to monitor the prevalence, distribution and occurrence of PPR (disease and infection).

The passive component of the surveillance system will be fully operational through the Field Veterinary Network and surveillance in slaughterhouses and markets; the active component of the preceding Stage is unlikely to be carried out with the same level of intensity.

At this stage surveillance has to provide evidence that the health status of the sub-population targeted for vaccination is clearly different from the one that remains unvaccinated and thus elements of analytical epidemiology are introduced into the overall surveillance system.

Nota bene: sero-surveillance should not be used as an active surveillance method in vaccinated populations. It is used for PVE purposes in vaccinated populations to evaluate vaccination programme effectiveness.

】 Vaccination

The vaccination strategy may have two main components:

- a) a normal control component, targeting a specific zone where PPR is endemic or at high risk, or a specific sub-population at higher risk or of higher commercial value to be vaccinated on a regular basis;
- b) an emergency component (associated with movement control) consisting of the delivery of vaccine upon detection of clinical outbreaks, either in the area/production system already vaccinated (investigations will be undertaken to determine the reason(s) for the failure of the vaccination measures) or in the area/production system not yet vaccinated.

The recommended vaccination protocols described above apply to all animals of flocks being vaccinated during two successive years followed by the vaccination of new born animals during one or two more years. Vaccination campaigns will be implemented as follows: one vaccination campaign per year in hyper-arid, arid, and semi-arid pastoral and agro-pastoral systems, twice yearly campaigns in mixed crop-livestock farming systems and a single or two vaccination campaigns, depending on the animal turnover in the flock, in peri-urban systems.²²

】 Post-Vaccination Evaluation

PVE (which is to be considered as a sub-component of the overall surveillance system) will require implementation of specific activities that are not only limited to the evaluation of the immune response in animals that have received the vaccine. These activities will include active disease search and passive outbreak reporting as well as the implementation

²¹ In this section, only those tools whose utilisation varies in the different stages are mentioned; this concerns namely: (i) surveillance; (ii) vaccination, including post-vaccination monitoring; and (iii) OIE standards relevant to PPR. All the other tools referred to in Part A Section 5 are used in the same way regardless of the Stage.

²² It is highly improbable to determine what exact percentage of the total population will be targeted since the local situations are very diverse. However, to be able to calculate the cost of the vaccination programmes in the Global Strategy, an estimation of a targeted population to be vaccinated during Stage 2 is within the range of 20% to 50% of the national small ruminant population

of a monitoring system to check that all along the vaccine delivery system (from purchase, consignment of vaccine custody by field operators to its final administration to the animals) the cold chain is maintained and there are no failures that could affect the efficacy and effectiveness of the vaccination campaigns. Details are given in Annex 3.4.

■ Stage 2 Enabling environment (Component 2)

In Stage 2, the VS must have the necessary authority and capacity to put in place effective control measures, based mostly on a targeted vaccination campaign. Fifteen CCs are relevant to support the PPR specific activities of Stage 2. The most important competencies to acquire and/or implement for Stage 2 are therefore the capacity linked to disease prevention, control and eradication (CC II.7), and passive surveillance (CC I.6.B, II.5.A et II.8.B) supported by a robust chain of command (CC I.6.A) and data management system (CC I.11). Also of paramount importance is the ability to access adequate and sustainable physical (CC I.7) and financial (CC I.8) resources as the VS embark on a multi-annual eradication programme. In Stage 2, countries can start envisaging zoning as the targeted vaccination campaigns, movement control, etc will allow establishing sub-populations with clear different health status (CC IV.7). Level of advancement 3 is in most cases targeted; however, the long term ambitious eradication objective requires level 4 for four CCs (funding and communication aspects are of particular importance).

OIE PVS CRITICAL COMPETENCIES			TARGETED OIE PVS LEVEL OF ADVANCEMENT
CC I.1.A	Professional and technical staffing of the VS – Veterinarians and other professionals	3	The majority of veterinary and other professional positions are occupied by appropriately qualified personnel at local (field) levels
CC I.1.B	Professional and technical staffing of the VS – Veterinary para-professionals and other technical staff	3	The majority of technical positions at local (field) levels are occupied by personnel holding appropriate qualifications
CC I.2.B	Competencies of veterinary para-professionals	3	The training of veterinary para-professionals is of a uniform standard that allows the development of only basic specific competencies
CC I.6.A	Coordination capability of the VS – Internal coordination (chain of command)	3	There are internal coordination mechanisms and a clear and effective chain of command for some activities
CC I.6.B	Coordination capability of the VS – External coordination	3	There are formal external coordination mechanisms with clearly described procedures or agreements for some activities and/or sectors
CC I.7	Physical resources	3	The VS have suitable physical resources at national, regional and some local levels and maintenance and replacement of obsolete items occurs only occasionally
CC I.8	Operational funding	4	Funding for new or expanded operations is on a case-by-case basis, not always based on risk analysis and/or cost benefit analysis.
CC I.11.	Management of resources and operations	4	The VS regularly analyse records and documented procedures to improve efficiency and effectiveness
CC. II.5.A	Epidemiological surveillance and early detection – passive epidemiological surveillance	3	The VS conduct passive surveillance in compliance with OIE standards for some relevant diseases at the national level through appropriate networks in the field, whereby samples from suspected cases are collected and sent for laboratory diagnosis with evidence of correct results obtained. The VS have a basic national disease reporting system.
CC II.7	Disease prevention, control and eradication	3	The VS implement prevention, control or eradication programmes for some diseases and/or in some areas with scientific evaluation of their efficacy and efficiency
CC II.8.B	Ante- and post mortem inspection at abattoirs and associated premises	4	Ante- and post mortem inspection and collection of disease information (and coordination, as required) are undertaken in conformity with international standards for export premises and for all abattoirs producing meat for distribution in the national and local markets
CC III.1	Communication	4	The VS contact point for communication provides up-to-date information, accessible via the Internet and other appropriate channels, on activities and programmes.
CC III.6	Participation of producers and other interested parties in joint programmes	3	Producers and other interested parties are trained to participate in programmes and advise of needed improvements, and participate in early detection of diseases.

OIE PVS CRITICAL COMPETENCIES		TARGETED OIE PVS LEVEL OF ADVANCEMENT	
CC IV.2	Implementation of legislation and regulations and compliance thereof	3	Veterinary legislation is generally implemented. As required, the VS have the power to take legal action/initiate prosecution in instances of non-compliance in most relevant fields of activity.
CC IV.7	Zoning	3	The VS have implemented biosecurity measures that enable it to establish and maintain disease free zones for selected animals and animal products, as necessary

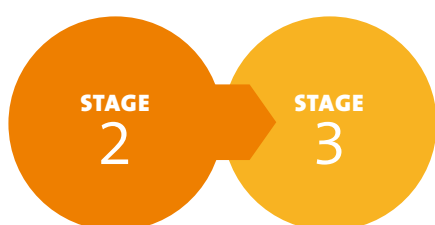
■ Stage 2 Combining control activities with other diseases (Component 3)

In relation to other diseases of small ruminants, it is difficult to anticipate to what extent those sectors or zones targeted for PPR may be complemented by prevention and control activities for other diseases. It is important, however, to emphasise that since vaccination against PPR is going to be the main tool, a preliminary evaluation on the feasibility of combining this with the administration of other vaccine can be considered. The discussions/consultations carried out with the livestock keepers may also be a good opportunity to discuss animal health (or welfare) issues more broadly.

Besides, some activities implemented in Stage 2 are actually not PPR specific and can serve the purpose of any other prevention and control programmes:

- outcome 1 → activity 1.5
- outcome 2 → activity 2.1; 2.2; 2.4
- outcome 3 → activity 3.1; 3.2; 3.4
- outcome 4 → activity 4.1.

2.3.3. Moving from STAGE 2 to STAGE 3



Minimum requirements:

1. All activities of Stage 2 are successfully completed
2. A national **Eradication Strategy** is developed with Components 1, 2 and 3 of the Global PPR Strategy.

Nota bene: the Eradication Strategy is a continuation/reinforcement of the Control Strategy established at the end of Stage 1 but in a more aggressive way, aimed at eradicating PPR in the entire territory (or zone).

■ STAGE 3) Eradication Stage

■ Stage 3 epidemiological situation

At the beginning of Stage 3, the occurrence of clinical disease in the sub-population covered by the vaccination programme carried out in Stage 2 is expected to be nil. In the sub-populations not covered by the vaccination programme, there are three possible scenarios:

1. there is no PPRV circulation,
2. cases/outbreaks occur only sporadically (as the programme is expected to have a secondary preventive effect in non-vaccinated animals in the surrounding area), or
3. the situation remains endemic (but with a small socio-economic impact, otherwise these sub-populations would have been chosen to be part of the targeted Stage 2 vaccination programme).

In the last two scenarios, strong control measures will need to be implemented. In the first scenario, strong preventive measures and emergency response capabilities have to be put in place.

At the end of Stage 3, no clinical outbreaks can be detected in the whole territory and diagnostic tests also indicate that the virus is no longer circulating in the domestic animal and wildlife populations.

■ Stage 3 focus

To achieve the eradication of PPR from the national territory of the country

The country has the capacity and resources to move towards an eradication programme. Whether this should be based on extending the vaccination to other production systems or to other geographical areas not yet covered under Stage 2 or possibly on strategies not based on vaccination will be decided by evaluating the results of Stage 2. Moving towards eradication may mean that the country will gain the capability and resources to adopt a more aggressive control strategy to suppress virus replication in those premises where new clinical outbreaks may be detected.

At this Stage, the country is moving towards eradication and any health events that could be related to the presence of PPR virus need to be promptly detected and reported and appropriate measures immediately put in place to control them. The country must develop and have the capacity to implement the contingency plan that forms part of the eradication strategy. If a new risk of introducing PPRV in the area or production system arises, the results of the surveillance system and of epidemiological analysis must identify and qualify the risks and appropriate measures should be rapidly implemented to mitigate the risk of introduction. Risk analysis and risk assessment guides and handbooks are available (24).

Recommended Stage 3 duration: average three years (from two to five years).

■ Stage 3 specific objectives

DIAGNOSTICS	To further strengthen laboratory capacity to support eradication through the introduction of a laboratory quality assurance system
SURVEILLANCE	To strengthen surveillance incorporating an emergency response mechanism
PREVENTION AND CONTROL	To achieve eradication, either by extending vaccination to areas/production systems not yet vaccinated or by adopting a more aggressive policy to suppress virus replication in identified outbreaks
LEGAL FRAMEWORK	To further improve the legal framework to support prevention and risk mitigation at population level, including the risk of PPR introduction from abroad, and possibly accommodate a compensation mechanism
STAKEHOLDER INVOLVEMENT	To fully involve stakeholders in establishing procedures for accessing compensation funds in the event of PPR outbreaks

Stage 3 PPR outcomes and activities (Component 1)

<p>Outcome 1 (Diagnostic system) The Laboratory starts to develop a quality assurance scheme.</p> <p>Laboratory maintains at least the same level of activities as in the previous Stage, while putting Quality Assurance in place, at least for all laboratories used by the Veterinary Services. A strong link with an international reference laboratory is also maintained.</p>	A1.1	Implement a quality control system in the central laboratory and its branches constituting the laboratory network in the country, and develop all procedures related to the manipulation and testing of samples for PPR virus according to the standards of a quality assurance scheme
	A1.2	Implement collateral procedures to ensure that stocks of reagents, laboratory devices, equipment, etc. are purchased following quality assurance procedures in all the laboratory/ies involved in the diagnosis of PPR
<p>Outcome 2 (Surveillance system) The surveillance system has been further upgraded and includes specific components addressing early warning.</p> <p>The surveillance system continues to operate as indicated in previous Stages but in addition, its sensitivity is increased in Stage 3: (i) information on neighbouring countries (or on countries from which animals/goods are imported that may carry the virus) is now routinely collected; (ii) high resolution surveillance may target specific sub-groups (newborn animals not yet vaccinated) or cattle as proxy indicators of virus circulation; (iii) the activities to detect cases in wildlife are increased.</p>	A2.1	Establish procedures to capture PPR health events in neighbouring countries or countries from which animals are imported. <i>The group dedicated to qualitative Risk Assessment already identified in Stage 1 should conduct this work</i>
	A2.2	Design and implement surveillance in those subpopulations or areas where the events can be captured and misinterpretation is minimised
	A2.3	Increase the collection of sero-surveillance data from wildlife and other susceptible species
<p>Outcome 3 (Prevention and control system) A more aggressive control strategy is in place aimed at eradication and possibly supported (if feasible) by a stamping-out policy (linked to a compensation scheme).</p> <p>It may be that either (i) a whole area or country vaccination programme or (ii) a targeted vaccination programme will be implemented as part of a more aggressive control strategy. In both cases it is expected that the control policy will lead to eradication. The vaccination programme is defined according to the results of Stage 2 vaccination (Post-Vaccination Evaluation [PVE]) and continuous surveillance.</p> <p>In case of (ii), an emergency preparedness and contingency response plan are now also implemented, possibly linked to a stamping-out policy, to control promptly a clinical outbreak of PPR in the infected premises and to reduce the infectious period at flock level.</p> <p>Breeders are encouraged to reinforce the biosecurity measures at farm level (this may be linked to the level of compensation in the event of stamping out); biosecurity is also reinforced in live markets.</p>	A3.1	Implement vaccination campaigns in areas where virus still circulates (in already vaccinated areas and/or in unvaccinated areas) according to the results of continuous monitoring and evaluation of the results of Stage 2. All vaccinated animals will be identified at the same time
	A3.2	Conduct surveillance activities and PVE with collection of data for evaluating the results of the vaccination programme and monitor the entire vaccination chain accordingly
	A3.3	Develop a contingency plan in case of (ii), officially endorsed and approved by the Veterinary Authorities. <i>The National PPR Committee will assign a group of experts (which could be supported by international experts if required) to formulate such a contingency plan</i>
	A3.4	Test the correct application of the contingency plan through field simulation exercises as part of the activities to maintain a high level of awareness
	A3.5	Carry out prompt preliminary precautionary measures once a suspicion is raised (they are withdrawn if the outbreak is not confirmed or are immediately followed up if the outbreak is confirmed)
	A3.6	Implement prompt measures to contain virus spread once an outbreak is confirmed (whether this should be based on animal movement restrictions, culling or emergency vaccination, or a combination of these, is a country policy choice)
	A3.7	Design and implement field procedures to officially close an outbreak and lift the restrictions put in place to be done by the National PPR Committee
	A3.8	(Voluntary) Submit a national control programme to the OIE for official endorsement, in accordance with the provisions of the OIE <i>Terrestrial Animal Health Code</i> (Chapters 1.6. and 14.7)

<p>Outcome 4 (Legal framework) The veterinary legislation includes clear provisions for: (i) compensation for small ruminants culled for disease control purposes (should stamping-out be adopted as one of the control policies), and (ii) improved biosecurity in live markets and at farm level. The PPR legal framework is properly enforced.</p> <p>Implementation of an identification system for small ruminants is an asset to improve their traceability and movement control.</p>	A4.1	Develop a procedure to compensate farmers whose animals were culled for disease control purposes. <i>(The National PPR Committee may appoint a Specific Working Groups to develop such a procedure)</i>
	A4.2	Carry out studies on how to improve biosecurity in live animal markets and at farm level and how biosecurity can impact on stakeholders <i>The National PPR Committee may appoint Specific Working Groups to do this</i>
	A4.3	Carry out feasibility studies to implement an animal identification system
	A4.4	<i>Propose concrete amendments to update the existing legal framework conducive to supporting the new control measures foreseen in Stage 4 (compensation scheme, biosecurity, animal identification); in addition, legal provisions for suspending/stopping the vaccination are also included</i>

<p>Outcome 5 (Stakeholder involvement) Stakeholders are actively consulted for the compensation arrangements and are involved in the identification of their animals.</p> <p>Stakeholder involvement at this Stage is essential and, as in the previous stages, there is sufficient evidence that stakeholders have been duly involved in sharing control programme overall outcomes and that they have been part of the decision process to move towards eradication. Communication continues to be a key element.</p>	A5.1	Establish a specific procedure (by the National PPR Committee) to address issues raised by a specific group of stakeholders concerning matters relating to PPR control/eradication that may impact on their business activities
	A5.2	Address specific requests from stakeholders (by the National PPR Committee, with the possible support of Working Groups)
	A5.3	Distribute communication material, use media and other oral means and organise specific meetings aimed at updating all stakeholders, including development partners active in the field (e.g. NGOs), where the country stands in its national efforts towards eradication and ensure their full and sustained support

■ Stage 3 specific use of tools²³ (Component 1)

› Surveillance (→ a combination of active and passive surveillance but with a special focus on passive surveillance to detect new outbreak occurrences)

The surveillance in Stage 3 has three objectives:

1. to provide early detection of possible PPR appearance;
2. to explain the reasons for this new introduction of the virus, to monitor the results of the immediate response and to give guidance for possible refining of the prevention and emergency response plan if appropriate;
3. to demonstrate the absence of PPR clinical disease or infection.

› Vaccination

In Stage 3, the vaccination strategy will depend on the outcomes of Stage 2. The pivotal role played by the monitoring and evaluation tools (PMAT and PVE) is again highlighted. The possible scenarios will be dependent of the monitoring and evaluation results²⁴.

- › If the situation is or has become endemic in the entire area or production system not targeted in Stage 2, an area- or production system-wide vaccination programme is to be implemented during two successive years followed by vaccination of new born animals during one or two successive years.

²³ In this section, only those tools whose utilisation varies in the different Stages are mentioned; this concerns namely: (i) surveillance; (ii) vaccination, including post-vaccination monitoring; and (iii) OIE standards relevant to PPR. All the other tools referred to in Part A Section 5 are used in the same way regardless of the Stage.

²⁴ As in Stage 2 (see footnote No. 21) it is very difficult to foresee the percentage of the small ruminant population to be vaccinated. In Stage 3, a range of 20 to 75% could be vaccinated.

- If PPR outbreaks are limited to clearly identified unvaccinated areas/production systems not targeted in Stage 2, an additional targeted vaccination campaign can be put in place for those zones/sectors; during one or two years according to the PVE results.
- If PPR outbreaks are very rare in the areas/production systems not targeted in Stage 2 and their origin is clearly identified, then a country may adopt a stamping-out programme, which may suffice to eliminate viral activity in otherwise unvaccinated zones/sectors.

The adoption of a targeted strategic approach will require the country concerned to have the capability to assess the risk of virus introduction into those sub-populations not covered by the vaccination programme and to implement measures to properly address such risks.

Should the risk assessment process suggest that the introduction of PPR virus may also occur because of its presence in neighbouring countries, then targeted vaccination in high-risk areas may be considered (e.g. buffer zone along borders or along trade routes) as an additional option.

› Post-Vaccination Evaluation

As in the previous Stage, PVE will require implementation of specific activities aiming at ensuring that:

- a) the level of protection in the vaccinated animals is maintained equal to or above the expected threshold over time;
- b) the vaccine distribution system is monitored over time to ensure that the cold chain is maintained and there are no failures that could affect the efficacy and effectiveness of the vaccination campaigns;
- c) the decrease and progressive disappearance of PPR outbreaks and PPRV circulation have been obtained (through the implementation of surveillance activities).

› Use of OIE standards

During Stage 3, countries are entitled to submit their national control programme (CP3) to the OIE for official endorsement, in accordance with the provisions of the OIE *Terrestrial Animal Health Code* (Chapter 1.6.). CP3 should build on the Control Strategy and Eradication Strategy, respectively produced at the end of Stage 1 and Stage 2, thus showing a long-term commitment to and continuity in the control of PPR.

■ Stage 3 enabling environment (Component 2)

In Stage 3, the VS must have the necessary authority and capacity to put in place aggressive control measures to eradicate PPR throughout the national territory and to maintain this situation through appropriate emergency measures as needed. Two CCs are relevant to support the PPR specific activities of Stage 3. The important competencies to acquire and/or implement for Stage 3 are to ensure that a laboratory quality assurance system is in place and to provide for animal identification and movement control (CC II.12.A).

OIE PVS CRITICAL COMPETENCIES		TARGETED OIE PVS LEVEL OF ADVANCEMENT	
CC II.2	Laboratory quality assurance	2	Some laboratories used by the public sector VS are using formal QA systems
CC II.12.A	Identification and traceability – Animal identification and movement control	3	The VS implement procedures for animal identification and movement control for specific animal subpopulations as required for disease control, in accordance with relevant international standards

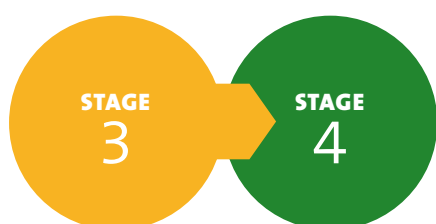
■ Stage 3 Combining control activities with other diseases (Component 3)

Depending on the strategic approach adopted by an individual country, complementarities with other small ruminant diseases may be found. If, for example, the implementation of the eradication strategy foresees a mass vaccination programme this may offer an opportunity (provided that the vaccination schedules coincide) for the concurrent elimination (or a significant decrease in the incidence) of other diseases.

Besides, some activities implemented in Stage 2 are not PPR specific and can serve the purpose of any other prevention and control programmes:

- outcome 1 → activity 1.1; 1.3
- outcome 4 → activity 4.1; 4.2; 4.3

2.3.4. Moving from STAGE 3 to STAGE 4



Minimum requirements:

1. All activities of Stage 3 are successfully completed
2. the **use of vaccine is suspended** and no clinical outbreaks have been detected in the previous 12 months

■ STAGE 4) Post-eradication Stage

■ Stage 4 epidemiological situation

There is a body of evidence that PPR virus is no longer circulating in domestic animals within the country or zone. PPR incidence is very low (reduced to zero incidence) and limited to occasional incursion from other countries.

It is worth noting that acceptance into Stage 4 is now clearly linked to the animal health status of the susceptible population in relation to PPR (differently from previous Stages).

Nota bene: For the purposes of the OIE *Terrestrial Animal Health Code*, PPR is defined as an infection of domestic sheep and goats with PPR virus (PPRV) (Chapter 14.7.). The official free status therefore takes into account the status in domestic animals only.

■ Stage 4 focus

To build evidence that, after suspension of vaccination, there is no clinical disease and no virus circulation

Entry into Stage 4 means that a country will be ready to start implementing a full set of activities that should lead to its being recognised as officially free from PPR.

In Stage 4, eradication and prevention measures are based on early detection and reporting of any new outbreak occurrence, emergency response and contingency planning. Vaccination is prohibited. If emergency vaccination needs to be implemented, the country or the vaccinated zone ('zone' as defined in the OIE *Terrestrial Code*) will be downgraded to Stage 3.

■ Stage 4 specific objectives (Component 1)

DIAGNOSTICS	To maintain laboratory capacity as in the previous Stage and strengthen the differential diagnostic pathways. To start implementing PPRV sequestration activities
SURVEILLANCE	To shift the goal of surveillance to proving the absence of PPR
PREVENTION AND CONTROL	To suspend vaccination. Eradication and prevention measures are based on stamping out, import movement control, biosecurity measures and risk analysis to understand the potential pathways of (re)introduction of PPR
LEGAL FRAMEWORK	To further improve the legal framework to accommodate more stringent border control policies; prepare additional legal provisions (such as containment) to implement in the context of an official PPR free status
STAKEHOLDER INVOLVEMENT	To keep stakeholders fully vigilant and committed with regard to PPR

■ Stage 4 PPR activities (Component 1)

Outcome 1 (Diagnostic system) The diagnostic activities carried out in the laboratories, while maintaining the same level of capability and performance in relation to PPR diagnosis, have been further extended to include all those diseases which may require a differential diagnosis with PPR. In addition, all material containing PPRV is sequestered in a well-defined secure location, under the supervision of the Veterinary Services, to avoid any PPR resurgence linked to accidental or intentional manipulations.	A1.1	Produce (and keep updated) a flowchart to indicate how a suspicion of PPR is handled and (once the suspicion is withdrawn) which other diseases will be investigated
	A1.2	Train laboratory staff in differential diagnosis of PPR
	A1.3	Identify, list and collate all PPRV-containing material and identify appropriate premises for its secure sequestration (in the future it may be destroyed)

<p>Outcome 2 (Surveillance system) The surveillance system operates as in the previous Stage with a focus on population at higher risk</p> <p>The surveillance system is robust enough to identify any animal with signs suggestive of PPR that require follow-up and investigation to confirm or exclude that the cause of the condition is PPRV.</p> <p>The case definition of a suspected case may be made broader so to be able to capture health events and rapidly rule out those that may be attributed to PPR.</p>	A2.1	Organise training sessions to make field veterinarians fully aware of where the country is now in relation to the eradication process
	A2.2	Design and implement specific studies aimed at proving that the cohort of animals born after the suspension of vaccination has not been exposed to the PPR virus (likely to be done through serology targeting the birth-cohort of animals born after cessation of the vaccination in accordance with procedures indicated by the OIE for being recognised as officially free)
	A2.3	Implement, when relevant, additional clinical inspection and serological testing of high-risk groups of animals following an alert, such as those adjacent to a PPRV-infected country

<p>Outcome 3 (Prevention and control system) Stringent preventive measures are put in place to maintain the absence of PPR outbreaks achieved at the end of Stage 3 and prevent any reintroduction; in the event of a PPR outbreak, emergency procedures are implemented.</p> <p>At this Stage, any true outbreak of PPR is treated as an emergency and consequently the contingency plan (prepared in Stage 3) is immediately activated to eliminate the virus as soon as possible.</p> <p>Stringent movement control and quarantine measures are applied at borders. Risk analysis is conducted on a regular basis and whenever justified by new factors that may jeopardise the free status. An emergency vaccination programme (combined or not with a stamping-out policy) may also be implemented in the worst case scenario, but will automatically downgrade the country or vaccinated zone to Stage 3.</p>	A3.1	In the event of an outbreak, implement the provisions of the contingency plan
	A3.2	Increase collaboration with the Customs services at borders to optimise border control
	A3.3	Conduct risk analysis on a regular basis
	A3.4	(Voluntary) Submit a dossier to the OIE requesting official recognition of PPR free status, in accordance with the provisions of Chapters 1.6. and 14.7. of the OIE <i>Terrestrial Animal Health Code</i>

<p>Outcome 4 (Legal Framework) The legal framework fully supports possible aggressive measures needed for prompt eradication of PPR in the country.</p> <p>The national legislation will require further improvement to include protective measures on imports of live animals to mitigate the risk of introduction.</p> <p>The review of the legal framework may at this Stage require consultation with international experts to ensure that the legal requirements for importers of livestock and livestock products (that may carry PPR virus) are in compliance with the SPS Agreement (should the country be a WTO member).</p> <p>Legal texts will also include provisions for additional measures, notably in the case of free status (e.g. establishment of a containment zone in accordance with OIE requirements).</p>	A4.1	Upgrade the legal framework, notably to ensure that it will include the necessary preventive and control measures foreseen in Stage 4 (in particular exclusion measures aimed at avoiding introduction of PPR virus from abroad)
--	-------------	--

<p>Outcome 5 (Stakeholder involvement) Stakeholders are fully aware of the health status of the country and are fully committed to promptly collaborate should an emergency occur.</p> <p>Stakeholder involvement at this Stage is essential not only in relation to the formulation of a legislation framework, as indicated in previous outcome, but also in relation to other activities. It is crucial that if a suspicion of PPR arises at this Stage all stakeholders are fully aware of the consequences this may have, thus ensuring their full collaboration. Communication remains a key element.</p>	A5.1	Organise meetings with groups of stakeholders to acquaint them with the status of the country and ensure that they are aware that any suspicion of PPR is to be treated as an emergency
	A5.2	Prepare and disseminate informative material in order to maintain a high level of awareness among livestock keepers and other stakeholders

■ Stage 4 specific use of the tools²⁵ (Component 1)

】 Surveillance (→ active and passive surveillance)

The surveillance in Stage 4 has the same three objectives as in Stage 3:

1. to provide early detection of possible PPR appearance;
2. to explain the reasons for this new introduction of the virus, to monitor the results of the immediate response and to give guidance for possible refining of the prevention and emergency response plan if appropriate;
3. to demonstrate the absence of PPR clinical disease or infection.

However, in Stage 4, the strongest focus of surveillance is to provide evidence that the country is free from disease/infection, with the clear objective of obtaining official OIE recognition of free status and thus entitling a country to leave the PPR step-wise approach. Therefore, in Stage 4, surveillance must be conducted in compliance with the provisions of OIE *Terrestrial Code* Chapter 14.7. (Articles 14.7.29., 14.7.30. and 14.7.31. in relation to surveillance requirements for Member Countries applying for OIE recognition of PPR free status).

Another major objective is to detect any new PPR outbreak occurrence and to provide epidemiological guidance for the management of the emergency response. The epidemiological tools will also address the risk of virus introduction, categorising the different animal sub-populations on the basis of the level or risk of exposure to PPR virus and adapting the prevention and emergency response plans if appropriate.

Nota bene: All materials, tissues (cultures or pathological samples) should be maintained in secured laboratory conditions or destroyed.

】 No vaccination and therefore no post-vaccination monitoring

All stocks of PPR vaccine (monovalent and multivalent) should be safeguarded by the competent authorities or removed/destroyed from non-accredited sites.

²⁵ In this section, only those tools whose utilisation varies in the different Stages are mentioned; this concerns namely: (i) surveillance; (ii) vaccination, including post-vaccination monitoring; and (iii) OIE standards relevant to PPR. All the other tools referred in Part A Section 5 are used in the same way regardless of the Stage.

Use of OIE standards

At the end of Stage 4, countries are entitled to apply for an OIE official PPR free status according to the provisions of the OIE *Terrestrial Code* (Chapter 1.6. on Procedures for self-declaration and for official recognition by the OIE and Chapter 14.7. on Infection with *peste des petits ruminants virus*).

Nota bene:

- when the country is granted an OIE official free status, the country leaves the PPR step-wise approach (i.e. ‘beyond Stage 4’);
- when the officially free status of a country is suspended by the OIE for reasons of evidence of PPRV circulation in domestic animals, the country can be considered as downgraded back to Stage 3 until its status is reinstated by the OIE; however, in this specific case, there is no need to move to Stage 4 again.

Stage 4 enabling environment (Component 2)

Four CCs are relevant to support the PPR specific activities of Stage 4. The VS must have the necessary authority and capacity to prevent the entry of PPR from neighbouring countries (CC II.4), to early detect and report any new PPR outbreak occurrence and to respond rapidly to it (CC II.6) by implementing the national PPR Contingency Plan, to maintain the PPR free status (not yet official) at national level or in a well-defined zone (CC IV.7), and to do this, to implement emergency measures supported by adequate funding (CC I.9). When applying for an OIE official status for PPR freedom, PPR must be a notifiable disease in the whole territory and proper notification to the OIE (CC IV.6) should operate (early reporting mechanism based on immediate notification).

OIE PVS CRITICAL COMPETENCIES		TARGETED OIE PVS LEVEL OF ADVANCEMENT	
CC I.9	Emergency funding	4	Funding arrangements with adequate resources have been established, but in an emergency situation, their operation must be agreed through a non-political process on a case-by-case basis
CC II.4	Quarantine and border security	3	The VS can establish and apply quarantine and border security procedures based on international standards, but the procedures do not systematically address illegal activities relating to the import of animals and animal products
CC II.6	Emergency response	4	The VS have an established procedure to make timely decisions on whether or not a sanitary emergency exists. The VS have the legal framework and financial support to respond rapidly to sanitary emergencies through a chain of command. They have national contingency plans for some exotic diseases that are regularly updated/tested
CC IV.6	Transparency	3	The VS notify in compliance with the procedures established by the OIE (and the WTO SPS Committee where applicable)

Stage 4 combining control activities with other diseases (Component 3)

The procedures to increase collaboration with customs to facilitate and/or enforce trade measures are not PPR specific and are therefore also applicable to other diseases.

At this Stage (if activities for other diseases have been combined with PPR) it will be appropriate to assess to what extent these combined efforts have led to an improvement for the other disease(s) addressed. The outcomes of this evaluation may dictate additional activities to be carried out with reference to those other diseases.

3. THE STRATEGY AT REGIONAL LEVEL

3.1. Peste des petits ruminants

Main features:

- 1. Regional coordination is needed.** Implementation of the Global Strategy will require regional harmonisation of the strategies and coordination of the activities. This harmonisation and coordination will be achieved through strong interactions between the Ministries in charge of animal health and their relevant structures, such as their VS, the laboratories and the epidemiology teams.
- 2. Regional coordination will benefit from the development of strong partnerships between international and regional organisations** (such as AU-IBAR in Africa, SADC in southern Africa, ASEAN in Asia, SAARC in South Asia, etc.), with regional or sub-regional projects, donors, regional and international unions of private sector stakeholders (animal product producers, vaccine-producing companies, international unions of private veterinarians, etc.).
- 3. The regional networks are tools of paramount importance.** The Global Rinderpest Eradication Programme demonstrated that networks are the best tools to develop such collaborations. There are many subjects that can benefit from networking approaches, such as harmonisation of diagnostic assays and epidemiology methods, exchange of information on animal health and on the control strategies being implemented, control of movements of animals, including border controls, legislation, dissemination and use of new scientific knowledge, combined training sessions for national laboratory and epidemiology officers to be implemented at regional level (economies of scale), etc.
- 4. The GF-TADs Regional Animal Health Centres can play an important role in implementing the Strategy at regional level.** Implementing all these regional activities would benefit from the establishment or strengthening of RAHCs, where regional multidisciplinary expertise would be located. It will be important for RECs and other relevant regional organisations (such as AU-IBAR in Africa) to be strongly associated with the RAHCs.

Main outcomes and activities at regional level:

<p>Outcome 1 (Diagnostic system) Regional Laboratory Networks are established or reinforced in the nine Regions/Sub-Regions proposed under the Strategy (see Part C, paragraph 2), which associate all national laboratories.</p> <p>One (or two) of them is (are) nominated as Regional Leading Laboratory (RLL) (regional network coordinator) with specific mandates and missions.</p> <p>If an OIE FAO Reference Laboratory/Centre exists in the region, it will act as the RLL; if not, the RLL will be closely associated with an international Reference OIE-FAO Laboratory/Centre.</p> <p>The RLL and the national laboratories will also be assisted by the Joint FAO/IAEA Division.</p>	A1.1	Establish or reinforce Regional Laboratory Networks and designate the RLL in each of the 9 regions/subregions
	A1.2	(RLL) Organise a regional meeting every year for exchanges between national laboratory staff or for training purposes
	A1.3	(RLL) Organise regional proficiency testing for PPR annually (ring trials)
	A1.4	(RLL) Organise regional training of diagnostic methods, quality assurance, etc. on a regular basis
	A1.5	(RLL) Provide reference diagnostics as needed
	A1.6	(RLL) Request twinning project when needed

<p>Outcome 2 (Surveillance system) Regional Epidemiology Networks are established or reinforced in the nine Regions/Sub-Regions proposed under the Strategy (see Part C, paragraph 2).</p> <p>The epidemiology networks are coordinated by a recognised regional epidemiology centre, which will become the Regional Leading Epidemiology Centre (RLEC) (regional network coordinator).</p> <p>If a specialised OIE/FAO Reference Centre already exists in the region, it will serve as the RLEC.</p> <p>The RLEC will work closely with the national laboratories and their regional networks.</p>	A2.1	Establish or reinforce Regional Epidemiology Networks and designate the Regional Leading Epidemiology Centre (RLEC) in each of the 9 regions/sub-regions
	A2.2	(RLEC) Organise a regional meeting every year for exchanges between national epidemiology staff or for training purposes
	A2.3	(RLEC) Undertake regional situation monitoring, risk analysis and disease intelligence studies with regard to PPR
	A2.4	(RLEC) Provide training and expertise as needed by the countries belonging to the Network
	A2.5	(RLEC) Request twinning project when needed
<p>Outcome 3 (Prevention and control system) The response capabilities are improved at regional level, notably through the support of the RHACs with multidisciplinary expertise and establishment of regional PPR vaccine banks.</p> <p>(Vaccines provided will meet or exceed the quality requirements provided in the OIE <i>Terrestrial Manual</i>)</p>	A3.1	Establish or strengthen the RAHCs as a source of expertise for members
	A3.2	Establish a PPR Regional vaccine bank
	A3.3	Organise simulation exercises
	A3.4	Undertake expert missions in countries when needed and contribute to the preparation of regional and national strategies and control programmes or of project proposals
<p>Outcome 4 (Legal Framework) The national legal framework for the control of PPR and more generally in the field of animal health is harmonised at regional level, whenever feasible.</p> <p>Specific issues such as cross-border movement of small ruminants (transhumance, trade), certification, compensation schemes, etc. are best addressed at regional level; REC policies need to be considered and defined, or updated, while respecting the national sovereignties.</p>	A4.1	Organise regional meetings
		Organise or undertake expert missions in countries (or for RECs) to identify areas for legislation improvement or updating and to define appropriate revised or new texts
<p>Outcome 5 (Regional coordination) Regional PPR initiatives are established in the nine Regions/Sub-Regions proposed under the Strategy (see Part C, paragraph 2).</p> <p>As part of these initiatives, there are ‘PPR Regional Roadmap meetings’. This is when the achievements of the strategy implementation, with its successes and failures, will be presented collectively and the challenges will be considered. This will serve as a basis for monitoring evolution of the regional situation (see Part C 2). Some key issues will be discussed during these Roadmap Meetings, such as any vaccination protocols being used, the control of movements of animals and the legislation in place.</p>	A5.1	(PPR Roadmap Secretariats, in collaboration with regional GF-TADs Secretariats and the PPR global GF-TADs Working Group) Organise ‘PPR Regional Roadmap meeting’ every year to bring together OIE Delegates/Chief Veterinary Officers and their collaborators <i>(These regional roadmap meetings will be combined as often as possible with the relevant GF-TADs Regional Steering Committee meetings)</i>
	A5.2	Organise regional meetings on specific thematic/disease subjects

3.2. Strengthening Veterinary Services

At regional level, there are a number of activities organised particularly in the context of the OIE's capacity building programme, which comprises a series of regional seminars for OIE national Focal Points.

Exchanges of health information and for harmonisation of animal health policies and strategies take place, for example through regular meetings of the OIE Regional Commissions and of the GF-TADs Regional Steering Committees.

3.3. Combining with other diseases

At regional level, the same principles and activities as for PPR apply to the combination of activities related to other diseases: establishment of regional laboratory and epidemiology networks specific to each selected disease, and organisation of annual regional meetings to exchange information on these diseases, harmonise policies and develop control strategies. The meetings will be combined as far as possible with other regional meetings, such the GF-TADs Regional Steering Committee meetings.

4. THE STRATEGY AT INTERNATIONAL LEVEL

4.1. *Peste des petits ruminants*

■ Main features:

1. The GF-TADs governing bodies (Global Steering Committee, Global Secretariat, Management Committee) will be maintained and supported as well as the new Global Secretariat for the implementation of the Global PPR Control and Eradication Programme (PPR-GCEP). The maintenance and possible roles of the GF-TADs PPR Working Group will be reconsidered when establishing the PPRGCEP.
2. **The development of partnerships at international level will add value to the Global Strategy.** The two international organisations, FAO and the OIE, will build partnerships with other international and regional organisations as well as with private sector unions.
3. The OIE Reference Laboratories and FAO Reference Centres specialised in PPR laboratory diagnosis and research and the OIE Collaborating Centres and FAO Reference Centres specialised in epidemiology related to PPR and other major small ruminant diseases will establish two global networks²⁶.
4. The FAO-OIE GF-TADs will establish the PPR-GREN platform to gather expertise in research and in the definition and implementation of control programmes. It will support appropriate updating of the national, regional and international strategies.
5. The joint FAO/IAEA Division continues to play an important role in supporting laboratories at national and regional levels,

Main Outcomes and activities at international level:

<p>Outcome 1 (Diagnostic system) A PPR International Laboratory Network is established by the OIE and FAO reference laboratories/centres, with specific international mandates and missions.</p> <p>There are three OIE Reference Laboratories (in France, UK and China), the first two also being FAO Reference Centres (see Annex 2). The Global Strategy will support them through financing certain activities and specific programmes (studies, applied research, etc.). The joint FAO/IAEA Division, in close links with the OIE and FAO PPR Reference Laboratories/Centres also plays and will continue to play an important role in supporting laboratories at national and regional levels, participating in regional and global networks and ensuring the transfer of new technologies to relevant laboratories. The Global Strategy will support the PPR-GREN.</p>	A1.1	Establish a PPR International Laboratory Network
	A1.2	(PPR International Laboratory Network) Organise international proficiency testing for the regional leading laboratories annually (ring trials) and support the regional leading laboratories in organising proficiency testing for the national laboratories and regional training sessions
	A1.3	(PPR International Laboratory Network) Organise international conferences in the field of PPR diagnostic methods
	A.1.4	(PPR International Laboratory Network) As the network of OIE and FAO Reference Laboratories/Centres, conduct strain characterisation monitoring, research programmes, training sessions, etc.
	A1.5	Establish the PPR-GREN platform

²⁶ See paragraphs 4.7 and 4.8 and footnotes Nos 11 and 12

<p>Outcome 2 (Surveillance system) A PPR International Epidemiology Network is established by the OIE and FAO Collaborating/Reference Centres specialising in epidemiology with specific international mandates and missions, to support the regional and national networks and centres/teams, but with activities specific to epidemiology.</p> <p>There are around ten OIE and FAO Collaborating/Reference Centres that work on PPR.</p>	A2.1	Establish a PPR International Epidemiology Network
	A2.2	(PPR International Epidemiology Network) Organise data collection and management, risk analysis, disease intelligence, etc.
	A2.3	PPR International Epidemiology Network) Organise international conferences in the field of PPR epidemiology
	A2.4	Support regional and national epidemiology networks and centres/teams through training, expertise work, etc.
	A2.5	Establish the PPR-GREN platform
<p>Outcome 3 (PPR information exchanges and data analysis) the availability and exchange of PPR information is ascertained.</p> <p>The FAO/OIE/WHO Global Early Warning System (GLEWS) will be supported as well as the FAO EMPRES-i information system in order to deliver information and warning messages or disease intelligence analysis to countries and the international community. The OIE international information system (WAHIS-WAHID) will continue to be the basis for the dissemination of official disease information.</p>	A3.1	Activities of GLEWS in information collection and analysis (supported by the Global Strategy)
	A.3.2	activities of WAHIS and EMPRES-i in disease information collection and dissemination (supported by the Global Strategy)
<p>Outcome 4 (prevention and control system) International emergency response capabilities are in place.</p> <p>At the request of a country, the FAOOIE Crisis Management Centre – Animal Health (CMC-AH) can provide a rapid response to help countries assess PPR epidemiological situations and recommend options to prevent or stop PPR spread.</p>	A4.1	Deploy PPR field missions at the request of individual countries

4.2. Veterinary Services

At international level, the activities are related to the participation of the OIE Delegates/CVOs and their technical experts at international meetings and conferences, including the annual General Session of the World Assembly of Delegates of the OIE (the Assembly) in Paris. The Delegates and relevant experts from Member Countries contribute to the OIE's standard-setting activities by participating in expert meetings (*ad hoc* Groups, Specialist Commissions, etc.) or by commenting on the draft versions of texts for the OIE *Codes* and *Manuals* to be proposed for adoption at the annual General Session of the Assembly.

4.3. Combining with other diseases

At international level, the activities will be of a similar nature to those implemented for PPR (e.g. specific networks).

PART C.

GOVERNANCE AND MONITORING, TIMELINES AND COSTING

1. GOVERNANCE

The GF-TADs principles and mechanisms will be used for coordination at the international level (e.g. Global Steering Committee, Management Committee). At regional level the GF-TADs Regional Steering Committees (RSCs) and the GF-TADs RSC Secretariats will continue to facilitate and support regional coordination in the field of animal health. These Global and Regional Committees include international organisations (in addition to FAO and the OIE), regional specialised organisations such as AU-IBAR, Regional Economic Communities (RECs such as SADC, ECOWAS, IGAD, GCC, ASEAN and SAARC), key member States and other relevant partners such as development partners (donor agencies) and the private sector. They will meet every year to consider how situations are evolving and what changes should be recommended in the strategy and its implementation.

A new PPR Global Control and Eradication Programme (GCEP) to implement the Global Strategy will be launched and a joint FAO-OIE Global Secretariat will be established to implement this programme. The maintenance and roles of the current PPR GF-TADs Working Group will then be considered.

2. MONITORING AND EVALUATION

2.1. *Peste des petits ruminants*

Monitoring and evaluation are key elements of Global Strategy implementation.

The PPR Monitoring and Assessment Tool (PMAT), as described in Part A Paragraph 4.2. and in Annex 3.3., explains in how the monitoring will be undertaken.

The performance indicators for each activity will be used to complete a questionnaire which will allow appropriate assessment. This will in turn make it possible to adjust the activities or refine relevant strategic elements.

The assessment will be used either as a means of self-assessment by the country or by external experts (country visits) at the country's own request and for the time being under the supervision of the GF-TADs Global PPR Working Group (external independent assessment).

Given the transboundary nature of PPR, a single country in an endemic zone cannot achieve PPR control – not to mention eradication – unless its neighbouring countries share a similar objective. As a result, the Global Strategy strongly encourages countries to participate in (sub)regional PPR Roadmaps that are designed according to FAO and OIE (sub)regions and epidemiological considerations (see map below). The number of countries and/or the small ruminant populations in a regional Roadmap should be appropriate to ensure proper monitoring and supervision.

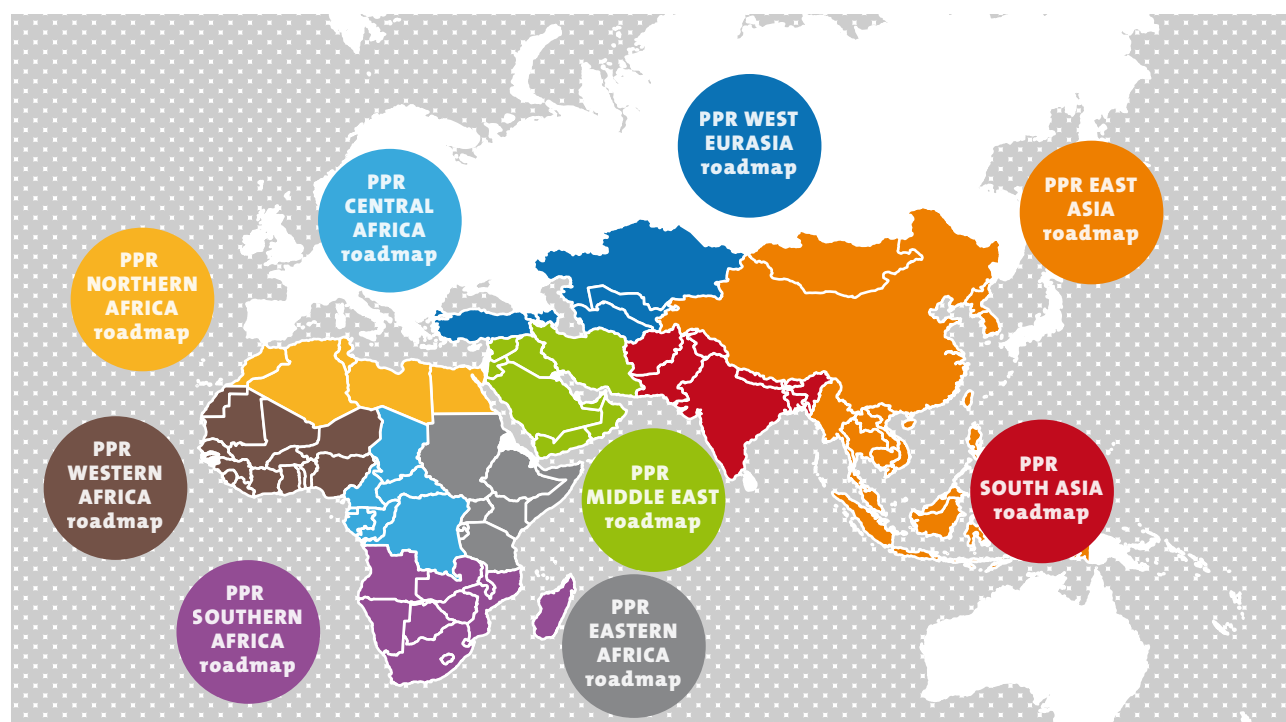
Regional PPR Roadmaps provide countries with a common long-term vision and create incentives for them to develop and embark on national risk-reduction strategies with similar progress pathways, milestones and timelines that are supportive of the regional effort. It is indispensable to link 'sustainable national PPR strategies' to 'regional long-term PPR roadmaps' and to 'global PPR progress'.

To gain recognition of the results of the assessments, an 'acceptance process' is being established to decide in which PPR stage a country can be classified. It follows the following successive steps:

- ▶ Self or external country assessment.
- ▶ Evaluation of the questionnaire by selected experts. For the time being the experts of the GF-TADs PPR Working Group and/or experts commissioned by the GF-TADs Working Group will undertake this task (until, when establishing the new GCEP, the maintenance and/or revision of the GF-TADs PPR WG missions is being reconsidered).
- ▶ Review and discussion of these assessments during the annual regional PPR Roadmap meetings. Nine (sub) regions are shown in the figure below for the definition of the Regional Roadmaps and meetings. A PPR Roadmap Advisory Group (RAG) is assigned to each Regional Roadmap; it is composed of nominated CVOs of three countries (nomination by the participants at the regional PPR Roadmap meeting) and the heads of the regional laboratory and epidemiological networks (members) as well as representatives of the OIE and FAO (Observers). The RAG reviews documents and evidence, and assigns each country a provisional (pending additional evidence) or final PPR stage, which is later presented to the participants at the regional PPR Roadmap meeting.

Information on annual progress of the regional PPR Roadmaps is transmitted to the GF-TADs Regional and Global Steering Committees, on an annual basis, as part for the time being of the Report of the GF-TADs PPR Working Group (to be reconsidered after the establishment of the GCEP and its Secretariat: see above).

The regional roadmap meetings will be organised at the regional/sub-regional level; nine regions/sub-regions have been defined according to the distribution of the member countries of the OIE and FAO regions/subregions as well as the existence of relevant RECs. The list of countries and a map are provided below.



SOUTHERN AFRICA/SADC (WITHOUT TANZANIA: SEE EAC)	Angola, Botswana, Democratic Republic of the Congo, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Zambia, Zimbabwe
CENTRAL AFRICA/CEMAC	Cameroon, Central African Republic, Chad, Republic of the Congo, Gabon, Equatorial Guinea
WEST AFRICA/ECOWAS	Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo
EAST AFRICA/IGAD + EAST AFRICAN COMMUNITY + RWANDA	Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Somalia, Sudan, Tanzania, Uganda
NORTH AFRICA/UMA + EGYPT	Algeria, Libya, Morocco, Mauritania, Tunisia + Egypt
MIDDLE EAST + ISRAEL	GCC (Bahrain, Kingdom of Saudi Arabia, Kuwait, Oman, Qatar, United Arab Emirates), Iran, Iraq, (Israel*), Jordan, Lebanon, Palestinian Autonomous Territories, Syria, Yemen + Israel
CENTRAL ASIA/WEST EURASIA	Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkey, Turkmenistan, Uzbekistan
SOUTH ASIA	Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan
EAST ASIA + SOUTH EAST ASIA + CHINA + MONGOLIA	Cambodia, People's Republic of China, Hong Kong (SAR – PRC), Indonesia, Japan, Republic of Korea, Democratic People's Republic of Korea, Laos, Malaysia, Maldives, Mongolia, Myanmar, Philippines, Singapore, Sri Lanka, Taiwan Province of China, Thailand, Timor-Leste, Vietnam

* Israel is part of this geographical region but is officially associated with the OIE and FAO Regional Commissions for Europe (and not with the Regional Commissions for the Middle East).

2.2. Veterinary Services

As part of the OIE PVS Pathway, the OIE PVS Follow-up mission allows an evaluation to be made of the progress that countries have made in sustainably improving their compliance with OIE's standards on quality since the time of the last PVS evaluation.

In general, the OIE recommends that an OIE PVS Follow up mission be conducted every two to three years. In the specific framework of the Global Strategy and when a country intends to move to the next Stage, it is recommended that a PVS Follow-up mission be conducted if a PVS initial or Follow-up mission has not been carried in the previous two years. The objective is to identify and address gaps in the 'enabling environment' and to ensure the optimal implementation of PPR specific activities related to the Stage.

2.3. Other diseases of small ruminants

Specific and effective monitoring and evaluation tools for diseases other than PPR and FMD do not exist. According to the conclusions of regional specific meetings which will better define the list of priority diseases to be combined with PPR control activities, specific monitoring and evaluation tools could be developed.

3. TIMELINES

3.1. PPR at national, regional and international levels

For management and evaluation purposes, the Global Strategy period is divided into three 5-year phases. The situation in 2015 is known for most of the countries and the expected results in 2020 are based on the analysis of their current situation and of realistic evaluations of their future perspectives.

The results in 2015 and 2030 are based on the expected achievements of the implementation of the Global Strategy. The PMAT and PVE will be used on a yearly basis to monitor progress at national level. However, a precise evaluation of the results will be undertaken in 2020 and this assessment will provide guidance on the continuation of the activities, with or without changes that could include substantial modifications or even a full reorientation.

After five years, around 30% of countries are expected to have reached Stage 3 and 30% to have reached Stage 4. It is expected that around 40% of countries will be implementing a control programme and less than 5% will still be in Stage 1.

After ten years, more than 90% of countries will be in Stages 3 or 4, which means that in these countries cessation of the virus circulation is on the way to being achieved. As some countries could be at the beginning of Stage 3 only, PPRV could therefore still be circulating in rare areas.

During this period of reducing and eradicating virus circulation in endemic countries, the risk of reintroducing PPRV in free countries will be reduced.

The Global Strategy will focus on countries where PPR is endemic, i.e. countries at Stages 0 (i.e. 'below Stage 1'), 1 or 2. For countries at Stage 4, the objective is to maintain that status and obtain official OIE free status recognition.

The timelines for the expected results are presented in Table 1 (global) and Tables 2 to 6 (by region). The percentage of countries progressing along the step-wise approach has been estimated based on analyses of their current situation and of realistic evaluations of their future perspectives.

Table 1
Timeline of expected results: Global

Global	2015					2020					2025					2030				
Stage	0*	1	2	3	4/5	0*	1	2	3	4/5	0*	1	2	3	4/5	0*	1	2	3	4/5**
No of countries	3	36	32	12	13	0	4	40	25	27	0	0	8	39	49	0	0	0	0	96
%	3	37	33	12	15	0	4	42	26	28	0	0	8	41	51	0	0	0	0	100

* Stage '0' means that the country is suspected to be 'PPR endemic' but the situation is not well known and no structured and effective activities are being implemented. The country is not considered to have entered the PPR step-wise approach yet.

** In 2030, countries will be either at Stage 4, on the way to obtaining OIE official free status, or 'beyond' Stage 4 since they have received the OIE official status ('Stage 5' means beyond the PPR stepwise 4-Stage strategy). This also means that 2030 is the date of cessation of PPRV circulation worldwide but that it is not the date of the official declaration of global PPR freedom.

Table 2
Timeline of expected results: Africa

Region	2015					2020					2025					2030				
Stage	0*	1	2	3	4/5	0*	1	2	3	4/5	0*	1	2	3	4/5	0*	1	2	3	4/5**
No of countries	3	19	19	3	11	0	4	25	12	14	0	0	8	24	23	0	0	0	0	55
%	5	35	35	5	20	0	7	46	22	25	0	0	15	44	43	0	0	0	0	100

Table 3
Timeline of expected results: Middle East

Region	2015					2020					2025					2030				
Stage	0*	1	2	3	4/5	0*	1	2	3	4/5	0*	1	2	3	4/5	0*	1	2	3	4/5**
No of countries	0	4	3	8	0	0	0	2	5	8	0	0	0	2	13	0	0	0	0	15
%	0	27	20	53	0	0	0	13	33	54	0	0	0	13	87	0	0	0	0	100

Table 4
Timeline of expected results: Central Asia + Caucasus + Turkey (West Eurasia)

Region	2015					2020					2025					2030				
Stage	0*	1	2	3	4/5	0*	1	2	3	4/5	0*	1	2	3	4/5	0*	1	2	3	4/5**
No of countries	0	5	4	0	0	0	0	5	4	0	0	0	0	5	4	0	0	0	0	9
%	0	56	44	0	0	0	0	56	44	0	0	0	0	56	44	0	0	0	0	100

Table 5
Timeline of expected results: South Asia

Region	2015					2020					2025					2030				
Stage	0*	1	2	3	4/5	0*	1	2	3	4/5	0*	1	2	3	4/5	0*	1	2	3	4/5**
No of countries	0	3	2	1	0	0	0	3	2	1	0	0	0	3	3	0	0	0	0	6
%	0	50	33	17	0	0	0	50	33	17	0	0	0	50	50	0	0	0	0	100

Table 6
Timeline of expected results: South-East and East Asia + China + Mongolia

Region	2015										2025					2030				
Stage	0*	1	2	3	4/5	0*	1	2	3	4/5	0*	1	2	3	4/5	0*	1	2	3	4/5**
No of countries	0	5	4	0	2	0	0	5	4	2	0	0	0	5	6	0	0	0	0	11
%	0	45	36	0	18	0	0	46	36	18	0	0	0	45	55	0	0	0	0	100

At regional level, the expected results are that after five years, all activities listed in Part B3 paragraph 1 have been successfully implemented, such as the establishment of regional epidemiology and laboratory networks with RLLs and RLECs, and the regular organisation of regional roadmap meetings with effective harmonisation of health policies, methods and strategies. The GF-TADs regional Steering Committees have been strengthened as well as the regional expertise capacity. The political commitment of governments has resulted in ownership of the regional networks being taken over by the relevant RECs within five years.

At the international level the global reference laboratories network (OIE PPR Reference Laboratories and FAO PPR Reference Centres) and the global network of reference epidemiology centres (OIE Collaborating Centres and FAO Reference Centres specialised in epidemiology) are established during the first 5-year period. The PPR-GREN platform is also put in place. During the same period and the following 10 years, the GF-TADs Global Steering Committee will continue to operate as well as its Global Secretariat and the specialised Working Groups, including for the time being the current GF-TADs Working Group on PPR (with possible reconsideration of its mandate or maintenance when the GCEP is being discussed). The PPR Global Control and Eradication Programme and its Secretariat will have started at the beginning of the first 5-year period and they will continue implementing the Global Strategy throughout the 15 years. Other tools such as GLEWS and the CMC-AH will also be carrying out effective activities during the 15-year period as will the FAO EMPRES-i information system.

The OIE international information system (WAHIS-WAHID) will continue to be the basis for the dissemination of official disease information and the OIE standards will continue to be updated to take into account the latest available scientific information.

3.2. Veterinary Services

Within a 15-year period, countries in PPR Stages 0 to 2 having VS that are not compliant with OIE standards (PVS CC Levels below Level 3) for all or some of the 33 relevant CCs will have reached at least Level 3 for all CCs (and in rare cases Level 4).

For countries that are in PPR Stage 3 and above, and therefore having most CCs compliant with OIE standards (CCs at Level 3 or above), the CC levels will at least be maintained or increased during the 15-year period.

Table 7 shows the number of CCs and the expected compliance level for each PPR Stage.

Table 7
Minimum number and level of PVS Critical Competencies (CCs) to be complied with at each PPR Stage

		PPR Stage			
		1	2	3	4
CCs Compliance level of advancement	1	0	0	0	0
	2	1	0	0	0
	3	11	11	1	2
	4	0	4	1	2
	5	0	0	0	0
Total number of CCs		12	15	2	4

3.3. Combining PPR control activities with other diseases at national, regional and international levels

Precise timelines for the control of other small ruminant diseases will be established after these diseases have been identified at regional meetings. A list of candidate diseases that could be combined with PPR control activities has already been proposed by the GF-TADs Regional Steering Committees.

4. COSTING

It is important to note that the cost of Component 2 (strengthening Veterinary Services) and Component 3 (combining with other diseases) has not been included in this exercise. The support to Veterinary Services is the subject of specific investments after countries have evaluated their needs, particularly through the use on a voluntary basis of the PVS Gap Analysis tool. The cost of combating other diseases in combination with PPR control and eradication activities is extremely difficult to estimate since the list of priority diseases to be addressed will be defined after discussions to be held during regional and national workshops and subsequent definition of specific control strategies against other diseases. But it is also worth highlighting that the investments in supporting activities against PPR will have benefits for the Veterinary Services' activities (e.g. surveillance systems) and ultimately for animal health improvement in all targeted countries.

The estimated maximum undiscounted costs for the Component 1 (specific activities against PPR) for a 15-year Global Strategy are between USD 7.6 and 9.1 billion, with the first five years costing between USD 2.5 and 3.1 billion. The lower range is 16.5% less and would be expected as a consequence of a rapid decrease in PPR incidence in countries employing an effective vaccination strategy. In all scenarios tested there are significant vaccination campaigns that could well be reduced with strong targeting of at-risk populations through carefully conducted epidemiological and economic analyses. These costs have also given a realistic figure on vaccine dose costs and an amount to cover the delivery costs in different scenarios. During the initial stages it is estimated that the annual costs will be in region of USD 0.5 billion which will be used for activities in 98 countries and to manage PPR in nearly 2 billion sheep and goats. This represents a major investment in a sector that affects the lives of 330 million poor livestock keepers.

The differences between the two estimates relate to:

- Assumptions on vaccine delivery cost – the lower estimate does not provide for a high amount for the delivery in mixed systems.
- Assumptions on the frequency of vaccination – the lower estimate does not provide for twice yearly vaccination for the mixed crop-livestock farming systems.
- Assumptions on the outbreak investigations – the lower estimate does not include a background level of outbreak investigation across all stages.

The determination of the exact percentage of the total population to be vaccinated is difficult due to highly variable local epidemiological situations. To calculate the costs of the vaccination programmes during the first five years, the chosen estimation of the population to be vaccinated is within the range of 20% to 50% of the national small ruminant populations in Stage 2 and 20% to 75% in Stage 3.

More information is given in Annex 5.

These costs need to be placed in the perspective of the numbers of animals that are being protected by the measures proposed – nearly a billion sheep and a billion goats. A rough estimate of the average cost per shoat year would mean an investment of between USD 0.27 and 0.32.

In contrast to an assessment of the annual global impact of the disease these costs are small. It has been estimated that annual losses of production and the death of animals due to PPR are between USD 1.2 and 1.7 billion. There is also an estimated ongoing expenditure without the proposed global strategy of between USD 270 to 380 million on

PPR vaccination. Therefore, the current annual impact of PPR alone stands at between USD 1.45 and 2.1 billion per year, and with a successful eradication programme this impact would be reduced to zero. It is important to recognise that without the strategy somewhere between USD 4.0 and 5.5 billion would be spent over a 15-year period on poorly targeted vaccination campaigns that are unlikely to lead to eradication. In summary, global spending in the current structures will be between USD 0.14 and 0.20 per sheep or goat year which will not result in eradication.

Given the importance of PPR and the availability of known technologies it is strongly recommended that a Global Strategy for Control and Eradication of PPR is funded and initiated.

Nota bene: The final cost is likely to be different from the cost estimates in this report, but they serve to demonstrate that the successful control and ultimate eradication of this disease would be economically profitable and that it will benefit the lives of many people around the world.

REFERENCES

1. African Union – Inter-African Bureau for Animal Resources (AU-IBAR)/Pan African Veterinary Vaccine Centre (AU PANVAC) & Soumare B. (2013). – Pan African Program for the Control & Eradication of PPR: A Framework to Guide & Support the Control and Eradication of PPR in Africa, 5th Pan African CVOs Meeting, Abidjan, Côte d'Ivoire, 13-15. Available at: [file:///C:/Users/jdom/Saved%20Games/Downloads/20130508_evt_20130418-19_abidjan_pan_african_program_for_the_control_and_eradication_of_ppr_en%20\(2\).pdf](file:///C:/Users/jdom/Saved%20Games/Downloads/20130508_evt_20130418-19_abidjan_pan_african_program_for_the_control_and_eradication_of_ppr_en%20(2).pdf).
2. Barrett T., Pastoret P.-P. & Taylor W.P. (2005). – Rinderpest and peste des petits ruminants: virus plagues of large and small ruminants. London: Academic Press, 341 pp.
3. Elsalwaly A., Mariner J., Chibeu D., Wamwayi H., Wakhusama S., Mukani W. & Toye Ph. (2010). – Pan African strategy for the progressive control of PPR (Pan African PPR Strategy). *Bull. Anim. Hlth. Prod. Afr.*, **58** (3), 185-193.
4. Ettair M. (2012). – Stratégie de surveillance et de lutte contre la PPR au Maroc, REMESA: atelier conjoint REPIVET-RESEPSA, 12 et 13 Juillet, Tunis, Tunisia.
5. European Food Safety Authority AHAW Panel (EFSA Panel on Animal Health and Welfare) (2015). – Scientific Opinion on peste des petits ruminants. *EFSA Journal*, **13** (1), 3985, 94 pp. doi:10.2903/j.efsa.2015.3985 Available at: www.efsa.europa.eu/efsajournal.
6. Fernández P. & White W. (2010). – Atlas of Transboundary Animal Diseases. World Organisation for Animal Health (OIE), 280 pp.
7. Food and Agriculture Organization of the United Nations (FAO) (2011). – World Livestock Livestock in food security. Rome, Italy.
8. Food and Agriculture Organization of the United Nations (FAO) (2011). – Special issue: Freedom from the world No. cattle plague: Rinderpest. Transboundary Animal Diseases. *EMPRES Bulletin*, **38**, 72 pp. Available at: www.fao.org/docrep/014/i2259e/i2259e00.pdf.
9. Food and Agriculture Organization of the United Nations (FAO) (2011). – Good Emergency Management Practices: The Essentials (N. Honhold, Douglas, W. Geering, A. Shimshoni & J. Lubroth, eds). FAO Animal Production and Health Manual No. 11. Rome. Available at: www.fao.org/docrep/014/ba0137e/ba0137e00.pdf.
10. Food and Agriculture Organization of the United Nations (FAO) (2013). – World livestock 2013: changing disease landscapes. FAO, Rome, 130 pp. Available at: www.fao.org/docrep/019/i3440e/i3440e.pdf (accessed on 3 December 2014).
11. Food and Agriculture Organization of the United Nations (FAO) (2013). – Position paper, FAO's approach for supporting livelihoods and building resilience through the progressive control of peste des petits ruminants (PPR) and other small ruminant diseases, Animal Production and Health Position Paper, Rome.
12. Food and Agriculture Organization of the United Nations (FAO) (2015). – EMPRES-i. Global Animal Disease Information System. Available at: <http://empres-i.fao.org/eipws3g/>.

13. Food and Agriculture Organization of the United Nations (FAO)/International Livestock Research Institute (ILRI) (2011). – Global livestock production systems. Rome, Italy. Available at: www.fao.org/docrep/014/i2414e/i2414e.pdf.
14. Food and Agriculture Organization of the United Nations (FAO)/World Organisation for animal Health (OIE) (2012). – FMD Global Control Strategy. Available at: www.fao.org/docrep/015/an390e/an390e.pdf.
15. Food and Agriculture Organization of the United Nations (FAO)/World Organisation for animal Health (OIE) (2012). – GLEWS: Global Early Warning System for Major Animal Diseases, including Zoonoses. Available at: www.fao.org/docs/eims/upload//217837/agre_glews_en.pdf.
16. Food and Agriculture Organization of the United Nations (FAO)/World Organisation for animal Health (OIE) (2015). – Crisis Management Centre – Animal Health (CMC-AH) CMC-AH. Available at: www.fao.org/emergencies/how-we-work/prepare-and-respond/cmc-animal-health/en/.
17. Food and Agriculture Organization of the United Nations (FAO)/World Organisation for animal Health (OIE) (2015). – GF-TADs FAO, available at: www.fao.org/3/a-ak136e.pdf and OIE website, available at: www.oie.int/en/for-the-media/press-releases/detail/article/new-initiatives-by-the-oie-and-its-partners-to-improve-animal-and-public-health-in-africa/.
18. Food and Agriculture Organization of the United Nations (FAO)/World Organisation for animal Health (OIE)/European Commission for the Control of Foot-and-Mouth Disease (EUFMD) (2011). – PCP FMD guide The Progressive Control Pathway for FMD control (PCP-FMD) Principles, Stage Descriptions and Standards. Available at: www.fao.org/ag/againfo/commissions/docs/PCP/PCP-26012011.pdf.
19. Lefèvre P.-C., Blancou J., Chermette R. & Uilenberg G. (2010). – Infectious and Parasitic Diseases of Livestock, Ed TEC et DOC, Lavoisier, Paris, France, 225-244.
20. Mariner J. & Paskin R. (2000). – FAO Animal Health Manual 10 – Manual on Participatory Epidemiology – Method for the Collection of Action-Oriented Epidemiological Intelligence Rome, Italy.
21. Pradère J.-P. (2014). – Improving animal health and livestock productivity to reduce poverty. *Rev. sci. tech. Off. int. Epiz.*, **33** (3), 735-744.
22. Steinfeld H., Wassenaar T. & Jutzi S. (2006). – Livestock production systems in developing countries: status, drivers, trends. In Animal production food safety challenges in global markets (S.A. Slorach, ed.). *Rev. sci. tech. Off. int. Epiz.*, **25** (2), 505–516.
23. World Bank (2014). – World development indicators. Available at: www.worldbank.org/en/topic/poverty.
24. World Organisation for animal Health (OIE) (2010). – Handbook on Import Risk Analysis for Animals and Animals Products, Volume 1. Introduction and qualitative risk analysis. 98 pp.

25. World Organisation for animal Health (OIE) (2011). – 79th-general-session of the World Assembly of Delegates, Paris, 22-27 May 2011, Resolution No. 18 Declaration of Global Eradication of Rinderpest and Implementation of Follow-up Measures to Maintain World Freedom from Rinderpest. Available at: www.oie.int/en/for-the-media/79th-general-session/ and http://www.oie.int/fileadmin/Home/eng/Media_Center/docs/pdf/RESO_18_EN.pdf.
26. World Organisation for animal Health (OIE) (2014). – Manual of Diagnostic Tests and Vaccines for Terrestrial Animals. Available at: www.oie.int/en/international-standardsetting/terrestrial-manual/access-online/.
27. World Organisation for animal Health (OIE) (2014). – Guide to Terrestrial Animal Health Surveillance. (A. Cameron, J. Mariner, L. Paisley, J. Parmley, F. Roger, Aaron Scott, P. Willeberg & M. Wolhuter), 104 pp.
28. World Organisation for animal Health (OIE) (2014). – Terrestrial Animal Health Code. Available at: www.oie.int/en/international-standard-setting/terrestrial-code/.
29. World Organisation for animal Health (OIE) (2015). – WAHID World Animal Health Information Database/WAHIS: World Animal Health Information System and OIE Info system. Available at: web.oie.int/home; www.oie.int/en/animal-health-in-the-world/the-worldanimal-health-information-system/the-oie-data-system/.
30. World Organisation for animal Health (OIE) (2015). – The OIE PVS Pathway. Available at: www.oie.int/en/support-to-oie-members/pvs-pathway/.
31. World Organisation for animal Health (OIE) (2015). – The OIE Tool for the Evaluation of Performance of Veterinary Services (OIE PVS Tool). Available at: www.oie.int/en/support-to-oie-members/pvs-evaluations/oie-pvs-tool/.
32. World Organisation for animal Health (OIE) (2015). – Vaccine banks. Available at: www.oie.int/en/support-to-oie-members/vaccine-bank/.

ANNEXES

1. Socio-economic impact of *peste des petits ruminants*
2. Regional situations
3. Description of tools:
 - 3.1. Laboratory diagnostic tools
 - 3.2. Vaccines
 - 3.3. Monitoring and assessment tool (PMAT)
 - 3.4. Post vaccination evaluation tool
 - 3.5. Surveillance
 - 3.6. OIE Standards related to PPR
4. Research
5. Costing of the PPR Global Control Eradication Strategy

Annex1

Socio-economic impact of peste des petits ruminants

Socio-economics of *peste des petits ruminants*

Jonathan Rushton, Tabitha Kimani, Nick Lyons, Joao Afonso, Alana Boulton, Ndama Diallo, Joseph Domenech

Background

Livestock represent approximately 40% of the global agricultural gross domestic product (World Bank, 2012). This important role will continue as demand for livestock products increases due to a combination of urbanisation, a rise in incomes and population growth. Estimation of these trends indicates that meat consumption is growing at 5% per year and that of milk and dairy products by between 3.5 and 4.0%. Such rapid growth creates opportunities for the livestock keepers and the people who live and work in the livestock food systems. Many of these people are part of the poorest in the world – the billion poor who are living on less than 2 US\$ a day – and many of these people live in Africa and Asia (Fig. 1).

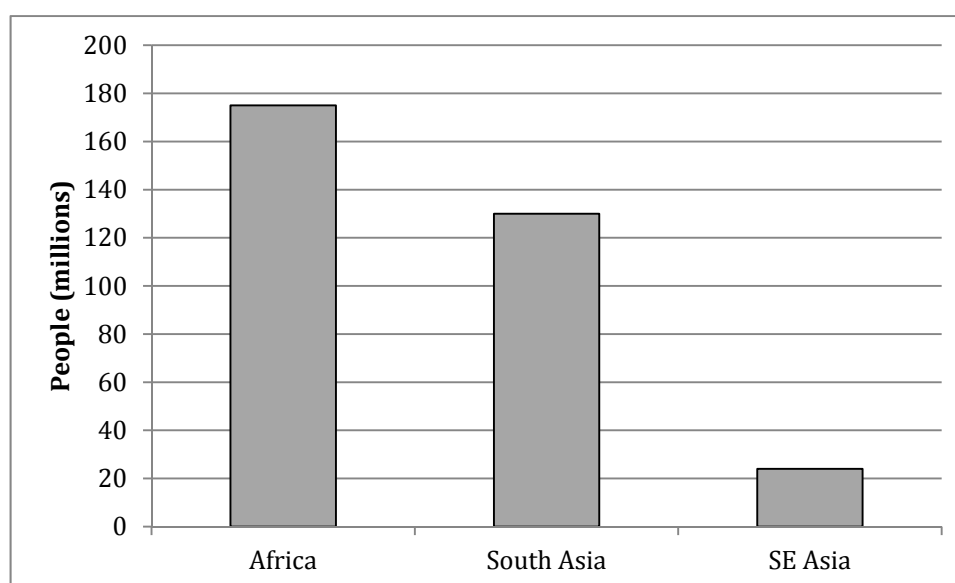


Fig. 1
Distribution of poor livestock keepers in African and Asian Regions
(ILRI report to DFID, 2012)

In a scenario where livestock play a major and increasing role in agriculture there would appear to be strong potential gains for the poorest – a possible win-win situation. Yet some of the fundamental aspects of achieving positive gains are being held back by **access to technologies**. One of the most critical are technologies associated with the control of contagious diseases which generate losses not just for the owners of animals but also the

people connected either as fellow producers or consumers. These **negative externalities** represent millions of dollars of unrecognized annual loss to societies. The current annex will explore this further in context of *peste des petits ruminants* (PPR), a contagious viral disease that affects sheep and goats – a disease that has advanced vaccine and diagnostic technologies that can be used control and eradicate this disease. The **challenge** facing the world is how to create **veterinary services** that can **deliver** these **technologies** to millions of **poor producers** in an efficient and sustainable manner in order to achieve **gains** in **livestock productivity** and thereby contribute to rural incomes and improved availability to meat and milk of all consumers.

Importance of sheep and goats to people

At a global level

The species such as sheep and goats play role in a large proportion of the world's poorer households – they affect the wellbeing of the lives of many of the rural poor (ILRI report to DFID, 2012). The sheep and goats – the small ruminants – are integrated in the crop-livestock systems and are fundamental to the pastoral and agro-pastoral systems that in Africa and Asia. Goats are particularly suited to the semi-arid zones due to their ability to adapt to harsh climatic conditions including drought, and due to their ability to reproduce in short cycles are an important species in recovering from drought conditions.

Within such systems small ruminants provide meat and milk for domestic consumption and their relatively small size make them ideal for sale and exchange for staple foods and other commodities required for the household. The main concentrations of sheep and goats are found in the poor regions of Africa, Asia and the Middle East demonstrating a strong link between poverty and small ruminants (Fig. 2).

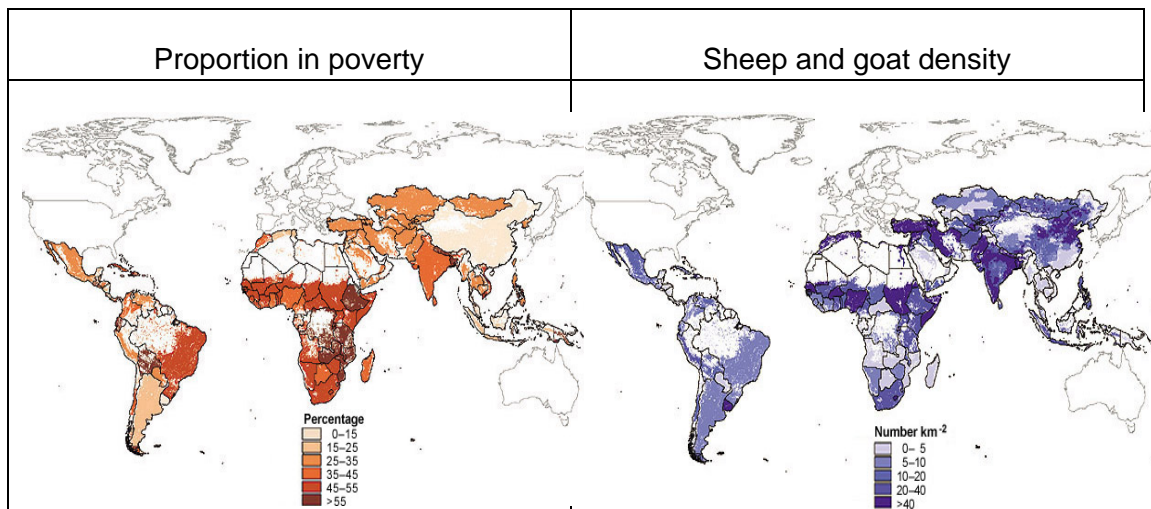


Fig. 2
Worldwide distribution of poverty and small ruminants (sheep and goats) density

Source: www.fao.org/ag/againfo/resources/documents/AH/PPR_flyer.pdf

At a local level

The global data give an indication of the importance of small ruminants across large areas of the world, yet this is only a partial picture. Data from Africa are presented in Table I from the pastoralist areas where it is very clear that households' livelihoods are closely linked to the health and productivity of their animals and of small ruminants. This is an impact for all people in the pastoral and agro-pastoral areas even the very poor. Without these animals these people would not be able to survive in harsh environments.

Table I
Small ruminants kept by the families of pastoral keepers in Northern Eastern Kenya (2007 HEA data) and Somalia (2010 fieldwork)

Region and item	Wealth group ¹			
	Very poor	Poor	Middle	Better off
NE Kenya				
Small ruminants	5 to 8	18	32 to 42	48 to 75
Cattle	0 to 2	0 to 6	3 to 20	5 to 35
Camels	0	0 to 5	5 to 19	15 to 39
Estimated total family income (US\$)	371 to 389	448 to 558	774 to 979	1,263 to 2,042
Income from livestock (US\$)	48 to 121	193 to 265	774 to 807	1,263 to 2,042
Somalia (Nugal Valley and Addun)				
Small ruminants	0 to 15	60	96 to 110	170 to 200
Cattle	0	0	0	0
Camels	0	2 to 3	10 to 11	20 to 23

Data from Nepal across the three different agro-ecological zones and in households with varying socio-economic circumstances demonstrate that rural people have sheep and goats well integrated into their farming systems and that this is also a critical element of the livelihood strategies of these people (Table II).

In a static situation the small ruminants represent a significant activity for the households. They also have a role in helping people improve their livelihoods. A clear demonstration of this in action comes from a Nepalese family who through their goats moved from being considered a poor family to one that would be classed a middle level family within their society. This was achieved through a combination of better access to animal health care, forage production and market access (Fig. 3).

These two examples from very different contexts, one in Africa and another in Asia, show the importance of small ruminants.

¹ These are ranks within the society of study, they do not represent the wealth relative to societies within the country in general and therefore most of the people in the studies would be considered poor.

Table II
The socio-economic differences between households in the different districts

Zone	Poor	Medium	Rich
Hill	<ul style="list-style-type: none"> – Landless or small plots of poor land – Dependent on household labour sales – No or few livestock (generally poultry and perhaps goats) 	<ul style="list-style-type: none"> – Access to poor land – Own goats, bullocks – Sometimes owned dairy cattle – Some had skilled or government service jobs – Some had businesses 	<ul style="list-style-type: none"> – Access to land – Own dairy animals – Skilled and government jobs – Own and run businesses and shops
Terai	<ul style="list-style-type: none"> – Landless or small plots of poor land – Dependent on human and animal labour sales – No or few livestock (generally local goats and cows) 	<ul style="list-style-type: none"> – Access to medium farm size – Own small number of improved dairy cows or buffaloes, goats and poultry – Some services and business/shops 	<ul style="list-style-type: none"> – Own large farm size (irrigated and rainfed) – Own smallholder commercial dairy farms with improved dairy cows – Some have improved buffaloes and commercial poultry farms – Own goats (common), a few HHs own sheep and pig – Some do service and own businesses/shops
Mountain	<ul style="list-style-type: none"> – Landless or small plots of poor land – Dependent on household labour sales – No or few livestock (generally local cows) 	<ul style="list-style-type: none"> – Access to medium irrigated land – Own medium size of goats – Own other animals such as dzopas, mules, horses and local cows – Some own businesses/hotels and shops – Overseas employment 	<ul style="list-style-type: none"> – Access to large irrigated land – Own large holding of goats – Own other animals such as dzopas, mules, horses and local cows – Own and run businesses/hotels/restaurants and shops – Overseas employment

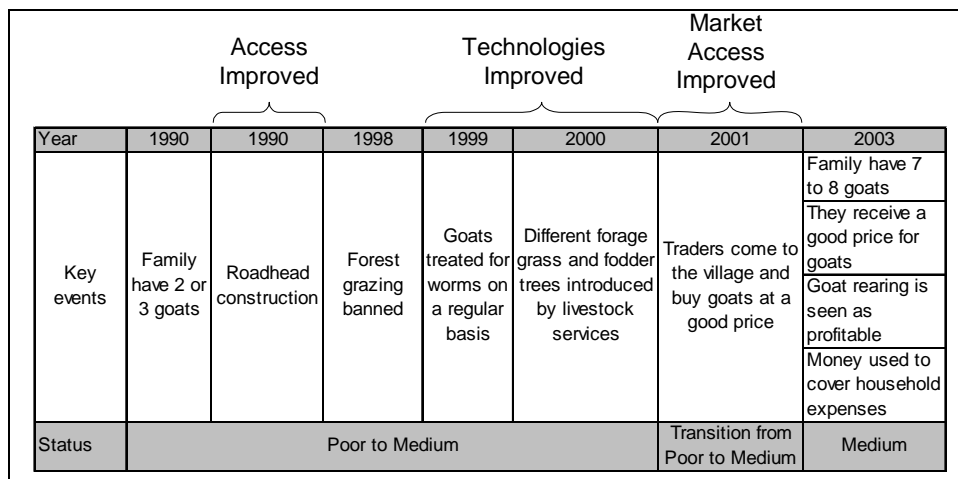


Fig. 3
Timeline for a family in Chitwan, Nepal who moved from poor to medium using goats

In terms of meat consumption

Meeting the increase in demand for food of animal origin will place enormous pressure on the global food system, the environment, the sustainable increase in livestock production,

food supply and distribution. Given this global context and with the view of addressing major challenges for effective pro-poor investments for poverty alleviation and to fight hunger in an efficient manner, FAO has conducted studies to map future animal production demands with that of population growth between the years 2000 and 2030. In the case of demand for mutton, the pressure will be mainly in Sub-Saharan Africa and South Asia (Robinson and Pozzi, 2011). The perspective of the substantial increase of mutton demand in these two regions calls for an important and over-riding improvement of small ruminant productivity, in particular the control of major small ruminant diseases. Amongst the threatening diseases, PPR is the most important sheep and goat infectious disease, and is certainly the main constraint to intensive small ruminant farming where PPR is endemic.

The socio economic impact of *peste des petits ruminants*

At a global level

Peste des petits ruminants is a flagship disease when addressing animal health issues related to poverty alleviation, food security, human wellbeing and socioeconomic development. The economic impact of PPR in small ruminants is as follows:

- Production losses
 - Mortality and morbidity.
- Control costs
 - vaccination
 - diagnosis and surveillance
 - enforcement of sanitary bans.
- Trade with impacts on producers, people in the value chain and consumes

A rapid calculation of the overall impact of PPR at global level has been carried out using the parameters in Table III.

Table III
Disease and vaccination parameters used to estimate the global impact of *peste des petits ruminants*

Stage	Prevalence	Vaccination
0	5.0%	0.0%
1	5.0%	0.0%
2	2.5%	20.0%
3	1.0%	40.0%
4	0.0%	0.0%

It has been assumed that of the animals affected two thirds will die and that this will be a loss of US\$ 35 per animal that dies, US\$ 3.50 per animal affected and that recovers. In addition the cost of vaccination is assumed to be US\$ 0.80 per dose delivered. This covers the cost of the dose and the time of the people involved – owners, veterinarians and animal health workers. It should be noted that the availability of vaccine is not always good.

Given the variability of the information at hand a sensitivity analysis was performed on the vaccination coverage, which was increased to 40 and 60% for the stages 2 and 3 respectively. The value of the animals was also increased to US\$ 50.00 for an animal that died and US\$ 5.00 for an animal that recovered.

With the lower level of vaccination coverage and the lower prices for the animals that die and recover a total annual impact of US\$ 1.4 billion was estimated. A large proportion of this comes from animals that are assumed to have died (Fig. 4).

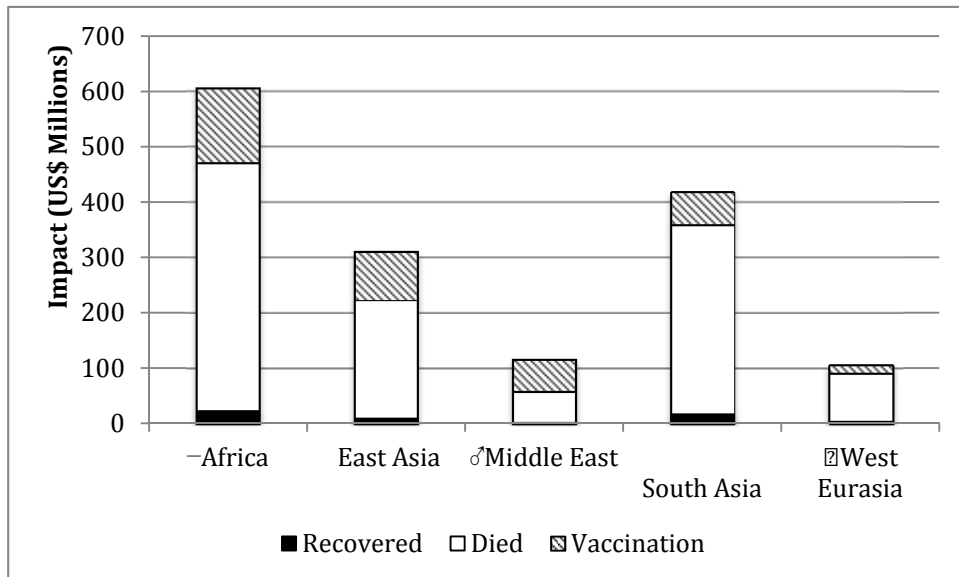


Fig. 4
Estimated global impact of *peste des petits ruminants* by region

The sensitivity analysis found that the global impact would increase to US\$ 2.1 billion. These estimates will be and should be contested. The assumptions are crude and need to be refined. It is hoped that countries will share their data on incidence and prevalence levels of PPR and also the levels of vaccination that is currently practised so the estimates can be refined and updated. This is an essential process of prioritisation of resources needed for animal health.

At a national and local level

The global level estimates provide no real feel for the trauma epidemics of PPR can cause to people who own small ruminants and those who depend on these animals for their trading and processing businesses. Even in endemic situations where losses may not be as dramatic there is found to be significant levels of disease and while many animals recovered there are significant reductions in weight and milk production. The following examples give some indication of the hardship suffered.

Evidence of the scale of PPR impacts in Kenya and Somalia indicate that households whose flocks infected with PPR lost a third to a half of their animals in a period of less than a year. In addition to such severe and rapid losses, the presence of such an important disease often leads to distress sales and steep reductions in prices paid for the animals. Impacts depend

on the farming systems, contribution of small ruminants to livelihoods and disease status. For example in Cote d'Ivoire, where small ruminant keeping is a minor livelihood activity, the impacts of PPR are not considered significant by the livestock keepers in the forested areas. Yet the impact of the disease in such situations will be specific to the keepers of the animals for those who are involved in the value chains of small ruminants.

South Asia has increasingly become a focus of the disease, which is causing serious losses in Pakistan, Afghanistan, Nepal, Bhutan, Bangladesh and India. Reports from Indian villages severely affected by PPR indicated a high incidence and mortality rate in small ruminants with losses both in terms of markets and in market value of animals. There was also additional expenditure on treatments. Such dramatic impacts can have serious implications in the viability of households as their core livelihoods are destabilised and this leads to a shift in foods the families have to rely on.

In more widespread terms it has been estimated that PPR was responsible for 1.2 million deaths in sheep and goats in Kenya with an estimated value of US\$ 23.6 million. In addition the disease was also estimated to create a drop in milk production 2.1 million litres.

Early studies and observations of the disease impact are as follows:

- A high seroprevalence of PPR antibodies was found in central Niger, suggesting frequent exposure to the disease (Stem, 1993). As such, the disease appears to be a major constraint to small ruminant production in Niger. Rumours of an outbreak are sufficient to deter the movement of flocks into an area. Outbreaks in the country are reported to occur approximately every five years (ibid.).
- Martenchar *et al.* (1997) conclude that mixed PPR and capripox infection, along with stongyles and external parasites are limiting factors in small ruminant production in Northern Cameroon. Serological studies however could find no relationship between seroconversion for PPR, and the appearance of any clinical symptoms. Most animals also survived for more than two months following seroconversion.
- Nawathe (1984) report that over 100 outbreaks were reported annually in Nigeria, and that many more go unreported. Epidemics tend to occur during the rainy season when goats are herded together, and around Christmas when movement towards markets increases.
- Roeder *et al.* (1994) describes an outbreak among a large herd of goats in the Addis Ababa area, where the morbidity rate was nearly 100% and the mortality rate up to day 20 of the outbreak was approximately 60%. The source of the infection appeared to be from the south west of Ethiopia, where it was suggested that the disease persists in endemic forms. The disease is also reported to have entered the country in 1989 via the Omo river valley in the south and to have spread by 1996 to the Ogaden and central Afar region.
- A serosurvey at Debre Zeit abattoir, Ethiopia in 1997 showed high prevalence rates of 86% among nomadic animals, 43% among those from sedentary systems and 33% among animals from mixed farms (Emergency Prevention System [EMPRES], 1998).

- Rinderpest was reported for the first time in Eritrea in 1993 and a nation-wide epidemic followed in 1994 with mortalities of 90% among sheep and goats in some outbreaks, efforts to control the disease by vaccination had limited success and outbreaks re-emerged in 1996 (EMPRES, 1998).
- Where the disease is endemic and small ruminants are kept in large numbers, quarantine and segregation are not realistic means of controlling the disease. As such, vaccination is the preferred method of control (Nawathe, 1984) and the uses of the Tissue Culture Rinderpest Vaccine (TCRV) were recommended.. The vaccine was known to provide protection for over one year. In addition the delivery of the vaccine has been problematic with a failure to maintain a cold chain leading to some non-viable doses being administered (Nawathe, 1984). In areas where the disease is endemic and animals harbour subclinical infections, subsequent vaccination with TRCV can trigger off the disease. Use of PPR hyper-immune serum produced in cattle was suggested as an alternative. Goats given hyperimmune serum along with a virulent PPR virus developed durable immunity. The cost of this treatment may however be prohibitive for most farmers (Adu & Joannis, 1984).

More recent detailed studies for Africa indicate the following critical information:

- In Cote d'Ivoire Agboville region, households whose flocks had been infected with PPR had lost between 28 to 60% of their sheep and goats due to PPR over a seven month period in 2013. Livestock keepers described goat mortality in the range of 30-97% while in sheep mortality ranged from 0 to 70%. There were also distress sales were associated with 50% reduction in farm gate price of the small ruminants.
- Socio-economic assets of PPR naive populations in eastern Africa, demonstrate the devastation associated with PPR. In Kenya, PPR increased vulnerability of pastoral livelihoods by raising poverty levels by 10% and had cumulatively accounted for 52%-68% reduction in small ruminant flock in two years depending on the wealth category of the households. At the end of two years since introduction, Turkana County had lost an estimated 863,122 animals. PPR resulted in food shifts where households increased reliance on markets for food following loss of home produced livestock products while share of wild foods consumed increased across all wealth groups. Households sold small ruminants and large livestock to purchase food from the markets leading to further depletion of livestock assets. The impacts resulted from delayed detection and response attributed to multiple response capacity factors.
- In Tanzania, PPR introduction resulted in about 33%-63% of the flocks in agropastoral and mixed farming systems respectively being infected over a one year period. The incidence rate (56.6%) was much higher small holder mixed farming systems compared to agropastoral (48.4%). Mortality loss ranged from 69.34% in agropsatorial to 73.60% in mixed farming. In each affected village, each household lost an average of 8 sheep/goats whose estimated value was US\$ 286. About 10.1% of the households in both systems lost entire small ruminants to PPR. Those with small number of sheep and goats (< 4) were the most affected. The average income that a household could earn but did not, due to PPR was estimated to be US\$ 233.6). At national level, estimates show that a total of 3.6 million animals had been infected in four years and about 1.0

million animals had died while about 64,661 had been culled due to PPR. About 330,910 kids were not borne as a result of abortions and 3,484,505 animals were subjected to antibiotics treatment costs and about 7.4 million had received vaccination. The cumulative loss due to PPR was estimated to be about (US\$ 67.9 million). Mortality losses contributed the highest (74%), followed by treatment and vaccination costs that both accounted for 13% while abortion and reproductive losses also accounted for 13%.

- In Somaliland, an overall baseline serological prevalence of 6.2% was established in 2001-2003, and in Puntland it was higher at 28.7%. In Central and Southern Somalia, a study conducted in 2007 showed a serological prevalence's ranging from 11.6% to 65% and an overall average of 35%. In 2008, the overall antibody prevalence in sheep and goat flocks sampled during outbreak investigations in 2008 in Awdal, Maroodijeh and Sahil regions was 26%, 23% and 30% respectively. The data indicate that PPR is endemic in all the regions of Somaliland. Continued reports and confirmed outbreaks of PPR prompted FAO to implement a massive vaccination programme in 2012 and 2013 that have been described as very successful. During the two year period, a total of 31.5 million animals vaccinated were making it the largest vaccination programme in the recent past in Somalia. In 2012, 19,666,847 sheep and goats were vaccinated which represented 60% of the sheep and goat population of 32.5 million. In 2013, 11,814,414 have been vaccinated and the exercise targeted young or unvaccinated animals. The 2013 PPR vaccination exercise simultaneously administers vaccine against sheep and goat pox. Also implemented alongside was vector control targeting 880,327 animals in the reverine districts only in south central Somalia
- Two studies from India indicate that while the mortality rate was relatively low per animal affected, the overall losses were high even when the animal recovered. The loss per animal affected was Rs 523 (US\$ 8.44) in Madhya Pradesh (Awase *et al.*, 2013) and Rs 918 (US\$14.81) and Rs 945 (US\$ 15.24) respectively for sheep and goats in Maharastra (Thombare and Sinha, 2009).

Summary

Peste des petits ruminants is a disease that appears to be becoming increasingly important. It is one of the few contagious diseases that are spreading rather than being controlled and effective control of the disease has not been achieved. The reasons for this appear to be that it affects small ruminants, species that are important to relatively poor groups within societies across Africa, Asia and the Middle East. However, the products from these animals are important to all people in these societies and therefore PPR has an impact that is often unappreciated. In summary PPR has both a social and an economic impact across the regions in which it circulates.

Economic rationale for *peste des petits ruminants* control

At a global level

The estimated maximum undiscounted costs for a fifteen year global PPR strategy is between US\$7.6 and US\$ 9.1 billion with the first five years costing between US\$ 2.5 and 3.1 billion. The lower range is 16.5% less and would be expected as a consequence of a rapid

decrease in PPR incidence in countries employing an effective vaccination strategy. In all scenarios tested there are significant vaccination campaigns that could well be reduced with strong targeting of at risk populations through carefully epidemiological and economic analysis. These costs have also given a realistic figure on vaccine dose costs and an amount to cover the delivery costs in different scenarios.

These costs need to be placed into the perspective of the numbers of animals that are being protected by the measures proposed – nearly a billion sheep and a billion goats. A rough estimate of the average cost per shoat year would mean an investment of between US\$ 0.27 and 0.32.

In contrast to an assessment of the annual global impact of the disease the estimated costs of the global strategy are small. It has been estimated that annual losses of production and the death of animals due to PPR are between US\$1.2 to 1.7 billion. There is also an estimated expenditure of between US\$270 to 380 million on PPR vaccination. Therefore the current annual impact alone PPR causes between US\$1.45 to 2.1 billion per year, and with a successful eradication programme this impact would be reduced to zero. It is important to recognise that without the strategy anything between US\$ 4.0 and 5.5 billion would be spent over a fifteen year period on poorly targeted vaccination campaigns that is unlikely to lead to eradication. In summary the global spending in the current structures will cost between US\$0.14 to 0.20 per sheep or goat year which will not result in eradication.

At a local and national level

Reports from localised vaccination campaigns against PPR have been reported to economically profitable and socially beneficial in East and West Africa and Asia. These programmes have been relatively shortlived and have not led to the eradication of the pathogen from the flocks and herds affected. However, they provide excellent evidence that a long term commitment to control, lead to the eradication of PPR will have positive social and economic impact. Some of the benefits will be in form of increased production of a great quality, others will be due to a reduction in the costs of treating sick animals and finally the absence of PPR will give people confidence to trade and process animals. Combined these will improve the supply chains of goat and sheep products leading to more sustainable food systems that benefit millions of consumers across Africa, Asia and the Middle East.

Costs of *peste des petits ruminants* control 2001-2013 in Somalia compared to production losses

The small ruminant populations were assumed to increase from 24,450,297 (2002) to 32,450,297 in 2013 and 300,000 were assumed to be vaccinated annually (based on available data) during the period 2002 to 2010. In 2011, the number of vaccinations increased to 450,000. In 2013, an estimated 11,814,414 small ruminants were also vaccinated for other diseases. During the period 2002 to 2011, an estimated 100,000 animals were assumed to have received treatment for other diseases alongside PPR vaccinations and that this number increased to 983,766 and 880,327 in 2012 and 2013 respectively. During the period, an estimated 38,221 samples were collected and cost of sample collection and analysis estimated. The unit cost of vaccine during the years 2002 to 2013 was assumed. Other costs considered were annual depreciation of cold chain

equipment, cost of sero-monitoring. The unit cost of vaccination (considering all costs) varied between US\$ 0.56 to 0.75 during the years 2002 to 2011 and decreased to US \$ 0.3 in 2012 and 2013 due to economies of scale.

A PPR prevalence rate of 10% in years 2002 to 2011 was used to compute mortality and morbidity losses. It should be noted that this prevalence is much lower than what has been reported in some sero-surveys. The decision to use a much lower was based on data gaps in many areas. The 2012-2013 vaccinations were assumed to lower prevalence to 5% and 2% respectively. A fatality rate of 50% was assumed during 2002 to 2005 and it was decreased to 30% in subsequent years. This was based on preliminary data on Kenya that showed that mortality rate had decreased during subsequent outbreaks. The analysis showed that annual mortality from PPR dropped from 1,222,515 animals in 2002 to 194,702 in 2013. The value of dead sheep and goats in each year was estimated from mortality and farm gate prices and was high as US\$ 23.6 million in 2011 and dropped to approximately US\$ 5 million in 2013.

Also estimated were loss of milk production due to PPR in milking goats (annual production assumed to be 10 litres and PPR resulted in 50% loss). Estimates showed that before the mass vaccination, about up to 2.1 million litres of goat milk was lost due to PPR infection. The vaccination reduced the losses by 76%. The unit farm gate price of 1 litre of goat milk was assumed to be US\$ 1 (2002) and US\$ 1.25 (2013).

Figure 5 compares the 13 year annual undiscounted costs of vaccination and combined value of mortality and milk production losses from morbid females. It is evident that mortality and morbidity are still much higher than control costs providing an opportunity to spend more money to save more losses as was the case in 2012 and 2013. The results should be interpreted with the knowledge that staff costs, vehicle depreciation and costs of surveillance have not been factored into due to data gaps. This study recommends that a review of PPR prevalence be undertaken to establish what the real burden of disease.

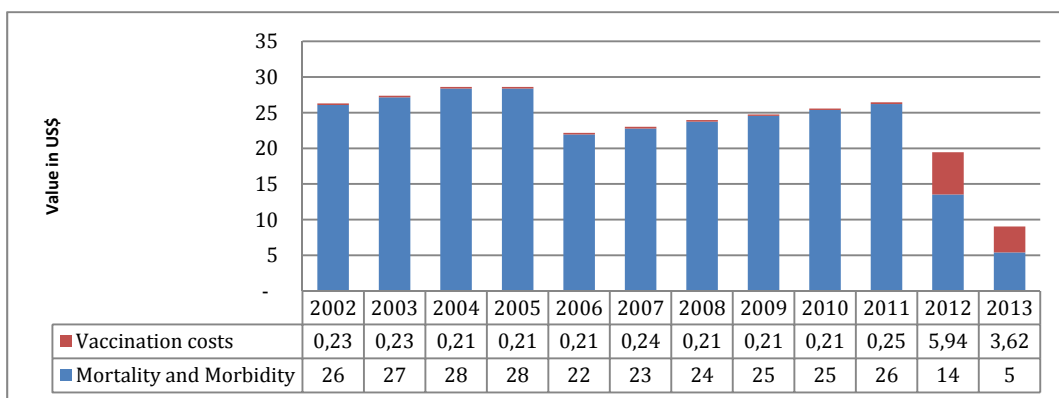


Fig. 5
Undiscounted costs of vaccination compared with production losses

Summary

The document has presented evidence of the importance of sheep and goats to millions of people across Africa and Asia and that these people tend to be from the poorest sections of society. These small ruminant populations are at risk from PPR and there is clear evidence

from case studies in a number of countries that PPR can affect people's livelihoods both of the livestock owners and the people who trade and process animals. These production losses and the costs of occasional vaccination efforts are estimated to have a global PPR impact of between US\$ 1.4 and 2.1 billion, estimates that need further data collection to refine them. However, even if these had to be corrected by 25% there are sufficiently large to justify the costs of successful global eradication programme that the current document supports. More detailed field level work from Somalia gives some indication that these campaigns can have immediate impacts.

References

Adu F.D. & Joannis T.E. (1984). – Serum-virus simultaneous method of immunisation against peste des petits ruminants. *Tropical Animal Health and Production*, **16**, 115-118.

Akerejola O.O., Veen T.W.S. & van Njoku C.O. (1979). – Ovine and caprine diseases in Nigeria: a review of economic losses. *Bulletin of Animal Health & Production in Africa*, **27** (1), 65-70.

Awa D.N., Njoya A. & Ngo Tama A.C. (2000). – Economics of prophylaxis against peste des petits ruminants and gastrointestinal helminthosis in small ruminants in north Cameroon. *Tropical Animal Health & Production*, **32** (6), 391-403.

Awase M., Gangwar L.S., Patil A.K., Goyal G. & Omprakash (2013). – Assessment of economic losses due to Peste des Petits Ruminants (PPR) disease in goats in Indore Division of Madhya Pradesh. *Livestock Research International*, **1** (2), 61-63.

Ba S.B., Udo H.M.J. & Zwart D. (1996). – Impact of veterinary treatments on goat mortality and offtake in semi-arid area of Mali. *Small Ruminant Research*, **19**, 1-8.

EMPRES (1998). – Assessment of PPR in the Middle East and the Horn of Africa. *EMPRES Transboundary Animal Diseases Bulletin*, **6**. Available at: <ftp://ftp.fao.org/docrep/fao/011/ak125e/ak125e00.pdf>.

Kumar Singh R., Balamurugan V., Bhanuprakash V., Sen A., Saravanan P. & Pal Yadav M. (2009). – Possible control and eradication of peste des petits ruminants from India: Technical aspects. *Veterinaria Italiana*, **45** (3), 449-462.

Martrenchar A., Zoyem N., Njoya A., Ngo Tama A-C., Bouchel D. & Diallo A. (1999). – Field study of a homologous vaccine against peste des petits ruminants in northern Cameroon. *Small Ruminant Research*, **31**, 277-280.

Mukasa-Mugerwa E., Lahlou-Kassi A., Anindo D., Rege J.E.O., Tembely S., Tibbo M. & Baker R.L. (2000). – Between and within breed variation in lamb survival and the risk factors associated with major causes of mortality in indigenous Horro and Menz sheep in Ethiopia. *Small Ruminant Research*, **37** (1/2), 1-12.

Nawathe D.R. (1984). – Control of peste des petits ruminants in Nigeria. *Preventive Veterinary Medicine*, **2**, 147-155.

New Agriculturalist (2000). – Peste des petits ruminants – an emerging plague? *New Agriculturalist on line*. Available at: www.new-ag.info/00-6/focuson/focuson9.html.

Reynolds L. & Francis P.A. (1988). – The effect of PPR control and dipping on village goat populations in southwest Nigeria. *ILCA Bulletin*, **32**, 22-27.

Robinson T.P. & Pozzi F. (2011). – Mapping supply and demand for animal-source foods to 2030. FAO, Animal Production and Health Working Paper. No. 2. Rome.

Roeder P.L., Abraham G., Kenfe G. & Barret T. (1994). – Peste des petits ruminants in Ethiopian goats. *Tropical Animal Health and Production*, **26**, 69-73.

Stem C. (1993). – An economic analysis of the prevention of peste des petits ruminants in a Nigerian goats. *Preventive Veterinary Medicine*, **16**, 141-150.

Taylor W.P. (1984). – The distribution and prevalence of peste des petits ruminants. *Preventive Veterinary Medicine*, **2**, 157-166.

Thombare N.N. & Mukesh Kumar Sinha (2009). – Economic Implications of Peste des petits ruminants (PPR) Disease in Sheep and Goats: A Sample Analysis of District Pune, Maharashtra. *Agricultural Economics Research Review*, **22** (2), 319-322.

Annex 2

Regional situations

The list of countries in each of the regions or sub-regions is largely based on the membership of the Regional Commissions of the Food and Agriculture Organization of the United Nations (FAO), and the World Organisation for Animal Health (OIE) and that of the relevant Regional Economic Communities. The lists and maps are shown in Part C, section 2.1.

East Asia, South East Asia, China and Mongolia

The first incursion of *peste des petits ruminants* (PPR) into the People's Republic of China (China) occurred in 2007. Since the end of 2013, 22 of the 31 provinces in China were infected in a series of consecutive outbreaks that continued into the second half of 2014. As a result, hundreds of animals were slaughtered and vaccination (300 million doses) was conducted in 27 provinces. These control measures have significantly reduced the number of outbreaks and, since May 2014, and at the date of end of January 2015 only eight sporadic outbreaks have been recorded.

The South East Asia countries, members of ASEAN, are not infected. Mongolia is also not infected but is at a high risk due to the situation in China and the level of awareness and preparedness has therefore been increased.

South Asia

In South Asia, a regional roadmap was formulated in 2011 by the SAARC member countries and it will be reviewed every two years. With the exception of Sri Lanka, all SAARC countries have reported PPR infection; however, the disease was reported only once in Maldives and Bhutan. Each SAARC country has a national laboratory suitable for PPR diagnosis and the Bangladesh national laboratory currently serves as the regional laboratory. Surveillance is ongoing as well as vaccination campaigns in high-risk-identified areas. Bangladesh, India and Nepal are producing PPR vaccine; however, there is an urgent need to improve the quality and quantity of these vaccines to meet national and regional requirements. At a regional meeting held in December 2013 several challenges were identified, including the lack socioeconomic impact assessment across the value chain, the need to develop a strategic plan and ensure a budget for its implementation and to enhance technical expertise and skills. Agreement was also reached on the need to raise awareness among farmers, to formulate or revise and enforce regulations regarding animal movements, to harmonise laboratory diagnostic tests in the region and to deliver quality assured vaccines. Some countries benefit from strong FAO technical support, such as Afghanistan and Pakistan where disease surveillance, laboratory diagnostic capacities, vaccine production and vaccination campaigns are being strengthened.

Central Asia

In Central Asia¹ few countries are or have been infected but the exact situation of some countries is not well known. Vaccination has been used in several countries. Vaccine is produced in countries associated with this region (see footnote on 'West Eurasia'), such as Iran and Pakistan. PPR control and eradication programmes are being developed but there is a need to better harmonise and coordinate all these efforts.

Turkey is heavily infected and vaccination, using nationally produced vaccines (the PPR virus [PPRV] Nigeria 75/1 vaccine strain), and surveillance are being implemented. One of the major challenges is to prevent any disease incursion into Europe, a region totally PPR free at present.

Middle East

The PPR situation in this region is quite favourable but some countries are infected and the precise situation in some others should be better assessed. Surveillance is ongoing in all countries and awareness is increasing. Vaccine is produced in Jordan and Saudi Arabia.

An FAO-OIE GF-TADs workshop held in 2014 identified major limiting factors and challenges as well as areas for improvement. Several important issues were addressed by the recommendations formulated at the meeting, including the need to improve epidemicsurveillance networks, control the movements of small ruminants and support the establishment of regional laboratory and epidemiology networks. An increase in awareness, communication and socioeconomic studies was also recommended, as well as training and capacity building in epidemiology and risk analysis. The need to formulate a PPR regional strategy was highlighted and the Gulf Cooperation Council C Secretariat was supported in its current efforts to develop a specific GCC PPR control strategy.

In three countries of the Middle East (Iraq, Syria and Yemen) with large small ruminant populations, the current political disturbances are hindering the surveillance and control programmes for PPR as well as for other major diseases. This represents a major risk to neighbouring countries and an obstacle to the implementation of the regional PPR strategy in the Middle East.

Europe²

There is no circulation of PPRV in Europe and 29 countries have an OIE-recognised official free status. Strong awareness, preparedness and epidemiological surveillance are already in place and they have been further strengthened due to the increased risks of introduction related to the expansion of PPR in neighbouring regions in recent years, such as in Northern Africa and Turkey.

¹ This region groups together Turkmenistan, Kazakhstan, Uzbekistan, Kyrgyzstan, Tajikistan and Caucasus countries (Georgia, Azerbaijan, Armenia). For epidemiological reasons some countries belonging to the Middle East (Syria, Iran) or South Asia (Afghanistan, Pakistan) regions as well as Turkey are related to what can be defined as 'West Eurasia' and they are invited to participate in 'West Eurasia' regional meetings.

² Geographical Europe (and not countries belonging to the FAO or OIE Regional Commissions for Europe)

The European Food Safety Authority (EFSA) has published a report in 2015³ giving its 'Scientific Opinion' on PPR and in particular assessing the risk of introduction of PPR into the European Union and neighbouring countries and the estimated speed of propagation. It was considered that the most likely route of introduction would be via illegal transboundary movement of animals from infected regions. Awareness-raising campaigns and training for farmers and veterinary staff in recognising the disease under field conditions is being recommended particularly for countries/regions bordering affected regions. Also highly recommended is a better knowledge of legal and illegal livestock and animal product movements, especially in areas at risk of or affected by PPR.

North Africa

PPR is currently present in some countries in the North African region. In this region, the situation has evolved in recent years. The disease has been recognised as present in Mauritania since the 1980s and has been regularly reported over the years. PPR occurred for the first time in Morocco in 2008, with a virus belonging to lineage IV (a virus present notably in South Asia and the Middle East) which was first detected in Egypt at the end of the 1980s. Subsequently, the disease due to the same lineage IV was notified in Tunisia in 2009 and Algeria in 2011, and has been reported there since. PPR due to lineage IV is widespread in Egypt. According to serological surveys it is suspected but not officially reported in Libya. In Mauritania, PPR is due to the virus lineage II.

Morocco implemented a mass vaccination campaign from 2008 to 2011, associated with other control measures such as intensified surveillance. This campaign was successful since no PPR case has been reported yet in this country. This result demonstrates that PPR can be controlled through mass vaccination campaigns. Other lessons are that a PPR-free country in the North African region can be very vulnerable because of numerous, repeated and mostly uncontrollable traditional animal movements across the countries in the region. This highlights the importance of intensive vigilance, with early detection of any outbreak reoccurrence and a rapid response. Designing and implementing a regional PPR control strategy in Northern Africa, based on coordinated mass vaccination in infected countries, together with efficient active surveillance measures and improved knowledge of legal and illegal livestock movements, is of crucial importance. All regional policies and activities in the field of animal health are coordinated by the well-established REMESA platform.

Eastern Africa

In Eastern Africa all countries are infected and a regional strategy has been developed aimed at developing or improving a series of activities, including surveillance, diagnostic procedures, vaccination and awareness campaigns. Currently, prevention and control measures for PPR as well as other diseases are based on vaccination campaigns conducted mostly in response to disease outbreaks and hence are focused around the outbreak area (i.e. ring vaccination). Nevertheless, mass PPR vaccination campaigns were conducted in Kenya in 2008/2009 and Somalia in 2012/2013. The Nigeria 75/1 strain (produced in Ethiopia, Kenya and Sudan) was

³ European Food Safety Authority AHAW Panel (EFSA Panel on Animal Health and Welfare) (2015). – Scientific Opinion on peste des petits ruminants. *EFSA Journal*, **13** (1), 3985, 94 pp. doi:10.2903/j.efsa.2015.3985. Available at: www.efsa.europa.eu/efsajournal.

used in these vaccination campaigns. The use of a thermotolerant vaccine would be an important improvement for vaccination efficacy.

Southern Africa

Most countries in Southern Africa are currently free from PPR but the SADC member countries, after the introduction of PPR in a few countries, developed in 2010 a regional PPR control strategy. The main objectives of this strategy are as follows:

1. to immediately contain/control PPRV circulating in Angola, Democratic Republic of the Congo and Tanzania,
2. to prevent the disease from spreading to Malawi, Mozambique and Zambia,
3. to propose a methodology for the long-term eradication of PPR from the SADC region.

Currently, only Botswana produces PPR vaccines in the SADC region. South Africa has an OIE-recognised official PPR free status. Support is being given by the FAO and AIEA to enhance laboratory diagnosis and vaccine production capabilities, improve disease surveillance, undertake socio-economic studies on PPR impact, and strengthen coordination/harmonisation of PPR prevention and control in the region.

Central Africa and West Africa

All countries in Central and West Africa are infected. Regional meetings and conferences have already addressed the PPR issue (e.g. Conferences of the OIE Regional Commission for Africa) and FAO has implemented several national projects supporting activities in laboratory diagnostic (together with AIEA), surveillance and other field operations or vaccine production (together with AU-PANVAC), formulation of national strategic plans, etc. Vaccination campaigns are undertaken in endemic and at-risk areas but the achievements are not always optimal. A pilot field project funded by the Bill & Melinda Gates Foundation was carried out by the OIE in Ghana and Burkina Faso to identify the major constraints that may hamper the successful implementation of vaccination programmes. Various production systems and vaccine delivery systems (public and private) were considered in the study and several evaluation methods were tested. Logistical issues and communication directed at owners and vaccinators were among the principle factors that could determine positive achievements or failures. This field component was combined with two other components, namely the improvement of the quality of PPR vaccines produced in Africa, implemented by AU-PANCVAC, and the establishment of a vaccine bank. Currently, Niger, Nigeria, Mali and Senegal are PPR vaccine producers. At the regional level, a number of limiting factors have been recognised, such as the efficacy of the delivery systems, particularly in the case of small-scale production systems or those in remote and insecure areas, and the vaccine cold chain. In Central and West Africa, the relevant RECs (ECOWAS, CEMAC, CEBEVIRHA, WAEMU, etc.) and other regional organisations continue to strengthen their political commitment as well as their financial and technical support together with their development partners. National and regional control and eradication strategies are being prepared.

In Africa, the support of AU-IBAR is critical and in 2014 it defined a continental strategy for PPR control⁴.

At the global, regional and national levels, the roles of FAO and the OIE to support regional organisations and member countries are multiple, in association with the for laboratory matters. In the case of the OIE, the adoption of new articles for the PPR-relevant chapters of the *Terrestrial Animal Health Code* have created a possibility for a country to be officially recognised by the OIE as free from PPR or to obtain OIE endorsement of their national control programmes. This has proven to be a very powerful incentive for countries when embarking on a control and eradication programme. In the case of the FAO, direct support to countries through the implementation of development projects is being very actively pursued. At regional and international level the two organisations are working together within the framework of the GF-TADs initiative to advocate and provide the appropriate expertise in support of their members.

⁴ African Union–Inter-African Bureau for Animal Resources (AU-IBAR)/Pan African Veterinary Vaccine Centre (AU PANVAC) & Soumare B. (2013). – Pan African Program for the Control & Eradication of PPR: A Framework to Guide & Support the Control and Eradication of PPR in Africa, 5th Pan African CVOs Meeting, Abidjan, Côte d’Ivoire, 13-15. Available at: [file:///C:/Users/jdom/Saved%20Games/Downloads/20130508 evt 20130418-19 abidjan pan african program for the control and eradication of ppr en%20\(2\).pdf](file:///C:/Users/jdom/Saved%20Games/Downloads/20130508 evt 20130418-19 abidjan pan african program for the control and eradication of ppr en%20(2).pdf).

Elsawalhy A., Mariner J., Chibeu D., Wamwayi H., Wakhusama S., Mukani W. & Toye Ph. (2010). – Pan African strategy for the progressive control of PPR (Pan African PPR Strategy). *Bull. Anim. Hlth. Prod. Afr.*, **58** (3), 185-193.

Annex 3.1: **Laboratory diagnostic tools**

If the first description of *peste des petits ruminants* (PPR) dates back to only 1942, this disease is certainly a very old disease which was overlooked in favour of many other small ruminants diseases that have similar symptoms, in particular rinderpest and pasteurellosis, the latter being in many cases a consequence of a secondary infection following the immune depressive effect of PPR virus. Knowledge on the geographical distribution of PPR started to expand steadily but dramatically as of the 1990's when specific and sensitive tests became gradually available: nucleic acid-based probes tests, monoclonal antibodies-based serological and nucleic acid amplification tests. It is clear that the development of those tests, their transfer to veterinary diagnostic laboratories and their successful implementation have greatly contributed to our current understanding of PPR and they will be essential for future programmes aiming at controlling this disease. For any disease control, the place of diagnostic laboratories is of prime importance: to treat/control a disease, it should be first diagnosed. Because of the transboundary nature of *peste des petits ruminants*, any strategy for its control, to be efficient, should be based on the regional approach with regular meetings and exchange of information between stakeholders of different countries. Networks are the best fora for such close collaborations.

This is one of the lessons learnt from the success of the Global Rinderpest Eradication (GREP). Indeed one of the key elements in that success has been the successful transfer of rinderpest diagnostic tests by the Joint FAO/IAEA Division as of 1988 to veterinary laboratories in most of the countries involved in the GREP. This transfer was ensured through laboratories networks: coordination of activities, harmonisation of diagnostic procedures with proficiency testing, updating and incorporation of new scientific developments, exchange of information and maintaining contacts between scientists involved in the same programme and thereby building trust between them. The joint FAO/IAEA Division, in close link with the FAO/OIE PPR Reference Laboratories will play the same coordination role in fostering the organisation of laboratories PPR regional and global networks and ensuring the transfer of new technologies to those laboratories. The advent of biotechnologies, bioinformatics and the quality improvement of electronic devices have considerably revolutionised disease diagnosis to enable a highly specific, highly sensitive and rapid identification of pathogens, results that are essential for early and effective reactions. Assays deriving from these new technologies are in constant improvement and this implies continuous capacity building efforts in veterinary laboratories: staff training, provision of required equipment and reagents. Most of veterinary diagnostic laboratories of countries where PPR is endemic are at variable levels for implementing these assays, some being able to perform only some classical assays because of very limited funding support. The PPR control strategy will try to mitigate those weaknesses by deploying efforts to strengthen animal disease diagnostic capacities, supports to be tailored according to the level of each laboratory, bearing also in mind that it will be impossible financially to bring all those laboratories at high standards. However, the support should be provided in a way to enable the full diagnosis of PPR, up to virus isolation and genotyping within the region, of course with the

collaboration of FAO/OIE PPR reference laboratories and the Joint FAO/IAEA Joint Division. Indeed, it is expected that the support the OIE twinning programme and the Joint FAO/IAEA Division veterinary laboratory support activities will enable the promotion of at least one or two laboratories in each region and network into a good standard so as to successfully implement modern techniques for the full identification and characterisation of PPR virus (PPRV). Those 'regional PPR reference laboratories' will be key players with FAO/OIE Reference Laboratories within the networks to be coordinated by the Joint FAO/IAEA Division. Support should be provided to facilitate the collection and shipment of test samples to the laboratory. The PPR control strategy will consider the disease diagnosis and monitoring at four levels:

1. use of penside test, immunochromatography strips, for the diagnosis in the field by specialised and non-specialised laboratory diagnosticians;
2. the serological-based test (ELISA) for either the antibody detection or the virus detection by immunocapture in the regional laboratories not well equipped;
3. the PPRV identification by nucleic acid amplification (RT-PCR) in national laboratories;
4. the virus isolation and genotyping at the regional 'reference laboratory' or at the FAO/OIE reference laboratories or the Joint FAO/IAEA laboratory.

Virus isolated in the 'regional PPR reference laboratories' should be made available to the FAO/OIE Reference Laboratories and the Joint FAO/IAEA Laboratory which is not only the FAO laboratory but is also the OIE Collaborating Centre pour the Application of ELISA and Molecular Techniques to Animal Disease Diagnosis. Considering that a PPR control programme, to be cost-effective, should include also at the same time the control of other major priority small ruminant diseases, veterinary diagnostic laboratories be strengthened accordingly to enable them carrying out not only PPR diagnosis but also those diseases in a timely manner.

Constant discussions with close interactions between laboratory scientists and epidemiologists will be fostered in view of better designing samples collection and interpretation of test results.

References

Banyard A.C., Parida S., Batten C., Oura C, Kwiatek O. & Libeau G. (2010). – Global distribution of peste des petits ruminants virus and prospects for improved diagnosis and control. *J. Gen. Virol.*, **91**, 2885-2897.

Baron J., Fishbourne E., Couacy-Hyman E., Abubakar M., Jones B.A., Frost L., Herbert R., Chibssa T.R., Van't Klooster G., Afzal M., Ayebazibwe C., Toye P., Bashiruddin J. & Baron M.D. (2014). – Development and testing of a field diagnostic assay for peste des petits ruminants virus. *Transbound. Emerg. Dis.*, **61**, 390-396.

Diallo A., Libeau G., Couacy-Hymann E. & Barbron M. (1995). – Recent developments in the diagnosis of rinderpest and peste des petits ruminants. *Vet. Microbiol.*, **44**, 307-317.

Annex 3.2.: Vaccines

Early serological studies on both rinderpest and *peste des petits ruminants* (PPR) demonstrated that there is only one rinderpest virus serotype and one PPR virus (PPRV) serotype. However gene sequence analysis have allowed classifying rinderpest virus strains into three lineages and PPRV strains into four lineages.

However, differences between lineages do not seem to have an impact on the efficacy of the host immune response to the live attenuated vaccine. Indeed one of the keys in the success of the global rinderpest eradication was the availability of a good rinderpest vaccine, the live cell culture attenuated Plowright vaccine, providing a lifelong immune protection response in the host and against all strains of the three rinderpest virus lineages. As for rinderpest, an animal which recovers from a PPR infection develops a lifelong immunity against this disease. Live cell culture attenuated PPR vaccine seems to have the same characteristic as the wild type strains. Currently there are six live attenuated PPR vaccines, all belonging to either lineage II or lineage IV. Experience in the field use of the vaccine of the lineage II indicates that it is effective against all PPR strains, whatever the lineage. This characteristic should be the same also for the second vaccine. Currently about 15 manufacturers produce PPR vaccines. One of the lessons from the GREP is the use of quality certified vaccine during the vaccination campaigns, vaccine quality meeting the OIE standards. The PPR control strategy foresees to adopt the same approach. In that regards, the certification body should be an independent institution such as the PANVAC in Africa.

Current PPRV attenuated vaccines have two main drawbacks. The first is the necessity to maintain them in the cold chain until their delivery to the animal to avoid their inactivation by the heat. Most of the endemic regions of PPR are of hot climate environment and they usually have poor infrastructure to maintain the cold chain needed to ensure the preservation of the vaccine potency. This drawback has now been addressed by many research laboratories by improving the freeze-drying conditions in the presence of cryoprotectants. It is expected that the transfer of these new technologies to vaccine manufacturers will improve the quality of the final products.

The second drawback of the current PPR vaccines is that the antibody response they induce in animals cannot be distinguished from those following the wild type virus infection. This makes sero-epidemiological surveillance of the disease impossible in endemic areas where a vaccination programme has been or is being implemented. A way to combine both vaccination and serosurveillance activities for the best management of the disease is the use of vaccine that allows the Differentiation between Infected and Vaccinated Animals (DIVA). Many approaches are being followed for addressing this issue: cloning the PPRV immune protective protein into the genome of a vector and use this product as recombinant vaccine, or use the reverse genetics technology to introduce a marker into the PPRV genome. Those products will certainly not be ready for field use before 10 years' time. Therefore the PPR control programme will be started with the use of the current available vaccines, with the improvement of their thermostability.

References

Diallo A. (2003). – Control of Peste des Petits ruminants: classical and new generation vaccines. *Dev. Biol. Basel*, **114**, 113-119.

Diallo A. (2005). – Control of Peste des Petits ruminants: vaccination for the control of Peste des Petits Ruminants. *Dev. Biol. Basel*, **119**, 93-98.

Diallo A., Minet C., Le Goff C., Berhe G., Albina E., Libeau G. & Barrett T. (2007). – The Threat of Peste des Petits Ruminants: Progress in Vaccine Development for Disease Control. *Vaccine*, **25**, 5591-5597.

Saravanan P., Sen A., Balamurugan V., Rajak K.K., Bhanuprakash V., Palaniswami K.S., Nachimuthu K., Thangavelu A., Dhinakarraj G., Hegde R. & Singh R.K. (2010). – Comparative efficacy of peste des petits ruminants (PPR) vaccines. *Biologicals*, **38**, 479-485.

Sen A., Saravanan P., Balamurugan V., Rajak K.K., Sudhakar S.B., Bhanuprakash V., Parida S. & Singh R.K. (2010). – Vaccines against peste des petits ruminants virus. *Expert Rev. Vaccines*, **9**, 785-796.

Silva A.C., Yami M., Libeau G., Carrondo M.J. & Alves P.M. (2014). – Testing a new formulation for Peste des Petits Ruminants vaccine in Ethiopia. *Vaccine*, **32**, 2878-2881.

Annex 3.3.



Food and Agriculture
Organization of the
United Nations

Oie
WORLD ORGANISATION
FOR ANIMAL HEALTH



PPR **MONITORING** and **EVALUATION TOOL (PMAT)**

A Companion Tool of the

**GLOBAL STRATEGY
FOR THE **CONTROL**
AND **ERADICATION**
OF **PPR****



Acknowledgements

The PMAT has been prepared by Dr Nadège Leboucq (OIE) and Dr Giancarlo Ferrari (FAO) with the support and contribution of Dr Joseph Domenech (OIE), under the FAO-OIE GF-TADs PPR Working Group responsibility.

The preparation of the PMAT has benefited from a similar work done by EuFMD, FAO and OIE experts to define an FMD Progressive Control Pathway (FMD-PCP) which allows monitoring the progress in the control of foot and mouth disease.

Table of content

ACKNOWLEDGEMENTS	2
TABLE OF CONTENT	3
INTRODUCTION	4
PRINCIPLES AND APPLICATION OF THE PMAT	6
1. OVERVIEW	6
2. PROGRESSION ALONG THE STAGES	6
3. TECHNICAL ELEMENTS	7
4. OBJECTIVES, OUTCOMES AND ACTIVITIES	8
5. CAPACITY OF VETERINARY SERVICES (ENABLING ENVIRONMENT)	10
PROGRESS FROM STAGE TO STAGE	11
1. OVERVIEW	11
2. THE PMAT QUESTIONNAIRE	12
ENTERING THE STEP-WISE APPROACH – STAGE 1	14
1. STAGE 1 – ASSESSMENT PHASE	15
PMAT QUESTIONNAIRE TO MOVE TO STAGE 2 ('GO-AHEAD GATEWAY')	28
MOVING FROM STAGE 1 TO STAGE 2	29
2. STAGE 2 – CONTROL PHASE	29
PMAT QUESTIONNAIRE TO MOVE TO STAGE 3 ('GO-AHEAD GATEWAY')	43
MOVING FROM STAGE 2 TO STAGE 3	44
3. STAGE 3 – ERADICATION PHASE	44
PMAT QUESTIONNAIRE TO MOVE TO STAGE 4 ('GO-AHEAD GATEWAY')	55
MOVING FROM STAGE 3 TO STAGE 4	56
4. STAGE 4 – POST-ERADICATION PHASE	56
MOVING BEYOND STAGE 4	65
ANNEX – CORRESPONDENCE TABLE BETWEEN THE PPR STAGES AND THE OIE PVS CRITICAL COMPETENCES (LEVEL OF ADVANCEMENT)	66

Introduction

Peste des petits ruminants (PPR) is a flagship disease when it comes to addressing animal health issues related to poverty alleviation and the assurance of food security and its control should be considered as a Global Public Good. Combatting PPR is included in the OIE's Fifth Strategic Plan and in FAO's Strategic Objectives 2, 3 and 5. It is also one of the GF-TADs priority diseases at regional and global level and as such, PPR control is included in the 5-year GF-TADs Action Plan at global level as well as of the five GF-TADs regions.

The world Organisation for Animal Health (OIE) and the Food and Agriculture Organization of the United Nations (FAO) have decided to embark on the control and eradication of PPR at a global scale and develop a global strategy ('Global Strategy for the control and eradication of PPR', hereafter called 'PPR Global Strategy'). There is indeed a need to approach the problem in a systematic way in order to prevent re-occurrence of epidemic episodes and assist countries in promoting concerted actions to keep the disease under control if not to reach eradication.

The decision to prepare the Global PPR Strategy has been made easier particularly because of:

- The lessons learnt from the global eradication of rinderpest, officially declared in 2011, which could serve as a model for the eradication of PPR. The OIE and FAO Members States encouraged these two organisations to build on this RP eradication experience to expand the approach to the eradication of PPR. It was stated in particular at the 37th FAO Conference held in June 2011 where MS 'Encouraged FAO to take full advantage of the rinderpest eradication achievement and apply the lessons learned to prevent and control other diseases impacting food security, public health, the sustainability of agriculture systems and rural development;
- The adoption in May 2013 of a PPR official country status which can be obtained through the World Organisation for Animal Health (OIE) with the option to apply for an official endorsement of their national control programmes (see chapters 1.6. and 14.8. of the OIE *Terrestrial Animal Health Code*);
- The existence of a similar approach adopted for the FAO-OIE Global Strategy on FMD control and its companion tools, namely the FMD PCP Guide, FMD PCP assessment Tool and FMD Control Program templates. Some of these general principles adopted for FMD control can be transferred to other diseases, such as PPR.

The PPR Monitoring and Assessment Tool (PMAT) is a PPR Global Strategy companion tool, aiming at:

- (i) Categorizing countries according to the prevailing epidemiological conditions and prevention and control activities with regard to PPR at the national and local levels;
- (ii) Guiding and facilitating the efforts of countries that have embarked on prevention and control activities for PPR. Notably, it gives PPR-endemic countries guidance and milestones based on epidemiological and activity-based evidence.
- (iii) Providing through the use of these milestones, and specific criteria a measure for comparing relative progress in PPR prevention within and between countries; and
- (iv) Ultimately obtaining an official OIE status.

The PMAT uses an evidence-based, transparent assessment procedure to determine each country's Stage of the Global Strategy. The countries being assessed must be able to provide clear evidence of activities performed and progress achieved towards the key outcomes described in this Tool.

The PMAT can be used either as a self-assessment by the country or for external independent assessment by external experts (country visits) operating at the request of the country and under the supervision of the GF-TADS Global PPR Working Group.

The PMAT was designed to be used as a stand-alone document; this is why the main elements of the Global PPR Strategy are recalled in this document.

The use of the PMAT presented in this document will be evaluated after one year and a specific expert meeting will be organised in order to revise or update the methods and to fine tune some of the elements such as the performance indicators, their relevant targets and the rules for ranking conclusions (expected results/targets have been fully/partially/not achieved).

Besides the PMAT is a living document which can be adjusted anytime as needs arise; experience collated from countries who will use it on a regular basis will also be an important trigger for its revision.

Principles and application of the PMAT

1. OVERVIEW

The PPR Monitoring and Assessment Tool is based on four different stages identified in the Global Strategy for the progressive control and eradication of PPR, which correspond to a combination of decreasing levels of epidemiological risk and increasing levels of prevention and control.

The different stages identified in the Global Strategy are as follows:

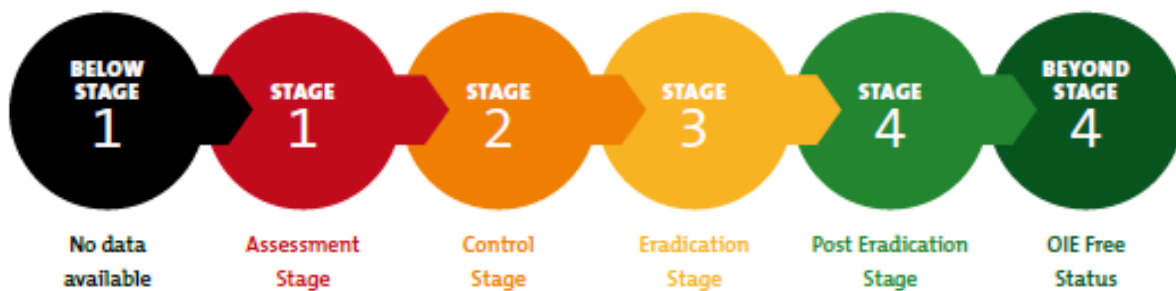


Fig. 1
Stages of the Global Strategy

The Stages range from Stage 1 – where the epidemiological situation is being assessed, to Stage 4 – when the country can provide evidence that there is no virus circulation either at zonal or national level, and is ready to apply for the OIE official country status of PPR freedom (see Fig. 1). On the contrary:

- A country where there are insufficient data to understand the true risk for PPR and where no appropriate structured epidemiological investigations are undertaken and where no coordinated prevention and national control programme is present, cannot be categorised in any of the four Stages (i.e. is ‘below Stage 1’);
- A country with an official OIE country status cannot be categorised either in any of the 4 Stages (i.e. is ‘beyond Stage 4’). A country is entitled to apply to the OIE for such an official free at the end of Stage 4.

2. Progression along the stages

The usual progression is to move from one Stage (n) to the Stage immediately after (n+1); this will be the case for most countries where PPR is endemic, notably in developing countries which may not have the resources to tackle the disease straightaway on a national scale. However, for countries willing to eradicate PPR more rapidly, there is a ‘fast-track’ procedure allowing them to move from Stage 1 to Stage 3, Stage 2 to Stage 4 and Stage 1 to Stage 4 (see Fig. 2).

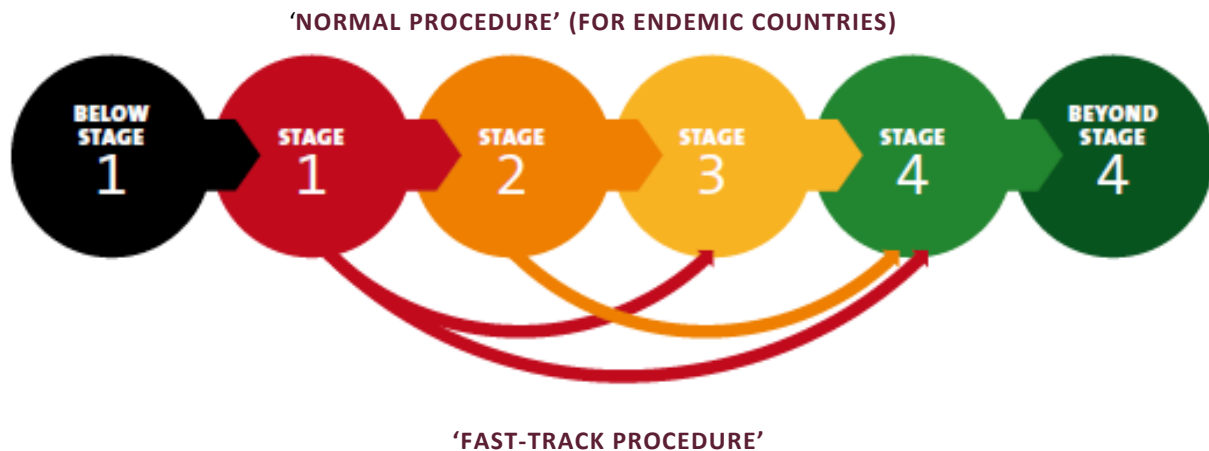


Fig. 2

Normal and fast-track procedures to progress along the PPR step-wise approach

Apart of the countries with an official OIE country status (in particular countries with an **historical freedom as per provisioned in the OIE Terrestrial Animal Health Code [the Terrestrial Code]**) and of countries which are already categorised in a PPR stage above Stage 1,

Stage 1 is unavoidable for any country wishing to embark into the PPR step-wise approach to understand the situation and decide the relevant next step towards eradication.

It should be considered that:

- A higher Stage (n+1) assumes compliance with the preceding Stage (n) requirements
- For countries using fast track pathway (n to n+2 or n+3), the compliance with the preceding Stage (n+1 or n+2 respectively) remains fully valid except for some prevention and control measures, the application of which is likely to be related to the presence or absence of the virus as determined in Stage 1.

The speed of progression is upon each country's decision, depending on the epidemiological situation and the VS capacity. However, the Global PPR Strategy recommends the following duration for each Stage:

- Stage 1 → minimum 12 months and up to 3 years
- Stage 2 → 3 years (from 2 to 5 years)
- Stage 3 → 3 years (from 2 to 5 years)
- Stage 4 → 24 months and up to 3 years

3. TECHNICAL ELEMENTS

The categorisation for any specific country in a given stage (= to a specific level of risk) is the result of a combination of the five main technical elements described in the Global Strategy:

- **PPR Diagnostic system(s)** – effective control of PPR requires that basic reliable laboratory diagnostic services are operational within individual countries (preferred option) or are outsourced. The capability of field veterinarians and their skill in recognising PPR and initiating a differential diagnostic procedure should be part of the overall diagnostic system.

- **PPR Surveillance system(s)** – surveillance is key to understand PPR epidemiology in a country as well as to monitor progress in the control and eradication efforts. Along the Stages of PPR efforts to control and eradicate the disease, the surveillance system is likely to become more and more complex. In any case, comprehensive surveillance activities imply a thorough understanding of the production and trading systems (value chain).
- **PPR Prevention and control system(s)** – PPR prevention and control measures are a combination of different tools, which can include vaccination, improved biosecurity, animal identification, movement control, quarantine and stamping out. These individual tools are likely to be applied at different levels of intensity while an individual country is moving along the pathway.
- **Legal framework in place for PPR prevention and control** – PPR legislation is the cornerstone that provides the Veterinary Services with the necessary authority and capability to implement PPR surveillance, prevention and control activities. For each Stage it should be guaranteed that the legislation framework in place is consistent with the types of activities due to be carried out.
- **Stakeholder involvement on PPR** – true progress in PPR prevention, control and eventually eradication cannot be achieved without serious involvement of relevant stakeholders in all sectors (private and public veterinarians, para-professionals, livestock keepers and their community-based animal health workers, traders, NGOs and other development partners). This implies defining their roles and responsibilities at each Stage – the control efforts are likely to be a combination of public and private contributions. This also implies strong awareness and communication strategies directed to all these different actors.

4. OBJECTIVES, OUTCOMES AND ACTIVITIES

For each Stage, specific objectives are described (see Global PPR Strategy, Part B, Paragraph 2.3. and relate to these five main technical elements listed above (diagnostic, surveillance, prevention and control, legislation and stakeholder involvement). Their progressiveness along the step-wise approach proposed in the Strategy is depicted in the Table next page.

Outcomes and Activities in each Stage – also relating to the five listed above technical elements – are appropriate to mitigate the risk in accordance with the evidence provided in the preceding Stage or to new evidence provided by the continuous monitoring of the epidemiological situation and progress achieved. Activities and their impacts (outcomes) are indeed measurable in each Stage (PPR Monitoring and Assessment Tool).

PPR Stages Elements	Stage 1 (Assessment)	Stage 2 (Control)	Stage 3 (Eradication)	Stage 4 (Post-eradication)
Diagnostic	<ul style="list-style-type: none"> To establish laboratory diagnostic capacity mainly based on ELISA methods 	<ul style="list-style-type: none"> To strengthen the laboratory capacity through the introduction of bio-molecular methods for a better characterisation of field strains 	<ul style="list-style-type: none"> To further strengthen laboratory capacity to support eradication through the introduction of a laboratory quality assurance system 	<ul style="list-style-type: none"> To maintain laboratory capacity as in the previous Stage and strengthen the differential diagnostic pathways. To start implementing PPRV sequestration activities
Surveillance	<ul style="list-style-type: none"> To implement monitoring activities and evaluate socio-economic impacts 	<ul style="list-style-type: none"> To implement surveillance incorporating a response mechanism and risk mitigation measures 	<ul style="list-style-type: none"> To strengthen surveillance incorporating an emergency response mechanism 	<ul style="list-style-type: none"> To shift the goal of surveillance to proving the absence of PPR
Prevention & control	<ul style="list-style-type: none"> To lay the ground for the implementation of prevention and control activities 	<ul style="list-style-type: none"> To implement targeted vaccination campaigns– on an area or production system basis – and thereby, manage secondary prevention in the whole country 	<ul style="list-style-type: none"> To achieve eradication, either through extending vaccination to areas/production systems not yet vaccinated or by adopting a more aggressive policy to suppress virus replication in identified outbreaks 	<ul style="list-style-type: none"> To suspend vaccination. Eradication and prevention measures are based on stamping out, import movement control, biosecurity measures and risk analysis to understand the potential pathways of (re)introduction of PPR
Legal framework	<ul style="list-style-type: none"> To assess the animal health legal framework with a focus on PPR 	<ul style="list-style-type: none"> To improve the legal framework to support the implementation of control activities in targeted sectors 	<ul style="list-style-type: none"> To further improve the legal framework to support prevention risk mitigation at population level, including the risk of PPR introduction from abroad, and possibly accommodate a compensation mechanism 	<ul style="list-style-type: none"> To further improve the legal framework to accommodate more stringent border control policies; prepare additional legal provisions (such as containment) to implement in the context of an official PPR free status
Stakeholder involvement	<ul style="list-style-type: none"> To engage stakeholders for their agreement and concurrence on the PPR control and eradication objectives (notably in terms of transparency) 	<ul style="list-style-type: none"> To actively involve stakeholders in increased reporting and in targeted sectors in the realisation of vaccination campaigns 	<ul style="list-style-type: none"> To fully involve stakeholders in establishing procedures for accessing compensation funds in the event of PPR outbreaks 	<ul style="list-style-type: none"> To keep Stakeholders fully vigilant and committed with regard to PPR

The implementation of all activities should enable countries to achieve the progressive decrease in the incidence of PPR to the point at which the disease can be eliminated from the domestic animal populations (and wildlife if relevant). Control/eradication activities are regularly monitored to ensure that efforts are providing the expected outputs.

5. CAPACITY OF VETERINARY SERVICES (ENABLING ENVIRONMENT)

The PPR Global Strategy recognises that quality Veterinary Services – according to Section 3 of the OIE *Terrestrial Animal Health Code* (The *Terrestrial Code*) – are indispensable to the successful and sustainable implementation of PPR (and other major TADs) prevention and control activities, and are considered as an integral component of PPR control ‘Enabling Environment’. As a result, VS capacity must be reinforced as the country moves along the PPR Stages (‘progressive institutionalisation of PPR prevention and control’),

However, the evaluation/monitoring of the progressive reinforcement of the VS and of the prevention and control of PPR – while intimately intricate – are carried out using two distinct evaluation/monitoring tools, the OIE PVS evaluation Tool and the PPR Monitoring and Assessment Tool, respectively. While it was not deemed relevant to merge the two tools, the evaluation/monitoring of the VS and PPR control will be conducted in parallel, the levels of advancement of the OIE PVS Critical Competences being considered as relevant and important conditions to moving along the PPR Stages, as defined in Volume 1 of the GF-TADs global control strategy against major TADs (for most OIE PVS Critical Competences, level 3 is targeted).

The relevant Critical Competences and targeted level of advancement for each PPR Stage are fully integrated as specific questions in the PMAT questionnaire (in each relevant outcome); the whole table of correspondence between the PPR Stages and the OIE PVS Critical Competences (and relevant level of advancement to achieve) is provided in Annex 1.

The overall relationship between the PPR Global Strategy and OIE standards is captured in the Chart below (Fig. 3):

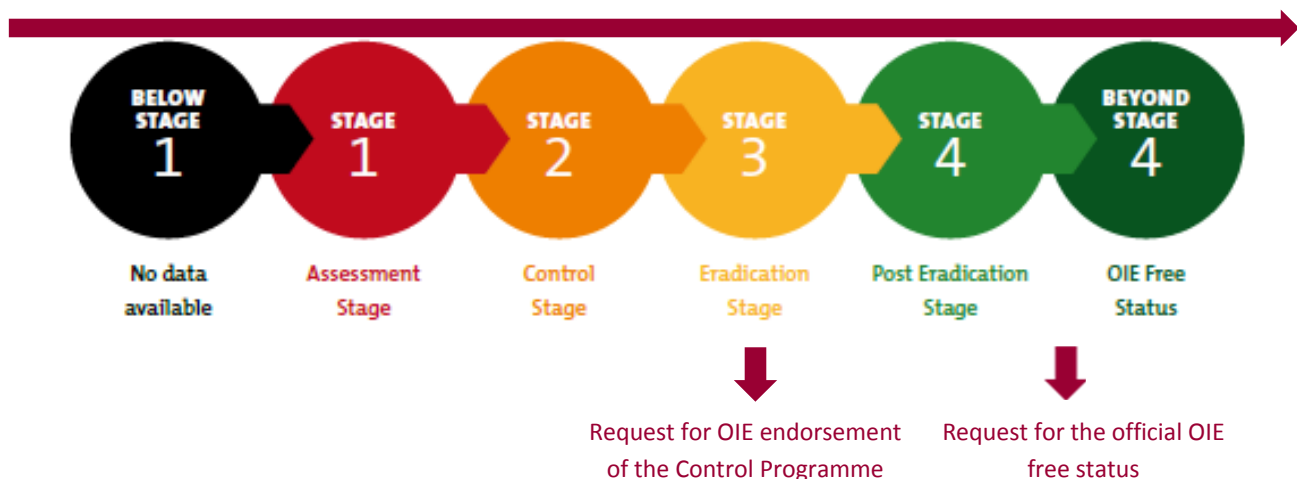


Fig. 3
‘Enabling Environment’ – Progressive compliance with OIE standards on the quality of Veterinary Services
(section 3 of the TAHC)

Progress from **stage** to **stage**

Each Stage is characterised by the following items:

- MINIMUM REQUIREMENTS to enter the Stage
- A key FOCUS
- OUTCOMES that relate to the five technical elements
- Typical ACTIVITIES
- Performance INDICATORS and TARGETS
- A QUESTIONNAIRE
- An annual PPR ROADMAP TABLE (for the year n+1)
- Indicative OIE PVS CRITICAL COMPETENCES relevant to each outcome as part of the Enabling Environment

1. OVERVIEW



	Assessment stage		Control stage		Eradication stage		Post-eradication stage
Focus Stage 1 – To gain a better understanding on the presence of PPR	• Outcome 1 (diagnostic)	Focus Stage 2 – To control both PPR clinical disease and infection in a specific zone or production system	• Outcome 1 (diagnostic)	Focus Stage 3 – To achieve PPR eradication throughout the national territory	• Outcome 1 (diagnostic)	Focus Stage 4 – To build evidence that there is no clinical disease nor virus circulation	• Outcome 1 (diagnostic)
	• Outcome 2 (surveillance)		• Outcome 2 (surveillance)		• Outcome 2 (surveillance)		• Outcome 2 (surveillance)
	• Outcome 3 (Surveillance)		• Outcome 3 (P&C)		• Outcome 3 (P&C)		• Outcome 3 (P&C)
	• Outcome 4 (P&C)		• Outcome 4 (P&C)		• Outcome 4 (legal Framework)		• Outcome 4 (legal Framework)
	• Outcome 5 (Legal Framework)		• Outcome 5 (Legal Framework)		• Outcome 5 (Stakeholders)		• Outcome 5 (Stakeholders)
	• Outcome 6 (Stakeholders)		• Outcome 6 (Stakeholders)				

Fig. 4
Overview of the Global Strategy stages and major features

THE PMAT QUESTIONNAIRE

The PMAT questionnaire – whose structure follows the one of a logical framework – is composed of a set of questions that allows assessing whether:

- The desired outcomes of each stage have been fully, partially or not achieved as a result of specific activities defined in the Global Strategy – one or several activities concurring to a given outcome – for which performance indicators and targets have been defined in most cases;
- The minimum requirements to proceed to the next Stage have been met or not ('go-ahead gateway'). In this case, it is a simple yes/no questionnaire which relates to these minimum requirements; to move forward, all questions must be responded by yes.

Note: the outcomes/activities are already presented in the relevant tables in the Global Strategy; the assessment methods through the definition and use of performance indicators are the important and key part of PMAT.

As a result, the questionnaire serves the two assessment and monitoring purposes:

- 1) To qualify countries at the appropriate stage along the step-wise approach for the control and eradication of PPR [assessment tool];
- 2) To monitor progress within a given Stage and provide an indicative list of activities to implement in the year to come (annual PPR Roadmap) [monitoring tool].

The questionnaire include questions linked to PPR prevention, control and eradication specific activities as well as the Enabling Environment (quality of the Veterinary Services); these questions (highlighted in pale yellow in the questionnaire) need also to be 'fully achieved' to move to the next Stage. As a result, the Strategic document (the Risk-based control Strategy to enter Stage 2 and the National Eradication Strategy to enter Stage 3) must consider how to timely address them.

How to fill the questionnaire

– **The monitoring component of the PMAT (Fig. 5)**

For the questions related to the OIE PVS Critical Competences, 'fully achieved' indicated that the level of advancement for these Competences are 3 or above (in most cases, refer to Annex 1); the results are available in the OIE PVS reports for the country; if the country has not requested an OIE PVS initial mission or if it was conducted more than three years ago, it is recommended to apply for an OIE PVS initial or follow up mission).

– **The Assessment component of the PMAT (Fig. 6)**

The criteria for a country to move to the higher next PPR stage is to fulfill all the outcomes indicated in the PMAT of the preceding stage as well as specific minimum requirements linked to the next stage (e.g. the formulation of a risk-based control Strategy to enter Stage 2).

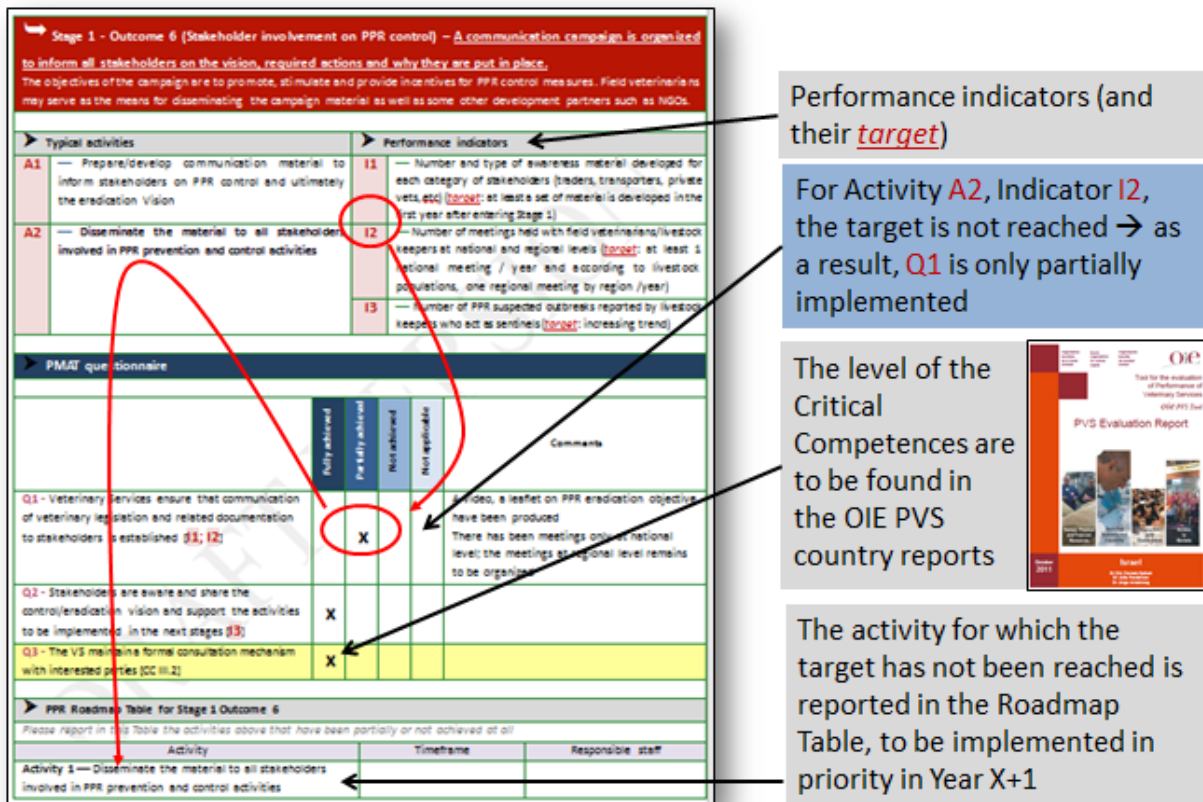


Fig. 5
How to fulfill the outcome tables (PMAT questionnaire)

PMAT questionnaire to enter Stage 2 ('Entrance Gateway')		Yes	No	Comments
Q1	- All activities of Stage 1 are successfully completed		X	Activities A1 (outcome 1), A1 (outcome 2), A2 and A3 (outcome 3) and A1 (outcome 6) are not fully implemented
Q2	- A comprehensive Report is produced capturing the findings of Stage 1	X		
Q3	- A comprehensive risk-based Control Strategy (CS1) is developed		X	A first draft has been produced but is not final yet
Q4	- The country participates in the annual Regional PPR roadmap meetings*	X		
Q5	- The countries does annual self-assessment of the PPR control progress using the PMAT tool*	X		
Q6	- An annual PPR roadmap is formulated following the results of the PPR assessments*	X		

**(in grey colour) not mandatory but strongly encouraged*

To move to the next stage, all 'mandatory' questions (Q1, Q2, Q3) must be achieved; this is not the case in this example, the country cannot move to Stage 2 (if external assessment, it can be granted with a 'provisional status 1 or 2' until all documents are provided and compliant)

Fig. 6
How to fulfill the PMAT questionnaires to enter the stage above('Entrance gateway')

Assignment of a country to a specific stage is done by a Regional Advisory Group (RAG) during the annual PPR regional roadmap meetings organised through the GF-TADs mechanism (refer to Part C, chapter 2 on monitoring and Evaluation of the Global Strategy).

The RAG is composed by at least three Chief Veterinary Officers (CVOs) nominated every two years by member countries of the roadmap. In addition to the CVOs the RAG is also composed by one laboratory and one epidemiology specialist respectively coordinators of the regional laboratory or epidemiology networks. The main task of the RAG is to assess and qualify the countries of the roadmap in the most appropriate stage and it is further assisted in this task by the GF-TADs PPR working group. The procedures for being qualified in a given stage are summarised as follows:

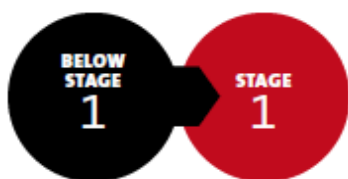
- (i) prior to the Regional Roadmap meeting, countries are sent the PMAT questionnaire through which they are supposed to self-assess in which PPR stage they claim to be;
- (ii) the claimed stage will then need to be supported by evidence and individual countries will be invited to make a presentation, during the physical regional meeting, in support of the claimed stage;
- (iii) discrepancies between the results of the PMAT questionnaire and the data presented by countries can be further discussed in face to face interview meetings between the RAG and the country delegation;
- (iv) based on the results of all the above the RAG will then assign the stage to each country.

Should disputes occur because of disagreement between the evaluation of the RAG and the claimed stage by a country an external evaluation process can be undertaken by independent expert/s visiting the concerned country.

A country where no structured information is available cannot be qualified in any of the four stages that will be described.

Entering the step-wise approach – **stage 1**

Minimum requirements:



- 1. An Assessment Plan is available and endorsed by the Veterinary Authorities**
to gain a better epidemiological understanding of the presence, distribution and (possibly) main risk factors associated with PPR in the country. The objectives, outputs and activities of the Assessment Plan can be derived directly from the outcomes that need to be fulfilled in Stage 1 in order to move to a higher Stage.
- 2. The country commits to joining the (sub)regional PPR Roadmap**
The objectives, outputs and activities of the RAP can be derived directly by the outcomes that need to be fulfilled in stage 1 in order to move to a higher stage.

● PMAT questionnaire to enter Stage 1 ('Entrance Gateway')		Yes	No
Q1	An Assessment Plan is available and endorsed by the Veterinary Authorities		
Q2	A national PPR Roadmap contact person is appointed		

1. STAGE 1 – ASSESSMENT PHASE

Stage 1 epidemiological situation

For countries entering the PPR control and eradication step-wise approach, at the beginning of Stage 1 the precise epidemiological situation is unknown or poorly known. PPR is most likely to be present, but due to poor surveillance and weak laboratory diagnostic capacity, it has not been reported. In this situation, there is no structured information available on the presence and distribution of PPR that would possibly lead to the formulation of effective control activity¹.

At the end of Stage 1 the epidemiological situation will be known based on (i) the occurrence or not of the disease expressed through clinical manifestations and (ii) the identification or not of the presence of infection using diagnostic tests, and will allow the conclusion to be drawn that:

- The country appears to be free of PPR, meeting or not the criteria of 'historically free' (see Article 1.4.6 of the OIE *Terrestrial Code*); or
- PPR is present in the country (epizootically and enzootically).

STAGE 1 FOCUS: to gain a better epidemiological understanding on the presence of PPR

In Stage 1, the main objective is to acquire elements for a better understanding of the presence (or possibly the absence) of PPR in the country, its distribution among the different farming systems and, ultimately, its impact on these systems. The generation of this information is an essential pre-requisite in order to reach a decision on what next needs to be done: it is important to distinguish whether the country will adopt the decision to implement activities with the initial aim to eradicate PPR only in specific sectors or geographical zones, recognising that the virus may still be circulating in other sectors/areas (Stage 2), or to eradicate PPR in the entire territory (Stage 3). The assessment phase may also demonstrate the absence of PPR, and in this case the country can directly move to Stage 4, applying for an OIE official free status.

Recommended Stage 1 duration: from one year, up to three years. It should be a relatively short period (one year) to allow control activities to start as soon as possible, but long enough to obtain a proper assessment, which will be the basis for the control Strategy.

¹ When a country is supposed or known to be free, even without specific PPR epidemiological surveillance programmes in place, it is ranked in stage 3 or 4 and the objective will be to document the freedom and to submit a dossier to the OIE for possible official recognition of PPR free status, following the provisions of Chapters 1.6. and 14.7. of the OIE *Terrestrial Code* (see below). The countries that are in a position to apply for PPR free status on a historical basis, according to *Terrestrial Code* Article 1.4.6., need to fulfil the OIE relevant criteria but without PPR-specific surveillance.

STAGE 1 KEY OUTCOMES

<p>➤ Stage 1 – Outcome 1 (Diagnostic Systems) – the laboratory diagnostic capacity of the country is established either because (outcome 1.a) the country has identified and equipped at least one national laboratory to provide diagnostic services using basic ELISA techniques for both antigen and antibodies detection or (outcome 1.b) the laboratory services are outsourced. In any case a laboratory service is guaranteed. (In case of 1.b, the capacity of one national laboratory to provide PPR diagnostic will be progressively built over Stage 1 and 2).</p>	
➤ Typical activities for outcome 1.a	➤ Performance indicators
<p>A1 — Assess throughout the country existing laboratory facilities candidates to be designated as the <u>National Laboratory</u> that will be responsible for testing field samples. <i>This process should lead to identify at least one laboratory that will act as national leading laboratory for PPR (Central National Laboratory)*Laboratories to be designated as Central National Laboratory and Provincial Laboratory</i></p>	<p>I1 — Number of facilities in all countries involved in the PPR Control and eradication programme visited and assessed out by relevant experts of all those existing in the country (<i>target</i>: all of the existing facilities potentially candidate to be Central or Provincial Laboratory have been visited and assessed in the first 12 months after entering stage 1).</p>
	<p>I2 — Number of designated laboratories out of those assessed and found eligible to become a leading laboratory (<i>target</i>: in each country participating to the PPR control and eradication programme, one laboratory is being designated as Central National Laboratory and others quality controlled laboratories are designated as Provincial Laboratories (within three months after the assessment))</p>
<p>A2 — Assess throughout the country existing laboratory facilities to be designated as <u>peripheral units</u> to receive and prepare samples before they are sent to the designated leading laboratory/ies</p>	<p>I3 — Number of facilities visited and assessed out of all those existing in the country (<i>target</i>: at least 70% of the existing facilities to become peripheral unit have been visited and assessed in the first three months after entering stage 1)</p>
	<p>I4 — Number of facilities out of those assessed and found eligible to become designated peripheral units depending on the country administrative organisation; the peripheral unit will be under the responsibility of the Central or Provincial Laboratory or of the Regional VS (<i>target</i>: minimum number of 1 to several peripheral unit per regional administrative level (e.g. province, directorate, district) according to the administrative organisation and to the livestock populations</p>
<p>A3 — Establish (or review) ELISA diagnostic procedures for antigen and antibody detection and train laboratory staff to its implementation</p>	<p>I5 — Number of laboratory staff trained on ELISA techniques in Central National Laboratory and eventually in Provincial laboratories (<i>target</i>: 100% of the staff that will be involved in the testing has received training before 12 months after entering into stage 1)</p>

A4	— Train peripheral units' staff to manipulate PPR samples before they are sent to the leading laboratory for testing	I6	— Number of peripheral units staff trained on proper manipulation of PPR field samples and eventually on basic first level diagnostic techniques (<i>target</i> : 70 % of the staff has received training before 12 months after entering into stage 1, 100% before two years)
A5	— Test samples (using basic ELISA techniques) and document them (if the laboratory has just started its activities)	I7	— Timeframe between receipt and testing of the samples for confirmatory purposes (i.e. clinical outbreaks) by the leading laboratory (<i>target</i> : five working days)
		I8	— Timeframe between receipt and testing of the samples for surveys purposes (i.e. serological surveys) by the Central National Laboratory and the Provincial Laboratories and after the whole survey has been completed (<i>target</i> : 90 working days)
		I9	— Timeframe between submission of a sample for confirmatory purpose to the peripheral units and testing by the Central National Laboratory and/or the Regional Laboratories (<i>target</i> : maximum 10 days)
		I10	— Percentage of testing sessions that needed to be repeated out of the total number of sessions (<i>target</i> : not exceeding 10 % in a 12-month period)
A6	— Design a Laboratory Information and Management System (LIMS) – if not already existing	X	No specific indicator

● PMAT questionnaire

		Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1	— The structure of the PPR laboratory network in the country has been established [A1 - I1, I2; A2 - I3, I4]					
Q2	— The Lab staff have acquired the necessary competences to manipulate properly field samples and conduct PPR diagnostic [A3 - I5; A4 - I6]					
Q3	— The PPR laboratory network is providing test results in accordance to the established procedure both in terms of quality and timely criteria [A5 - I7, I8, I9, I10]					

Q4	— Samples from all regions (where small ruminants are present) of the country have been tested [A2- I4; A4 - I6]					
Q5	— For major zoonoses and diseases of national economic importance, the VS have access to and use a laboratory to obtain a correct diagnosis [CC II.1.A level 2]					
Q6	— The national laboratory infrastructure generally meets the needs of the VS. Resources and organisation appear to be managed effectively and efficiently, but their regular funding is inadequate to support a sustainable and regularly maintained infrastructure [CC II.1.B level 3]					
➤ PPR Roadmap Table for Stage 1 Outcome 1.a						
<i>Please report in this Table the activities above that have been partially or Not achieved at all</i>						
Activity		Timeframe		Responsible staff		
Activity 1 —						
Activity 2 —						
Activity 3 —						
➤ Typical activities for outcome 1.b				➤ Performance indicators		
A1	— Formulate Standard Operating Procedures on how to handle field samples (if not already existing)	I1	— Number of Central National Laboratory, Provincial Laboratories and peripheral units staff trained on proper manipulation and shipment of PPR field samples (<i>target</i> : 100% of the staff has received training before 24 months after entering into stage 1)			
A2	— Train all staff involved in the reception of field samples to receive, record, manipulate, package and ship the field samples received					
A3	— Collect and ship samples to an OIE or FAO reference laboratory	I2	— Number of samples shipped out of those received (<i>target</i> : 100% samples)			
		I3	— Average time required from receipt of samples to forwarding them to the unit that will ship abroad (<i>target</i> : five working days)			
		I4	— Average time required from shipping abroad to receiving the result from the laboratory abroad (TAT) (<i>target</i> : two weeks)			

● PMAT questionnaire						
		Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1	— Diagnostic for PPR is carried out using outsourced capacity and there is a comprehensive description of the network of units involved in the manipulation of samples [A1 – I1]					
Q2	— The samples are properly handled from the field to the regional/international laboratory abroad [A1 – I1; A2 – I1; A3 – I2, I3, I4]					
Q3	— Samples from all regions (where small ruminants are present) of the country have been tested [A3-I2]					
Q4	— For major zoonoses and diseases of national economic importance, the VS have access to and use a laboratory to obtain a correct diagnosis [CC II.1.A level 2]					
➤ PPR Roadmap Table for Stage 1 Outcome 1.b						
<i>Please report in this Table the activities above that have been partially or Not achieved at all</i>						
Activity		Timeframe		Responsible staff		
Activity 1 —						
Activity 2 —						

↪ **Stage 1 – Outcome 2 (Surveillance System) – A surveillance system is progressively established; however, at this stage, active surveillance should be fully operational allowing an understanding of how PPR may be introduced and/or maintained and what its impact is.**

The monitoring/surveillance system will include implementation of specific field interventions and surveys based on clinical, epidemiological, serological, etc investigations and/or Participatory Disease Surveillance (PDS) or some other approaches. The case definition for a possible and likely case of PPR is developed (to serve as basis for building the reporting system and for delivering training to field veterinarians).

➤ Typical activities		➤ Performance indicators	
A1	— Formulate/design and implement an overall monitoring/surveillance system (with its active and passive components)	I1	— Number of field veterinarians trained to conduct active surveillance (<i>target</i> : at least one veterinarian per administrative level – Province, Directorate, district...- and according to livestock populations is trained)
A2	— Develop related Procedures for each component (continuing vs. <i>ad hoc</i> surveys) of the surveillance system, as well as Forms to register data		No specific indicator
A3	— Implement a post-assessment evaluation Form to quantify the clinical and (possibly) the socio-economic impact at this Stage. Visit confirmed clinical outbreaks for such purposes	I2	— Number of post-assessment visits out of the number of confirmed clinical outbreaks (<i>target</i> : 75%)
		I3	— Maps of the geographical distribution of the clinical outbreaks confirmed (<i>target</i> : at least one annual map)
A4	— Design (and possibly implement already at this Stage) an information system in support of surveillance activities (each component and sub-component of the system should be managed through an information system)	I4	— Map of the distribution of serum samples collected (should serologic surveys be implemented), their number and the test results (in the past 12 months) (<i>target</i> : at least one annual map)
A5	— Train veterinary officers from central and peripheral level on value chain and risk analysis	I5	— Number of Veterinarians at central, regional (Province, Directorate, district....) level involved in value chain and risk analysis trained (<i>target</i> : 75% of the staff has received training before 12 months after entering into Stage 1, 100% before two years)
A6	— (VS) Identify risks hotspots and transmission pathways using the value chains and risk analysis principles	I6	— Number of meetings organized by the Veterinary Services to identify and involve stakeholders along the value chain. Evidence of meetings should be available through minutes of the meetings (<i>target</i> : at least one meeting per year at national level and if possible one meeting during the first two years at each regional level)Number of hotspots identified (no specific targets)

PMAT questionnaire						
		Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1	— The implementation of the surveillance system with its passive and active (mostly) component and additional surveys has led to a good understanding of the dynamics of PPR virus in the entire country in domestic species [A1 – I1; A2 - x; A3 – I2, I3; A4 – I4]					
Q2	— Value chains and risk analysis studies have provided a good understanding of hotspots and transmission pathways to an extent that those can be specifically targeted and mitigated (basis for implementing a Risk based strategic plan to move to stage 2) [A5 – I5; A6 – I6]					
Q3	— Post-assessment visits have led to gain insights into the impact of PPR at epi-unit level both in terms of morbidity/mortality and socio-economic impact [A3 – I2, I3]					
Q5	— The veterinarians' practices, knowledge and attitudes usually allow undertaking all professional/technical activities of the VS (e.g. epidemiological surveillance, early warning, public health, etc.) [CC I.2.A level 3]					
Q6	— The VS have access to CE that is reviewed annually and updated as necessary, but it is implemented only for some categories of the relevant personnel [CC I.3 level 3]					
Q7	— The VS compile and maintain data and have the capability to carry out risk analysis. The majority of risk management measures are based on risk assessment [CC II.3 level 3]					
Q8	— The VS conduct active surveillance in compliance with scientific principles and OIE standards for some relevant diseases, apply it to all susceptible populations, update it regularly and report the results systematically [CCII.5.B level 3]					
➤ PPR Roadmap Table for Stage 1 Outcome 2						
<i>Please report in this Table the activities above that have been partially or Not achieved at all</i>						
Activity		Timeframe		Responsible staff		
Activity 1 –						
Activity 2 –						
Activity 3 –						

↪ **Stage 1 – Outcome 3 (Surveillance Systems) – the ability of field veterinarians to relate health events to PPR is improved.**

Progressive organisation of a well-distributed Field Veterinary Network throughout the territory as well as the education of field veterinarians to recognise PPR and make a differential diagnosis are essential aspects in order to capture clinical events that may match the case definition of a possible case of PPR and ensure that such cases are adequately further investigated.

➤ Typical activities		➤ Performance indicators	
A1	— Train field veterinarians to increase their awareness about PPR and its differential diagnosis (training should also address collection, storage and submission to the closest delivery place in proper condition and to avoid potential spoiling of test results).	I1	— Number of field veterinarians trained on PPR diagnostic (including differential diagnostic) (<i>target</i> : at least one veterinarian per regional level (Province, directorate, district and according to livestock populations has received training before 12 months after entering into Stage 1)
		I2	— Number of PPR suspicions by veterinarians (<i>target</i> : increasing trends in the first year after entering into Stage 1)
A2	— Provide incentives for the installation of private veterinarians in remote areas to capture PPR clinical events	I3	— Number of new private veterinarians engaged in PPR prevention and control activities in remote areas (<i>target</i> : at least one to several new veterinarian is exercising per region (Province, Directorate, District) and according to livestock populations
		I4	— Maximal distance from a Field Veterinary Unit to a farmer (<i>target</i> : few kilometres to 25 kilometres in agropastoral and mixed crop production systems and from 25 km to 50 km in pastoral/nomadic production systems)

● PMAT questionnaire						
		Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1	— PPR occupies an appropriate place in the veterinary education curricula and in training programmes (specialized and continuing education) to maintain professional knowledge at national levels. [A1 – I1, I2]					
Q2	— The Field Veterinary Network covers the whole territory and any clinical outbreak (or suspicion) of PPR can be investigated by a field veterinarian in the next day [A2 – I3, I4]					
Q3	—The public sector of the VS develops accreditation/authorisation /delegation programmes for certain tasks, but these are not routinely reviewed [CCIII.4 level 3]					
Q4	—The VSB regulates veterinarians in all relevant sectors of the veterinary profession and applies disciplinary measures [CCIII.5.A level 3]					
Q5	—The VSB is an independent representative organisation with the functional capacity to implement all of its objectives [CCIII.5.B level 3]					
➤ PPR Roadmap Table for Stage 1 Outcome 3						
<i>Please report in this Table the activities above that have been partially or not achieved at all</i>						
Activity		Timeframe		Responsible staff		
Activity 1 —						
Activity 2 —						
Activity 3 —						

➤ **Stage 1 – Outcome 4 (Prevention and Control system) – A national PPR Committee is established to coordinate all activities related to PPR prevention and control measures.**

The Committee should be headed by the Central Veterinary Services and include representatives of other ministries / agencies involved in PPR control (Environment; Interior; etc.) as well as private veterinarians (Veterinary Statutory Bodies and Veterinary Association) and all actors involved in small ruminant production.

No official prevention activity is foreseen in Stage 1

➤ Typical activities		➤ Performance indicators	
A1	— Define the modus operandi and tasks of the National PPR Committee	x	No specific indicator
A2	— Organise meetings of the PPR Committee and prepare meeting reports	I1	— Number of meetings held by the national PPR Committee (<i>target</i> : at least one meetings per year)
A3	— Formulate/design and implement a Standard Operating Procedure for a response mechanism (appropriate to this Stage) in case of a suspected/confirmed outbreak(<i>In order for such procedures to be fully implemented, it is necessary that awareness material be prepared and distributed to livestock keepers (see Stage 1 Outcome 6).</i>)	I2	— Number of days to have a response mechanism in place after a clinical case of PPR is suspected or confirmed (<i>target</i> : no longer than 10 days)

● **PMAT questionnaire**

	Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1					– The National PPR Committee has been established and there is evidence that the Committee takes relevant decision on medium to long term planning in relation to PPR control/ eradication [A1 – x; A2 – I1]
Q2					– A mechanism and procedures to visit PPR suspected and confirmed outbreaks are in place and guarantees that some follow-up action is taken not to discourage livestock keepers from reporting [A3 – I2]

➤ **PPR Roadmap Table for Stage 1 Outcome 4**

Please report in this Table the activities above that have been partially or not achieved at all

Activity	Timeframe	Responsible staff
Activity 1 —		
Activity 2 —		

↪ **Stage 1 – Outcome 5 (Legal Framework) – The legal framework is improved during this stage to ensure that the Veterinary Services have the authority to take actions, which may be needed in the following stages; in particular, PPR is a notifiable disease in the domestic population and suspected/confirmed cases in the wild animal population are also notified to the Veterinary Authorities.**

➤ Typical activities		➤ Performance indicators	
A1	— (National PPR Committee) Establish specific Working Groups (involving competent authorities, legal experts and relevant stakeholders) to evaluate gaps in the veterinary legislation with regard to PPR that may need to be addressed	I1	— Number of meetings of the Working Groups held in the past 12 months to address legislation issues (<i>target</i> : at least one meetings in the first year after entering Stage 1)
		I2	— Number of views / concerns expressed by the relevant stakeholders taken into account (<i>target</i> : 100% comments made by relevant stakeholders are responded orally during or after the meetings and 75% in writing to the ‘authors’)
A2	— (WGs) Propose concrete amendments to update the legal framework conducive to efficient PPR prevention and control	I3	— Number of amendments proposed to update the PPR legal framework (<i>target</i> : no specific target as it is really dependant on the existing framework, whether comprehensive or not)

● **PMAT questionnaire**

		Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1	– The PPR legal framework is being developed/modernized in consultation with stakeholders of the small ruminants sector [A1 – I1, I2; A2 – I3]					
Q2	– The OIE international standards on PPR (as well as those more horizontal on surveillance, notification, certification etc) are taken into account when developing/modernizing the PPR legal framework [A2 – I3]					
Q3	– The legal framework provides a comprehensive basis for the VS to complete activities foreseen in Stage 1 (collection, transmission and utilisation of epidemiological data relevant to PPR) [A2 – I3]					

Q4	– The legal framework provides the possibility for the Veterinary Authority to delegate specific tasks related to PPR official activities (such as vaccination) to private veterinarians [A2 – I3]					
Q5	– The VS have the authority and the capability to participate in the preparation of national legislation and regulations, with adequate internal and external quality in some fields of activity, but lack the formal methodology to develop adequate national legislation and regulations regularly in all domains [CC IV.1 level 3]					
➤ PPR Roadmap Table for Stage 1 Outcome 5						
<i>Please report in this Table the activities above that have been partially or not achieved at all</i>						
Activity		Timeframe			Responsible staff	
Activity 1 —						
Activity 2 —						
Activity 3 —						

Stage 1 – Outcome 6 (Stakeholder involvement on PPR control) – A communication campaign is organized to inform all stakeholders on the vision, required actions and why they are put in place.

The objectives of the campaign are to promote, stimulate and provide incentives for PPR control measures. Field veterinarians may serve as the means for disseminating the campaign material as well as some other development partners such as NGOs.

➤ Typical activities		➤ Performance indicators	
A1	— Prepare/develop communication material to inform stakeholders on PPR control and ultimately the eradication Vision	I1	— Number and type of awareness material developed for each category of stakeholders (traders, transporters, private vets, etc) (<i>target</i> : at least a set of material is developed in the first year after entering Stage 1)
A2	— Disseminate the material to all stakeholders involved in PPR prevention and control activities	I2	— Number of meetings held with field veterinarians/livestock keepers at national and regional levels (<i>target</i> : at least one national meeting / year and according to livestock populations, one regional meeting by region /year)
		I3	— Number of PPR suspected outbreaks reported by livestock keepers who act as sentinels (<i>target</i> : increasing trend)

● PMAT questionnaire

		Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1	– Veterinary Services ensure that communication of veterinary legislation and related documentation to stakeholders is established [A1 – I1; A2 – I2]					
Q2	– Stakeholders are aware and share the control/eradication vision and support the activities to be implemented in the next stages [A2 – I3]					
Q3	– The VS maintain a formal consultation mechanism with interested parties [CC III.2 level 3]					

➤ PPR Roadmap Table for Stage 1 Outcome 6

Please report in this Table the activities above that have been partially or not achieved at all

Activity	Timeframe	Responsible staff
Activity 1 —		
Activity 2 —		
Activity 3 —		

PMAT questionnaire to move to Stage 2 (‘go-ahead Gateway’)

● PMAT questionnaire to enter Stage 2 (‘Entrance Gateway’)		Yes	No	Comments
Q1	– All activities of Stage 1 are successfully completed			
Q2	– A comprehensive Report is produced capturing the findings of Stage 1			
Q3	– A comprehensive risk-based Control Strategy (CS1) is developed			
Q4	– <i>The country participates in the annual Regional PPR roadmap meetings*</i>			
Q5	– <i>The countries does annual self-assessment of the PPR control progress using the PMAT tool*</i>			
Q6	– <i>An annual PPR roadmap is formulated following the results of the PPR assessments*</i>			

**(in grey colour) not mandatory but strongly encouraged*

Moving from Stage 1 to Stage 2

Minimum requirements:

1. All activities of Stage 1 are successfully completed
2. A **comprehensive Report** is produced capturing the findings of Stage 1 and should include: (i) the identification of specific 'hot spots' defined by the combination of high PPR impact, high risk of spread to other areas or of regular (re)introduction of new infected animals and their mapping in the country; (ii) risk factors for the presence of PPRV and subsequent risk pathways; (iii) a detailed value chain analysis of the small ruminant sector.
3. A **comprehensive risk-based Control Strategy (CS1)** is developed based on the outcomes of activities carried out in Stage 1 and includes Components 1, 2 and 3 of the Global PPR Strategy.



[Tool] A model Control Strategy is available

2. STAGE 2 – CONTROL PHASE

Stage 2 epidemiological situation

All activities carried out while in Stage 1 have led to its being established that PPR is widespread/endemic in the country, where the virus is continually circulating. However, the results of the epidemiological investigations will also have shown that the PPR prevalence, incidence and socio-economic impacts are different from one area or production system to another and that high-risk areas ('hot spots') may exist in the country. In some cases, the production and marketing profiles could identify areas or production systems where, even if PPR is not important, prevention and control measures are needed. This information will allow the identification of areas and/or production systems where control activities should take place in priority.

STAGE 2 FOCUS: To control both PPR clinical disease and infection in a specific zone or production system

A risk-based Control Strategy has been formulated and will be implemented during Stage 2 in areas or production systems identified based on the outcomes of the activities carried out in Stage 1. However, if any new PPR epidemiological event appears in the non-targeted areas or production system, the control activities of Stage 2 will be extended to include them as well.

The control phase will be mainly based on a targeted vaccination programme aimed at controlling the disease, which means that the virus may be eradicated from the targeted small ruminant populations but without the aim of eradicating the disease nation-wide, foreseen in Stage 3.

Recommended Stage 2 duration: average three years (from two to five years).

Stage 2 KEY OUTCOMES



Stage 2 – Outcome 1 (*Diagnostic system*) – the laboratory diagnostic system works with a higher level of efficiency than in Stage 1 as possible shortcomings identified are now being solved; in addition, the system is further improved by introducing the use of bio-molecular techniques to obtain a characterisation of field virus isolates

The assumption used is that molecular epidemiology may provide additional insights into PPR distribution and dissemination pathways.

Should this not be a feasible option, a link with an international reference laboratory is established to which representative samples can be sent.

Characterisation of field virus isolates – and more generally the upgrading of laboratory capacity – is facilitated by the involvement of one or several national laboratories in the Regional Laboratory Network (when existing).

➤ Typical activities		➤ Performance indicators	
A1	Train laboratory staff in bio-molecular testing methods and equip at least one laboratory, if the use of bio-molecular testing is an option	I1	— Number of laboratory staff trained to laboratory bio-molecular technics (<i>target</i> : at least five staff per laboratory)
		I2	— Number of national laboratories equipped and performing laboratory bio-molecular diagnostic tests (<i>target</i> : at least one per country – unless outsourcing is the preferred option) Alternatively indication (name) of which International Reference laboratory has been chosen for sending samples for bio-molecular testing should be given.
A2	Establish Standard Operating Procedures for bio-molecular testing and regularly update them	I3	— Number of revisions of the Standard Operating Procedures for bio-molecular testing (<i>target</i> : SOPs reviewed each year and last revision not to exceed 12 months) Alternatively the SOPs have been fully established to ship samples abroad;
		I4	— Ratio between the number of test performed out of the number of test submitted (<i>target</i> : 100%)
A3	Establish written protocols to define criteria to select samples eligible for being processed using bio-molecular techniques	I5	— Protocols describing the criteria to select samples for being further processed with bio-molecular tests have been fully established and applied in the routinary work of the laboratory (no specific target is set for this indicator)
A4	Test all submitted samples meeting the eligible criteria for bio-molecular testing	I6	— Percentage of clusters for which the characterization of the PPR virus has been obtained (<i>target</i> : 100%)
A5	The laboratory actively participates in international proficiency test led by either an International Reference Laboratory or a Regional laboratory designated as leading laboratory in the regional network.	I7	— Number of proficiency tests conducted (<i>target</i> : at least, one regional network test / year and 100% of identified problems at laboratory level investigated and solved).

● PMAT questionnaire						
		Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1	– The country has the capacity to perform bi-molecular tests in compliance with international laboratory standards [A1 – I1, I2; A2 – I3, I4; A3 – I5]					
Q2	– There is a good understanding of all the PPR strains circulating and their distribution across the country [A4 – I6; A5 – I7]					
Q3	— The LIMS is the central repository of (PPR) information generated by the PPR laboratory network, and serves as a data management control tool; it is also responsible for generation of laboratory management reports and dissemination of PPR information (I6)					
PPR Roadmap Table for Stage 2 Outcome 1						
<i>Please report in this Table the activities above that have been partially or not achieved at all</i>						
Activity		Timeframe			Responsible staff	
Activity 1 —						
Activity 2 —						
Activity 3 —						

↪ **Stage 2 – Outcome 2 (Surveillance System) – The surveillance system is further strengthened – notably in its passive surveillance component – to capture any possible event linked to PPR.**

New components are now added into the system, namely: (i) passive surveillance in slaughterhouses and markets; (ii) passive surveillance in wildlife through functional external coordination with Ministry in charge of wildlife/environment/hunters' organisations (some wild animals may act as sentinels, indicating any spill-over of PPR virus from domestic small ruminants); and (iii) involvement in the (sub-) Regional Epidemio- surveillance Network (when existing).

➤ Typical activities		➤ Performance indicators	
A1	— Train inspectors in slaughterhouses to increase their awareness of PPR and its differential diagnosis (training should also address collection, storage and submission to the closest delivery place in proper condition and to avoid potential spoiling of test results)	I1	— Number veterinarians working at slaughterhouses trained to PPR clinical and differential diagnostic (target: 75% of veterinarians operating in slaughterhouses have received training and refreshed training on PPR with last training held no longer than 12 months ago and 100% no longer than two years).
		I2	— Number of samples submitted to the laboratory for testing originating from slaughterhouses (<i>target: 75% of suspected cases at the abattoir' pre and post-mortem inspection</i> are sampled (tissue samples collected from animals that presented changes) for PPR diagnostic
A2	— Design a procedure to improve external coordination with MoE and other organisations involved in wildlife management (notably for improved reporting of PPR cases in wildlife)	I3	— Number of clinical samples collected from wildlife suspected cases either shot or naturally found dead (<i>target: 50% of carcasses of naturally found dead wild animals susceptible to PPR and presenting symptoms that could relate to PPR are sampled and tested for PPR</i>)
A3	— Organise an awareness campaign on PPR for hunters	I4	— Number of meetings held with representatives of hunters to promote awareness about PPR in wildlife (<i>target: one national meeting with hunters and eventually at Regional level</i>).
A4	— Participate in Regional Epidemio-surveillance Network activities (when existing); feed the Network with appropriate set of data	I5	— Number of times that the agreed set of data to be shared within the regional network has been sent to the designated regional hub (<i>target: the transfer of data is always done according to the agreed schedule</i>).




● PMAT questionnaire						
		Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1	– The network of slaughter houses (and slaughter slabs) throughout the country is fully contributing to the passive component of the national surveillance system [A1 – I1, I2]					
Q2	– The national surveillance system in place is able to capture PPR events in wildlife (which provide good indications of a possible spill over from domestic small ruminants) [A2 – I3; A3 – I4]					
Q3	– A list of wild animals susceptible to PPR is available and a possible case definition of PPR in wildlife is also available [A2 – I3]					
Q4	– The country fully benefits from its active participation in the regional epidemiosurveillance network (when existing) [A4 – I5]					
Q5	– The training of veterinary para-professionals is of a uniform standard that allows the development of only basic specific competencies [CC I.2.B level 3]					
Q6	– The VS conduct passive surveillance in compliance with OIE standards for some relevant diseases at the national level through appropriate networks in the field, whereby samples from suspected cases are collected and sent for laboratory diagnosis with evidence of correct results obtained. The VS have a basic national disease reporting system [CC II.5.B level 3]					
Q7	– Ante- and post mortem inspection and collection of disease information (and coordination, as required) are undertaken in conformity with international standards for export premises and for all abattoirs producing meat for distribution in the national and local markets [CC II.12 level 4]					

Q8	– There are formal external coordination mechanisms with clearly described procedures or agreements for some activities and/or sectors [CC I.6.B level 3]					
-----------	---	--	--	--	--	--

PPR Roadmap Table for Stage 2 Outcome 2
--

Please report in this Table the activities above that have been partially or not achieved at all

Activity	Timeframe	Responsible staff
Activity 1 —		
Activity 2 —		
Activity 3 —		

 Stage 2 – Outcome 3 (Prevention and control system) – A targeted vaccination campaign is implemented.			
<p>The government has decided to allocate some financial resources to the PPR vaccination programme in the targeted area or sub-population (vaccination in other zones may remain a private initiative). The targeted vaccination zone or sub-population may evolve during Stage 2, notably upon detection of clinical outbreaks outside the initial targeted zone and constantly taking into account the results of the monitoring system in place.</p>			
 Typical activities	 Performance indicators		
A1	— Formulate/design field vaccination Procedures (according to the strategy adopted by the country); for this purpose, the national PPR Committee appoints a specific Working Group	I1	— Number of Working Group meeting (<i>target</i> : at least two meetings in the first year after entering Stage 2)
A2	— Train field vaccination teams	I2	— Number of field veterinarians involved in vaccination field operations trained (<i>target</i> : 100% of field veterinarians involved)
A3	— Implement field vaccination (according to the strategy adopted by the country)	I3	— Intermediate vaccination coverage (<i>target</i> : at least 35% of the eligible animals are vaccinated 60 days after the beginning of the vaccination campaign (which represents 50% of the final expected 70% vaccination coverage)
		I4	— Final vaccination coverage (<i>target</i> : not less than 70% of eligible animals are vaccinated in each campaign) <i>Remark</i> : vaccination coverage is expressed as the number of animals administered with the vaccine divided by the number of animals eligible for being vaccinated in the target areas/sectors)
A4	— Conduct Post-Vaccination-Evaluation (PVE) with collection of data for evaluating the results of the vaccination programme and monitor the whole vaccination chain accordingly	I5	— Number of PVE undertaken (in order to evaluate for example the percentage of PPR clinical cases in vaccinated small ruminants populations, as an indicator of the vaccination effectiveness = number of cases in vaccinated population / total number of cases in the country) (<i>target</i> : one simplified PVE per year and one comprehensive PVE at key occasions e.g. when a country foreseen to move from one stage to a stage above (see description of the PVE tool in Annex 3.4)
		I6	— Temperature registration cards are used in each point of the vaccine distribution system (<i>target</i> : the temperature along the cold chain is always between +2°C and +8°C. Specific procedures for managing failures in the cold chain must be part of the cold chain monitoring system.

	17	— Immune response (expressed as the percentage of animals developing a protective serological titre out of the number of animals actually administered with the vaccine) (<i>target</i> : at least 80% of animals should have a serological titre to be considered protective at 21 or 28 days post PPR vaccination).
--	-----------	--

● PMAT questionnaire

		Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1	– The PPR Vaccination Campaign is delivered according to the Risk-based Control Strategy [A1 – I1; A2 – I2; A3 – I3, I4]					
Q2	– The vaccine distribution and delivery system is monitored on a regular basis and allows for immediate corrective actions if needed [A4 – I5, I6]					
Q3	– The vaccines used comply with OIE quality requirements [A1 – I1]					
Q4	– The majority of veterinary and other professional positions are occupied by appropriately qualified personnel at local (field) levels [CC I.1.A level 3]					
Q5	– The majority of technical positions at local (field) levels are occupied by personnel holding appropriate qualifications [CC I.1.B level 3]					
Q6	– There are internal coordination mechanisms and a clear and effective chain of command for some activities [CC I.6.A level 3]					
Q7	– The VS have suitable physical resources at national, regional and some local levels and maintenance and replacement of obsolete items occurs only occasionally [CC I.7 level 3]					
Q8	– Funding for new or expanded operations is on a case-by-case basis, not always based on risk analysis and/or cost benefit analysis [CC I.8 level 4]					

Q9	– The VS implement prevention, control or eradication programmes for some diseases and/or in some areas with scientific evaluation of their efficacy and efficiency [CC II.7 level 3]					
Q10	– The VS have implemented biosecurity measures that enable it to establish and maintain disease free zones for selected animals and animal products, as necessary [CC IV.7 level 3]					

PPR Roadmap Table for Stage 2 Outcome 3

Please report in this Table the activities above that have been partially or not achieved at all

Activity	Timeframe	Responsible staff
Activity 1 —		
Activity 2 —		
Activity 3 —		

↪ **Stage 2 – Outcome 4 (Prevention and control system) – Additional measures are put in place to ensure the success of the vaccination campaign.**

In particular, (i) all outbreaks are investigated to (a) clearly understand why clinical outbreaks may be observed in the sectors/zones covered by the vaccination, and (b) assist in deciding if the vaccination sectors/zones needs to be extended or not (in this case, it will remain limited to what is indicated in Stage 1); and (ii) animal movements (within the country at this Stage) are controlled to ensure that the two sub-populations with a different health status as a result of the vaccination campaign remain separate; however, some countries may not be in the position to efficiently regulate animal movement. In such a case, it could be feasible to manage the obligation of introducing only vaccinated animals (or animals to be vaccinated) in those sectors/areas where targeted vaccination is on-going.

➤ Typical activities		➤ Performance indicators	
A1	— Design an outbreak investigation form to collate the following information: (i) possible date of introduction of the virus into the infected premises; (ii) possible means of introduction; and (iii) potential spreading		no specific indicator
A2	— Conduct investigations for all detected/reported outbreaks, whether in or outside the vaccination sectors/zones	I1	— Number of PPR clinical outbreaks investigated (<i>target</i> : 75% of PPR outbreaks are investigated).
		I2	Average number of days required from confirmation to the first visit for outbreaks investigation purposes (<i>target</i> : no more than one week from confirmation to first visit for epidemiological enquiries).
A3	— Implement movement controls between the vaccinated/non-vaccinated sectors/zones, in close collaboration with other Services involved (police notably)	I3	— Number of trainings on movement control of animals delivered to local police (<i>target</i> : at least one training at national level and possible other trainings at regional levels where appropriate (according to livestock populations and importance of movements) <i>Nota bene</i> : the responsibility of implementing movement controls is under VS responsibility but when it implies restriction measures, as defined in relevant regulatory texts, their enforcement will involve the police in this particular case no related indicator is proposed; however, a strong external coordination is expected to be put in place for the VS to supervise the police activities in small ruminants movement control

PMAT questionnaire						
		Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1	- The PPR epidemiological situation is further understood thanks to the systematic investigations of PPR clinical outbreaks [A1 – x; A2 – I1, I2]					
Q2	- The vaccination measures have been further consolidated taking into account the results of systematic PPR clinical outbreak investigations [A2 – I1, I2]					
Q3	- The unregulated movements of small ruminants are not affecting the effectiveness of the control measures in Stage 2 [A3 – I3, I4]					
Q4	- The VS regularly analyse records and documented procedures to improve efficiency and effectiveness [CC I.11 level 4]					
➤ PPR Roadmap Table for Stage 2 Outcome 4						
<i>Please report in this Table the activities above that have been partially or not achieved at all</i>						
Activity	Timeframe	Responsible staff				
Activity 1 —						
Activity 2 —						
Activity 3 —						

↪ **Stage 2 – Outcome 5 (Legal framework) – The legal framework is fully supportive of the control and prevention activities foreseen in stage 2.**

➤ Typical activities		➤ Performance indicators	
A1	— Organise meetings of specific working groups (mixed Veterinary Services, other authorities, and stakeholders) to better understand the impact of control measures (including financial aspects) on stakeholders and upgrade the legislation framework to support field control activities	I1	— Number of PPR specific acts issued by the Veterinary Services in support of the field control activities (no specific targets are set)
A2	— Propose concrete amendments to update the legal framework conducive to efficient PPR prevention and control	I2	— Number of proposals submitted to update the legal framework (no specific target)

● **PMAT questionnaire**

		Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1	– The impact of the control measures has been evaluated [A1 – I1]					
Q2	– The legal framework includes the necessary provisions for implementing the control measures foreseen in Stage 3 (notably compulsory vaccination of sheep and goats in the country or zone) [A2 – I2]					
Q3	– The legal framework provides for the financing of PPR control measures, such as operational expenses [A1 – I1]					
Q4	– The legal framework defines the prerogatives of veterinarians and veterinary para-professionals in PPR prevention and control measures [A2 – I2]					
Q5	– Veterinary legislation is generally implemented. As required, the VS have the power to take legal action/initiate prosecution in instances of non-compliance in most relevant fields of activity [CC IV.2 level 3]					

➤ PPR Roadmap Table for Stage 2 Outcome 5		
<i>Please report in this Table the activities above that have been partially or not achieved at all</i>		
Activity	Timeframe	Responsible staff
Activity 1 —		
Activity 2 —		
Activity 3 —		

➤ Typical activities		➤ Performance indicators	
A1	— Prepare and disseminate informative material to increase awareness among livestock keepers and thereby facilitate reports of suspected cases.	I1	— Number of awareness material printed and distributed (no specific targets set)
A2	— Prepare communication material to explain and convince (advocacy) all stakeholders particularly farmer that control of PPR is needed	I2	— Number of awareness meetings organized with livestock keepers (<i>target</i> : a least, on meeting at national level and possibly one meeting at regional level(Province, Directorate, district...)/ year according to small ruminant populations
A3	— Organise meetings with the livestock keepers and their partners active in the field (NGOs, etc.)	I3	— Number of meetings held in the past 12 months with livestock keepers (<i>target</i> : at least one meeting at national level and possibly one meeting at regional level(Province, Directorate, district...)/ year according to small ruminant populations
A4	— Should wildlife be identified among the issues to be addressed, organise meetings involving wildlife specialists and other stakeholders (such as hunters)	I4	— Number of meetings held with wildlife specialists and stakeholders to address issue related to wildlife (<i>target</i> : at least one meeting at national level and possibly one meeting at regional level(Province, Directorate, district...)/ year according to small ruminant populations

● PMAT questionnaire						
		Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1	– The livestock keepers and other actors (forest guards, etc) fully act as sentinels for the early detection of PPR clinical outbreaks [A1 – I1; A3 – I3; A4 – I4]					
Q2	– The livestock keepers are actively contributing to the implementation of the control measures foreseen in Stage 2 [A2 – I2; A3 – I3]					
Q3	– The Veterinary Services ensure communication of PPR legal framework and related documentation to actively involve the various stakeholders [A1 – I1; A2 – I2; A3 – I3; A4 – I4]					
Q4	– The VS contact point for communication provides up-to-date information, accessible via the Internet and other appropriate channels, on activities and programmes [CC III.1 level 4]					
➤ PPR Roadmap Table for Stage 2 Outcome 6						
<i>Please report in this Table the activities above that have been partially or not achieved at all</i>						
Activity	Timeframe	Responsible staff				
Activity 1 —						
Activity 2 —						
Activity 3 —						

PMAT questionnaire to move to Stage 3 (‘go-ahead Gateway’)

• PMAT questionnaire to enter Stage 3 (‘Entrance Gateway’)		Yes	No	Comments
Q1	– All activities of Stage 2 are successfully completed			
Q2	– A comprehensive risk-based Control Strategy (CS1) is developed			
Q3	– <i>The country participates in the annual Regional PPR roadmap meetings*</i>			
Q4	– <i>The countries does annual self-assessment of the PPR control progress using the PMAT tool*</i>			
Q5	– <i>An annual PPR roadmap is formulated following the results of the PPR assessments*</i>			

**(in grey colour) not mandatory but strongly encouraged*

Moving from Stage 2 to Stage 3



Minimum requirements:

1. All activities of Stage 2 are successfully completed
2. A national eradication Strategy is developed with Component 1, 2 and 3 of the Global PPR Strategy.

Nota bene: the Eradication Strategy is a continuation /reinforcement of the Control Strategy established at the end of Stage 1 but in a more aggressive way, aiming at eradicating PPR in the entire territory (or zone).

3. STAGE 3 – Eradication phase

Stage 3 epidemiological situation

At the beginning of Stage 3, the occurrence of clinical disease in the sub-population covered by the vaccination programme carried out in Stage 2 is expected to be nil. In the sub-populations not covered by the vaccination programme, three scenarios are possible: (i) there is no PPRV circulation, (ii) cases/outbreaks occur only sporadically (as the programme is expected to have a secondary preventive effect in non-vaccinated animals in the surrounding area), or (iii) the situation remains endemic (but with a small socio-economic impact, otherwise they would have been chosen to be part of the targeted Stage 2 vaccination programme). In the last two scenarios, strong control measures will need to be implemented. In the first scenario, strong preventive measures and emergency response capabilities have to be put in place

At the end of Stage 3, no clinical outbreaks can be detected in the whole territory and diagnostic tests also indicate that the virus is no longer circulating in the domestic animal and wildlife populations.

STAGE 3 FOCUS: To achieve the eradication of PPR from the national territory of the involved country

The country has the capacity and resources to move towards an eradication programme. Whether this should be based on extending the vaccination to other production systems or to other geographical areas not yet covered under Stage 2 or possibly on strategies not based on vaccination will be decided by evaluating the results of Stage 2. Moving towards eradication may mean that the country will gain the capability and resources to adopt a more aggressive control strategy to suppress virus replication in those premises where new clinical outbreaks may be detected.

At this Stage, the country is moving toward eradication and any health events that could be related to the presence of PPR virus need to be promptly detected and reported and appropriate measures immediately put in place to control them. If a new risk of introducing PPRV in the area or production system arises, the results of the surveillance system and of epidemiological analysis must identify and qualify the risks and appropriate measures should be rapidly implemented to mitigate the risk of introduction.

Recommended Stage 3 duration: average three years (from two to five years).

STAGE 3 KEY OUTCOMES

➔ **Stage 3 – Outcome 1 (*Diagnostic system*) – The Laboratory starts to develop a quality assurance scheme.**


Laboratory maintains at least the same level of activities as in the previous Stage, while putting Quality Assurance in place, at least for all laboratories used by the Veterinary Services. A strong link with an international reference laboratory is also maintained

➤ Typical activities		➤ Performance indicators	
A1	— Implement a quality control system in the central laboratory and its (or relevant administrative official umbrella)branches or relevant structures constituting the laboratory network in the country (Regional laboratories and eventually ‘Peripheral Units’)	I1	— Frequency with which the AQ SOPs are reviewed and updated (<i>target</i> : at least once a year and the last revision has been made no longer than two years ago at any point in time).
A2	— Implement collateral procedures to ensure that stocks of reagents, laboratory devices, equipment, etc. are purchased following quality assurance procedures in all the laboratory/ies involved in the diagnosis of PPR	I2	— Percentage of SOPs for which shortcomings have been identified (<i>target</i> : less than 25%)

● PMAT questionnaire

		Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1	– A quality control system for PPR laboratories activities has been established that covers the entire laboratory network in the country [A1 – I1]					
Q2	– The quality control system adopted by the diagnostic laboratory is audited regularly (<i>nota bene</i> : this may not be feasible in several developing countries where independent evaluation services may not be available. It maybe would be interesting if this capacity is implemented within the regional laboratory network) [A1 – I1; A2 – I2]					
Q3	– The QA system in place fully ensures the reliability of the PPR (and other small ruminant diseases) diagnostic tests performed [A1 – I1; A2 – I2]					
Q4	– Some laboratories used by the public sector VS are using formal QA systems [CC II.2 level 2]					

➤ PPR Roadmap Table for Stage 3 Outcome 1		
<i>Please report in this Table the activities above that have been partially or not achieved at all</i>		
Activity	Timeframe	Responsible staff
Activity 1 —		
Activity 2 —		
Activity 3 —		

 Stage 3 – Outcome 2 (Surveillance system) – <u>The surveillance system has been further upgraded and includes specific components addressing early warning.</u>			
<p>The surveillance system continues to operate as indicated in previous Stages but in addition, its sensitivity is increased in Stage 3: (i) information on neighbouring countries (or on countries from which animals/goods are imported that may carry the virus) is now routinely collected; (ii) high resolution surveillance may target specific sub-groups (newborns not yet vaccinated) or cattle as proxy indicators of virus circulation; (iii) the activities to detect cases in wildlife are increased.</p>			
➤ Typical activities		➤ Performance indicators	
A1	— Establish procedures to capture PPR health events in neighbouring countries or countries from which animals are imported (the Group dedicated to qualitative Risk Assessment already identified in Stage 1 should conduct this work).	A1	— Number of Import Risk Assessment conducted (<i>target</i> : as often as required)
A2	— Design and implement surveillance in those sub-populations or areas where the events can be captured and misinterpretation is minimised	A2	— Number and type of samples tested in those sub-populations selected for high resolution surveillance and where negative results are expected (<i>target</i> : surveillance to detect disease at least at 10% level with herd sensitivity of 95%)
		A3	— Number of PPR clinical outbreaks detected in the last 12 months before considering moving to Stage 4 (<i>target</i> : 0 outbreaks)
A3	— Increase the collection of sero-surveillance data from wildlife and other susceptible species	A4	— Number of samples collected and tested from wildlife in the past 12 months or from species utilised as proxy for virus circulation; i.e. large ruminants (<i>target</i> : surveillance to detect disease/infection at least at 20% level with herd sensitivity of 95%).

● PMAT questionnaire

		Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1	– The national surveillance system has been further strengthened to address the risk of PPR introduction from abroad [A1 – I1]					
Q2	– The national surveillance system has been further strengthened to detect both the PPR clinical outbreaks and virus circulation in domestic animals and wildlife (susceptible species) [A1 – I1; A2 – I2, I3]					
Q3	– Investigations in other susceptible species, including wildlife, is now improving the level and quality of information generated through the surveillance system [A3 – I4]					

➤ PPR Roadmap Table for Stage 3 Outcome 2

Please report in this Table the activities above that have been partially or not achieved at all

Activity	Timeframe	Responsible staff
Activity 1 —		
Activity 2 —		
Activity 3 —		

➔ **Stage 3 – Outcome 3 (Prevention and control system) – A more aggressive control strategy is in place aiming at eradication and possibly supported (if feasible) by a stamping out policy (linked to a compensation scheme).**

It may be possible that either (i) a whole area or country vaccination programme or (ii) a targeted vaccination programme will be implemented as part of a more aggressive control strategy. In both cases it is expected that the control policy will lead to eradication. The vaccination programme is defined according to the results of Stage 2 vaccination (Post-Vaccination Evaluation [PVE]) and continuous surveillance.

In case of (ii), an emergency preparedness and contingency response plan are now also implemented, possibly linked to a stamping-out policy, to control promptly a clinical outbreak of PPR in the infected premises and to reduce the infectious period at flock level.

Breeders are encouraged to reinforce the biosecurity measures at farm level (this may be linked to the level of compensation in the event of stamping out); biosecurity is also reinforced in live markets.

➤ Typical activities		➤ Performance indicators	
A1	— Implement vaccination campaigns in areas where virus still circulates (either in already vaccinated areas and/or in unvaccinated areas) according to the results of continuous monitoring and evaluation of the results of stage 2. All vaccinated animals will be identified at the same time.	I1	— Intermediate vaccination coverage (target : at least 35% of the eligible animals are vaccinated 60 days after the beginning of the vaccination campaign (which represents 50% of the final expected 70% vaccination coverage)
		I2	— Final vaccination coverage (target : not less than 70% of eligible animals are vaccinated in each campaign) Remark : vaccination coverage is expressed as the number of animals administered with the vaccine divided by the number of animals eligible for being vaccinated in the target areas/sectors)
A2	— Conduct surveillance activities and PVE with collection of data for evaluating the results of the vaccination programme and monitor the entire vaccination chain accordingly	I3	— Number of PVE undertaken (in order to evaluate for example the percentage of PPR clinical cases in vaccinated small ruminants populations, as an indicator of the vaccination effectiveness = number of cases in vaccinated population / total number of cases in the country) (target : one simplified PVE per year and one comprehensive PVE at key occasions (e.g. when a country foreseen to move from one stage to a stage above (see description of the PVE tool in Annex 3.4)
		I4	— Temperature registration cards are used in each point of the vaccine distribution system (target : the temperature along the cold chain is always between +2°C and +8°C. Specific procedures for managing failures in the cold chain must be part of the cold chain monitoring system.

		I5	— Immune response in the areas/sectors where the vaccination has been expanded (immune response is expressed as the percentage of animals developing a protective serological titre out of the number of animals actually administered with the vaccine (target : at least 90% of animals should have a serological titre to be considered protective at 21 or 28 days post PPR vaccination).
A3	— Develop a contingency plan in case of (ii), officially endorsed and approved by the Veterinary Authorities. The National PPR Committee will assign a group of experts (which could be supported by international experts if required) to formulate such a contingency plan.	I6	— Number of meetings held by the group of experts to develop the contingency plan (target : at least two in the first year after entering Stage 3)
A4	— Test the correct application of the contingency plan through field simulation exercises as part of the activities to maintain a high level of awareness	I7	— Number of field simulation exercises carried out in areas already recognized as cleared from the PPR virus (target : at least one simulation exercise in at least one area recognized as cleared from the PPR virus)
A5	— Carry out prompt preliminary precautionary measures once a suspicion is raised (they are withdrawn if the outbreak is not confirmed or are immediately followed up if the outbreak is confirmed)	I8	— Average time required from the date of suspicious to the date of notification by the Veterinary Authorities of precautionary measures (target : from suspicious raised by the owner to notification of precautionary measures the timeframe should not exceed 3 days).
A6	— Implement prompt measures to contain virus spread once an outbreak is confirmed (whether this should be based on animal movement restrictions, culling or emergency vaccination, or a combination of these, is a country policy choice)	I9	— Average time from the date of confirmation to the date when containment measures are applied (target : not to exceed 3 days from the date of confirmation).
A7	— Design and implement field procedures to officially close an outbreak and lift the restrictions put in place (to be done by the National PPR Committee).	I10	— No specific indicator is set for this activity
A8	— (Voluntary) Submit a national control programme to the OIE for official endorsement, in accordance with the provisions of the OIE <i>Terrestrial Animal Health Code</i> (Chapters 1.6. and 14.7.).	I11	— No specific indicator is set for this activity

● PMAT questionnaire						
		Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1	- PVS provides evidence that the expanded vaccination programme is effective [A1 – I1, I2; A2 – I3, I4]					
Q2	- Any new PPR clinical outbreak – whether suspected or confirmed – is properly and timely managed [A3 – I6; A4 – I7; A5 – I8; A6 – I9; A7 – I10]					
Q3	- The aggressive control strategy now fully integrates the application of biosecurity measures					
➤ PPR Roadmap Table for Stage 3 Outcome 3						
<i>Please report in this Table the activities above that have been partially or not achieved at all</i>						
Activity	Timeframe	Responsible staff				
Activity 1 —						
Activity 2 —						
Activity 3 —						

<p>➔ Stage 3 – Outcome 4 (Legal framework) – The veterinary legislation includes clear provisions for: (i) the compensation of small ruminants culled for disease control purposes (should stamping out be adopted as one of the control policies) and (ii) improved bio-security in live markets and at farm level. The PPR legal framework is properly enforced. Implementation of an identification system for small ruminants is an asset to improve their traceability and movement control.</p>			
➤ Typical activities		➤ Performance indicators	
A1	— Develop a procedure to compensate farmers whose animals were culled for disease control purposes. <i>(The National PPR Committee may appoint a Specific Working Group to develop such a procedure)</i>	I1	— Number of meetings held by the specific Working Group on compensation (<i>target</i> : at least two meetings in the first year after entering Stage 3)
A2	— Carry out studies on how to improve biosecurity in live animal markets and at farm level and how biosecurity can impact on stakeholders <i>(The National PPR Committee may appoint Specific Working Groups to do this)</i>	I2	— Number of meetings held by the specific Working Group on biosecurity in live markets and at farm level (<i>target</i> : at least two meetings in the first year after entering Stage 3)
A3	— Carry out feasibility studies to implement an animal identification system <i>(The National PPR Committee may appoint a Specific Working Group to do this)</i>	I3	— Number of meetings held by the specific Working Group on animal identification (<i>target</i> : at least two meetings in the first year after entering Stage 3)
A4	— Propose concrete amendments to update the existing legal framework conducive to supporting the new control measures foreseen in Stage 4 (compensation scheme, biosecurity , animal identification); in addition, legal provisions for suspending/stopping the vaccination are also included	I4	— Number of proposals submitted (no specific target)

● PMAT questionnaire						
		Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1	– The small ruminants' owners are properly compensated for any animal which is culled for official PPR control purpose [A1 – I1; A4, I4]					
Q2	– Movement control of small ruminants at farm level and live markets is officially regulated and enforced [A4 – I4]					
Q3	– A national identification system for small ruminants is in place and allows at least to differentiate vaccinated from not vaccinated animals [A3 – I3; A4 – I4]					
Q4	– The aggressive control strategy now fully integrates the application of biosecurity measures [A2 – I2]					
Q5	– The VS implement procedures for animal identification and movement control for specific animal subpopulations as required for disease control, in accordance with relevant international standards [CC 12.A level 3]					
➤ PPR Roadmap Table for Stage 3 Outcome 4						
<i>Please report in this Table the activities above that have been partially or not achieved at all</i>						
Activity	Timeframe	Responsible staff				
Activity 1 —						
Activity 2 —						
Activity 3 —						

➔ **Stage 3 – Outcome 5 (*Stakeholder involvement*) – Stakeholders are actively consulted for the compensation arrangements and are involved in the identification of their animals**

Stakeholder involvement at this Stage is essential and, as in the previous stages, there is sufficient evidence that stakeholders have been duly involved in sharing control programme overall outcomes and that they have been part of the decision process to move towards eradication. Communication continues to be a key element.

➤ Typical activities		➤ Performance indicators	
A1	Establish a specific procedure (by the National PPR Committee) to address issues raised by a specific group of stakeholders concerning matters relating to PPR control/eradication that may impact on their business activities	I1	— Number of requests received by the national PPR Committee made by specific individual or group of stakeholders (no specific targets are set)
A2	Address specific requests from stakeholders (by the National PPR Committee, with the possible support of Working Groups)	I2	— Average time required by the national PPR Committee to provide a response to specific request raised by stakeholders (<i>target</i> : no more than three months should pass from the date of the request to the date of response).
A3	Distribute communication material, use media and other oral means and organise specific meetings aimed at updating all stakeholders, including development partners active in the field (e.g. NGOs) where the country stands in its national efforts towards eradication and ensure their full and sustained support	I3	— Number of meetings held for stakeholders (<i>target</i> : at least, one meeting at national level and possibly one meeting at regional level (Province, Directorate, district...)/year according to small ruminant populations

● **PMAT questionnaire**

		Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1	–Stakeholder involvement into the eradication process is optimal [A1 – I1; A2 – I2]					
Q2	– The communication component of the National Eradication Strategy is fully implemented [A1 – I1; A2 – I2; A3 – I3]					

➤ **PPR Roadmap Table for Outcome Stage 3 Outcome 5**

Please report in this Table the activities above that have been partially or not achieved at all

Activity	Timeframe	Responsible staff
Activity 1 —		
Activity 2 —		
Activity 3 —		

PMAT questionnaire to move to Stage 4 (‘go-ahead Gateway’)

• PMAT questionnaire to enter Stage 3 (‘Entrance Gateway’)		Yes	No	Comments
Q1	All activities of Stage 3 are successfully completed			
Q2	– the use of vaccine is suspended and no clinical outbreaks have been detected in the previous 12 months			
Q3	– <i>The country participates in the annual Regional PPR roadmap meetings*</i>			
Q4	– <i>The countries does annual self-assessment of the PPR control progress using the PMAT tool*</i>			

**(in grey colour) not mandatory but strongly encouraged*

Moving from Stage 3 to Stage 4



Minimum requirements:

1. All activities of Stage 3 are successfully completed
2. the use of vaccine is suspended and no clinical outbreaks have been detected in the previous 12 months

4. STAGE 4 – Post-eradication phase

Stage 4 Epidemiological situation

There is a body of evidence that PPR virus is no longer circulating in domestic animals within the country or zone. PPR incidence is very low (reduced to zero incidence) and limited to occasional incursion from other countries.

It is worth noting that the acceptance into Stage 4 is now clearly linked to the animal health status of the susceptible population in relation to PPR (differently from previous Stages).

Nota bene: For the purposes of the OIE *Terrestrial Code*, PPR is defined as an infection of domestic sheep and goats with PPRV (Chapter 14.7.). The official free status therefore takes into account the status in domestic animals only.

STAGE 4 FOCUS: To build evidence that, after suspension of vaccination, there is no clinical disease and no virus circulation for at least 12 additional months (after entering Stage 4)

Entry into Stage 4 means that a country will be ready to start implementing a full set of activities that should lead to its being recognised as officially free from PPR.

In Stage 4, eradication and prevention measures are based on early detection and reporting of any new outbreak occurrence, emergency response and contingency planning. Vaccination is prohibited. If emergency vaccination needs to be implemented, the country or the vaccinated zone ('zone' as defined in the OIE *Terrestrial Code*) will be downgraded to Stage 3.

STAGE 4 KEY OUTCOMES

➤ Stage 4 – Outcome 1 (Diagnostic system) – The diagnostic activities carried out in the laboratories, while maintaining the same level of capability and performance in relation to PPR diagnosis, have been further extended to include all those diseases which may require a differential diagnosis with PPR. In addition, all material containing field PPRV is sequestered in a well-defined secure location, under the supervision of the Veterinary Services, to avoid any PPR resurgence linked to accidental or intentional manipulations

➤ Typical activities		➤ Performance indicators	
A1	Produce (and keep updated) a flowchart to indicate how a suspicion of PPR is handled and (once the suspicion is withdrawn) which other diseases will be investigated	I1	— Number of suspicious samples submitted to the laboratory for excluding the presence of PPR virus in the same 12 months during which no clinical outbreaks have been observed (and required to enter stage 4) (<i>target</i> : no target as it depends on the country situation with regard to other small ruminants diseases)
A2	Train laboratory staff in differential diagnosis of PPR	I2	— Number of analysis undertaken to exclude PPR by identifying the involved cause of the case on those samples where PPR presence needed to be excluded (<i>target</i> : at least 90% of PPR suspicion are the object of laboratory diagnosis investigations)
A3	Identify, list and collate all PPRV-containing material and identify appropriate premises for its secure sequestration (in the future it may be destroyed)	I3	— Number of facilities in which PPR field virus-containing material can be held (<i>target</i> : no more than one facilities per country, depending on the country size)
		I4	— Number of site visits to those facilities to verify whether their biosafety/biosecurity conditions are adequate (<i>target</i> : at least, each facility is visited one time / year)

• PMAT questionnaire

		Fully achieved	Partially achieved	Not achieved	Not applicable
Q1	– Most of small ruminant diseases present in the country can be diagnosed by the national laboratory network [A1 – I1; A2 – I2]				
Q2	– The risk of accidental or intentional mis-use of field PPRV is minimized [A3 – I3, I4]				

➤ PPR Roadmap Table for Outcome Stage 4 Outcome 1		
<i>Please report in this Table the activities above that have been partially or not achieved at all</i>		
Activity	Timeframe	Responsible staff
Activity 1 —		
Activity 2 —		
Activity 3 —		

↪ **Stage 4 – Outcome 2 (Surveillance System) – the surveillance system operates as in the previous Stage with a focus on population at higher risk**

The surveillance system is robust enough to identify any animal with signs suggestive of PPR that require follow-up and investigation to confirm or exclude that the cause of the condition is PPRV.

The case definition of a suspected case may be made broader so to be able to capture health events and rapidly rule out those that may be attributed to PPR

➤ Typical activities		➤ Performance indicators	
A1	Organise training sessions to make field veterinarians fully aware of where the country is now in relation to the eradication process	I1	— Number of field veterinarians informed and trained (<i>target</i> : 100% of veterinarians in the two years after entering Stage 4)
A2	Design and implement specific studies aimed at proving that the cohort of animals born after the suspension of vaccination has not been exposed to the PPR virus (likely to be done through serology targeting the birth-cohort of animals born after cessation of the vaccination in accordance with procedures indicated by the OIE for being recognised as officially free).	I2	— Number of samples collected and tested in new born small ruminants (<i>target</i> : compliance with OIE requirements for official free status)
A3	Implement, when relevant, additional clinical inspection and serological testing of high-risk groups of animals following an alert, such as those adjacent to a PPRV-infected country.	I3	— Number of investigations undertaken after an alert (<i>target</i> : 90% of alerts are followed by appropriate investigations)

● **PMAT questionnaire**

	Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1					– The national surveillance system is able to capture any PPR event in any PPR susceptible population (domestic and wildlife); susceptible wildlife species may act as sentinels indicating the spill over of PPRV from domestic sheep and goats [A1 – I1]
Q2					– The national surveillance system provides evidence that the country is free from PPR (disease and infection) [A2 – I2; A3 – I3]
Q3					– The country notifies within 24 hours (after confirmation) any changes in the PPR epidemiological situation or other significant events linked to PPR, OIE according to the OIE <i>Terrestrial Animal Health Code</i> [xxx]

➤ PPR Roadmap Table for Outcome Stage 4 Outcome 1		
<i>Please report in this Table the activities above that have been partially or not achieved at all</i>		
Activity	Timeframe	Responsible staff
Activity 1 —		
Activity 2 —		
Activity 3 —		

➤ **Stage 4 – Outcome 3 (Prevention and control system) – Stringent preventive measures are put in place to maintain the absence of PPR outbreaks achieved at the end of Stage 3 and prevent any reintroduction; in the event of a PPR outbreak, emergency procedures are implemented**

At this Stage, any true outbreak of PPR is treated as an emergency and consequently the contingency plan (prepared in Stage 3) is immediately activated to eliminate the virus as soon as possible.

Stringent movement control and quarantine measures are applied at borders. Risk analysis is conducted on a regular basis and whenever justified by new factors that may jeopardize the free status. An emergency vaccination programme (combined or not with a stamping-out policy) may also be implemented in the worst case scenario, but will automatically downgrade the country or vaccinated zone to Stage 3

➤ Typical activities		➤ Performance indicators	
A1	In the event of an outbreak, implement the provisions of the contingency plan	I1	— Number of days required to manage a PPR clinical outbreak after it has been confirmed (<i>target</i> : less than one week)
		I2	— Number of PPR secondary outbreaks (<i>target</i> : 0 secondary outbreaks)
A2	Increase collaboration with the Customs services at borders to optimise border control	I3	— Number of joint training programmes in coordinated border management organized (<i>target</i> : at least, one veterinarian and one custom officer per Border Inspection Post in the country have attended the training on CBM)
A3	Conduct risk analysis on a regular basis	I4	— Number of risk analysis conducted with regards to PPR (<i>target</i> : as often as required)
A4	(voluntary) Submit a dossier to the OIE requesting official recognition of PPR free status, in accordance with the provisions of Chapters 1.6. and 14.7. of the OIE <i>Terrestrial Animal Health Code</i>		No specific indicator

● **PMAT questionnaire**

	Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1					– The Rapid Response implemented prevent any occurrence of secondary PPR outbreak (primary prevention) [A1 – I1]
Q2					– The risk of introduction of PPR is fully characterized and addressed (secondary prevention) [A2 – I2; A3 – I3]

Q3	- The use of PPR vaccines are restricted to the emergency management of confirmed PPR outbreaks under the authority of the Veterinary Services (in particular, PPR vaccines are not used to protect animal populations from other morbillivirus infections) [A1 – I1]					
Q4	- The VS can establish and apply quarantine and border security procedures based on international standards, but the procedures do not systematically address illegal activities relating to the import of animals and animal products [CC II.4 level 3]					
Q5	- The VS have an established procedure to make timely decisions on whether or not a sanitary emergency exists. The VS have the legal framework and financial support to respond rapidly to sanitary emergencies through a chain of command. They have national contingency plans for some exotic diseases that are regularly updated/tested [CC II.6 level 4]					

➤ **PPR Roadmap Table for Outcome Stage 4 Outcome 3**

Please report in this Table the activities above that have been partially or not achieved at all

Activity	Timeframe	Responsible staff
Activity 1 —		
Activity 2 —		
Activity 3 —		

↪ **Stage 4 – Outcome 4 (Legal Framework) – The legal framework fully supports possible aggressive measures needed for prompt eradication of PPR in the country.**

The national legislation will require a further improvement to include protective measures on imports of live animals to mitigate the risk of introduction.

The review of the legal framework may require at this Stage consultation with international experts to ensure that the legal requirements for importers of livestock and livestock products (that may carry PPR virus) are in compliance with the SPS Agreement (should the country be a WTO member).

Legal texts will also include provisions for additional measures, notably in the case of free status (e.g. establishment of a containment zone in accordance with OIE requirements).

➤ Typical activities		➤ Performance indicators	
A1	Upgrade the legal framework, notably to ensure that it will include the necessary preventive and control measures foreseen in Stage 4 (in particular, exclusion measures aimed at avoiding introduction of PPR virus from abroad).	I1	Number of amendments included (no specific target)

● **PMAT questionnaire**

		Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1	– The legal framework includes specific measures for emergency response for PPR [A1 – I1]					
Q2	– The legal framework includes provision for emergency funding in case of PPR [A1 – I1]					
Q3	– The legal framework includes measures aimed at avoiding importation of live animals and goods which may carry the PPR virus [A1 – I1]					
Q4	– Funding arrangements with adequate resources have been established, but in an emergency situation, their operation must be agreed through a non-political process on a case-by-case basis [CC I.9 level 4]					

➤ **PPR Roadmap Table for Outcome Stage 4 Outcome 4**

Please report in this Table the activities above that have been partially or not achieved at all

Activity	Timeframe	Responsible staff
Activity 1 —		
Activity 2 —		
Activity 3 —		

➤ **Stage 4 – Outcome 5 (Stakeholder involvement) – Stakeholders are fully aware of the health status of the country and are fully committed to promptly collaborate should an emergency occur.**

Stakeholder involvement at this Stage is essential not only in relation to the formulation of a legislation framework, as indicated in previous outcome, but also in relation to other activities. It is crucial that if a suspicion of PPR arises at this Stage all stakeholders are fully aware of the consequences this may have, thus and ensuring their full collaboration. Communication remains a key element.

➤ Typical activities		➤ Performance indicators	
A1	Organise meetings with groups of stakeholders to acquaint them with the status of the country and ensure that they are aware that any suspicion of PPR is to be treated as an emergency	I1	– Number of awareness meetings organized with livestock keepers (<i>target</i> : a least, one meeting at national level and possibly one meeting at regional level(Province, Directorate, district...) according to small ruminant populations in the first year after entering Stage 4)
A2	Prepare and disseminate informative material in order to maintain a high level of awareness among livestock keepers and other stakeholders	I2	– Number of Field Veterinary Unit where the informative material is distributed (<i>target</i> : 100% of the FVU have received the material)

● **PMAT questionnaire**

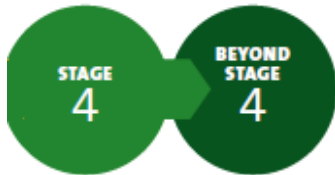
		Fully achieved	Partially achieved	Not achieved	Not applicable	Comments
Q1	– The stakeholders operating in the small ruminant sector fully contribute to the maintenance of the country free status [A1 – I1; A2 – I2]					
Q2	- The VS notify in compliance with the procedures established by the OIE (and the WTO SPS Committee where applicable) [CC IV.6 level 3]					

➤ **PPR Roadmap Table for Outcome Stage 4 Outcome 5**

Please report in this Table the activities above that have been partially or not achieved at all

Activity	Timeframe	Responsible staff
Activity 1 —		
Activity 2 —		
Activity 3 —		

Moving beyond Stage 4



Minimum requirements:

1. All activities of Stage 4 are completed
2. There is no evidence of clinical disease and no evidence of virus circulation both in domestic animals and wildlife for 24 months.
3. A dossier is mounted to fulfil the requirement specified in the OIE TAHC to request an official PPR free status.
4. Once the official PPR free status is obtained the country is out of the pathway

ANNEX – Correspondence table between the PPR Stages and the OIE PVS Critical Competences (level of advancement)

OIE PVS Critical Competences		PPR Stages			
		Stage 1 (Assessment)	Stage 2 (Control)	Stage 3 (Eradication)	Stage 4 (Post-eradication)
CC I.2.A	Professional competencies of veterinarians	3			
CC I.3	Continuing education (CE)	3			
CC II.1.A	Veterinary laboratory diagnosis – Access to veterinary laboratory diagnosis	2			
CC II.1.B	Veterinary laboratory diagnosis – Suitability of national laboratory infrastructures	3			
CC II.3	Risk analysis	3			
CC II.5.B	Epidemiological surveillance and early detection – active epidemiological surveillance	3			
CC III.2	Consultation with interested parties	3			
CC III.3	Official representation	3			
CC III.4	Accreditation / authorisation / delegation	3			
CC III.5.A	Veterinary Statutory Body – authority	3			
CC III.5.B	Veterinary Statutory Body – capacity	3			
CC IV.1	Preparation of legislation and regulations	3			
CC I.1.A	Professional and technical staffing of the VS – Veterinarians and other professionals		3		
CC I.1.B	Professional and technical staffing of the VS – Veterinary para-professionals and other technical staff		3		
CC I.2.B	Competencies of veterinary para-professionals		3		
CC I.6.A	Coordination capability of the VS – Internal coordination (chain of command)		3		

CC I.6.B	Coordination capability of the VS – External coordination		3		
CC I.7	Physical resources		3		
CC I.8	Operational funding		4		
CC I.11.	Management of resources and operations		4		
CC. II.5.A	Epidemiological surveillance and early detection – passive epidemiological surveillance		3		
CC II.7	Disease prevention, control and eradication		3		
CC II.8.B	Ante- and post mortem inspection at abattoirs and associated premises		4		
CC II.12.A	Identification and traceability – Animal identification and movement control		3		
CC III.1	Communication		4		
CC III.6	Participation of producers and other interested parties in joint programmes		3		
CC IV.2	Implementation of legislation and regulations and compliance thereof		3		
CC IV.7	Zoning		3		
CC II.2	Laboratory quality assurance			2	
CC II.12.A	Identification and traceability – Animal identification and movement control			3	
CC I.9	Emergency funding				4
CC II.4	Quarantine and border security				3
CC II.6	Emergency response				4
CC IV.6	Transparency				3

Annex 3.4: **Post vaccination evaluation tool**

Contents

Acknowledgments

1. Introduction

2. Purpose

3. Vaccine effectiveness

3.1 Vaccine attributes

3.2 Vaccine delivery

3.3 Vaccine coverage

3.4 Vaccination campaign

3.5 Vaccination protocols

4. Methods

4.1. Post vaccination serology

4.1.1 General Principles

- Preconditions
- Assumptions
- Definitions
- Sampling methods
- Statistical methods
- Interpretation of serology results

4.1.2 Protocols for PVE serological surveys

- Protocol 1
- Protocol 2
- Protocol 3

4.2. Evaluation of PPR incidence / prevalence

4.2.1 Passive surveillance

4.2.2 Active surveillance

- Participatory disease search

4.3. Sociological surveys

4.3.1. Methodology rationale

4.3.2. Study design

4.3.3. Visualisation

4.3.4. Data extraction

4.4. Flock productivity

4.4.1. Animal productivity

4.4.2. General design

4.4.3. Productivity surveys

4.4.4. Training and implementation

5. Follow up of the post vaccination evaluation: investigating vaccination failure

Annexes: Examples for Protocol 1 and Protocol 3

Acknowledgments

This PVE tool has been prepared by Susanne Munstermann and Felix Njeumi from the FAO-OIE GF TADs Working Group in strong collaboration with Renaud Lancelot, Marisa Peyre and Fanny Bouyer from CIRAD (Montpellier France), Gregorio Torres from OIE Paris, with the support of Daniel Bourzat (OIE Bamako, Mali) and with the general guidance from Joseph Domenech.

1. INTRODUCTION

Vaccination is one of the key tools to control *peste des petits ruminants* (PPR) and is the main option in Stages 2 and 3 of the GF-TADs Global Strategy for the Control and Eradication of PPR. In order to monitor the effectiveness of a vaccination programme, several performance indicators need to be taken into consideration. One of them is *vaccine effectiveness*, an indicator of how well animals are protected in the field by a programme of vaccination. A *post vaccination evaluation* (PVE) is one of the tools to carry out this assessment.

The purpose of the vaccination programme is to contribute to the control (Stage 2) or eradication (Stage 3) of the disease. In both stages, the (i) vaccine attributes, (ii) vaccine delivery and coverage and (iii) assessment of the immune response need to be monitored.

Several factors can influence the effectiveness of the vaccination programme. It is therefore necessary to monitor the process from the moment the vaccine is produced (quality control) until it is used in the field (including cold chain and storage). Critical control points (CCPs) need to be identified along this line to reduce the risk of programme failure. The CCPs need to be systematically monitored along the chain of events of the vaccination programme.

If all steps along the CCPs have been implemented correctly, then it can be assumed that the vaccination programme has been delivered effectively and that a desired threshold of the animals targeted by the vaccination programme have seroconverted and have detectable antibodies in a serological test.

Serology is one of the main methodologies for PVE; however, the nature of small ruminant production, particularly in extensive husbandry systems, calls for a combination of serology, such as participatory methodologies, or surveillance.

The PPR PVE tool is a companion to the GF-TADs Global Strategy for the Control and Eradication of PPR.

2. PURPOSE

PVE can contribute to the overall assessment of vaccine effectiveness, which encompasses the vaccine attributes and its delivery, vaccination coverage and immune response to vaccination.

3. VACCINE EFFECTIVENESS

3.1 Vaccine attributes

Several homologous PPR vaccines, based on cell culture-attenuated strains of PPR virus are available. Manufacture and quality testing of these vaccines must be done in accordance with the OIE *Manual of Diagnostic Test and Vaccines for Terrestrial Animals (Terrestrial Manual)* Chapter 2.7.11 in order to guarantee vaccine safety, potency and efficacy. In cases where this guarantee is not available, independent quality control of the vaccine should be done before mass utilisation. Institutions such as PANVAC¹ in Africa have the mandate to carry out this independent quality control.

Commercially available PPR vaccines prepared with the Nigeria 75/1 vaccine strain confer an immunity of at least 2, which can be considered almost lifelong for the commercial life of small ruminants. This particular vaccine attribute is the key to the possibility of using mass vaccinations for disease eradication (stage 3).

¹ Pan African Veterinary Vaccine Centre, Debre Zeit, Ethiopia

Besides these currently available thermolabile vaccines, thermotolerant PPR vaccines have been developed and can be produced by several laboratories; however, they have yet to be fully commercialised and some applied research is still being undertaken to improve the thermotolerance. The need for DIVA² vaccines has been identified.

3.2 Vaccine delivery

In order to delivery vaccine to the field in good quality and in sufficient quantity, several factors need to be considered, namely the cold chain, the size of vaccine vials, the estimation of required vaccine quantity and the actual vaccination.

The currently commercially available thermolabile vaccines have to be stored at cold temperature. This is one of the challenges for a successful large-scale vaccination programme. Vaccine in the freeze-dried form is stable for at least two years at 2–8°C and for several years at -20°C. These cold temperatures have to be maintained in a cold chain system that needs to be assured throughout the different delivery stages, from central purchase point to distribution centres to the vaccinators in the field. Once the vaccine is reconstituted, it needs to be utilised as soon as possible, but not later than 30 minutes after dilution.

Vaccine delivery also includes the task of planning the correct quantities of vaccine for the different vaccination points in order to provide vaccinators with a sufficient quantity of vaccine to achieve the desired vaccine coverage. Vaccine vial size and the number of vaccine doses contained per vial need to be taken into consideration to reduce cost and wastage, with smallholder production systems needing smaller sized and large herds larger sized vials.

This implies an appropriate estimate of animal population size, considering the rapid annual replacement rate of small ruminants, estimated at around 30%, which is a major challenge in most developing countries, remote areas and in extensive and pastoral husbandry systems.

3.3 Vaccine coverage

Information on vaccine coverage is used for a variety of purposes: to monitor the performance of the vaccination services at the local and national level, to identify areas of weak delivery system performance that may require extra resources and focused attention and eventually to give feedback and to guide disease control decision makers. Good vaccine coverage is the result of a delivery system that is working properly. The vaccine coverage can be calculated from:

$$\text{Number of animals vaccinated} / \text{Number of animals eligible for vaccination} (\times 100)$$

where the denominator should reflect the carefully defined target population, i.e. those eligible for vaccination. If the denominator estimate is incorrect, coverage estimates will also be incorrect. Estimation of the denominator can be difficult in small ruminant populations.

For PPR vaccine it is assumed that if a quality vaccine is properly administered the animals will seroconvert and be immune, hence the vaccination coverage is a proxy of the population immunity if the vaccine delivery is done correctly.

Restocking/replacing of small ruminants, renewal of the herd through births and migrations (passing through a country or movement within a country or zone) needs to be taken into consideration when determining vaccine coverage. The desired overall threshold of immune animals should not be compromised. While ideally 100% of animals in the target population should be vaccinated, for PPR conventional expected vaccination coverage is 80%, in line with the assumptions that were made for

² DIVA: differentiating infected from vaccinated animals

rinderpest eradication. However, there have been multiple examples of rinderpest virus elimination without reaching such immunity levels. Besides, no scientific publications give evidence that such levels of immunity are needed to stop PPR virus maintenance and spread. On the contrary, the recent experience of Morocco in PPR eradication has shown that 70% immunity was sufficient to eliminate the virus circulation in the country³. Field experiences and modelling work show that the desired 80% protection cannot be achieved under field conditions. Therefore, the design of the PVE methodology for serology surveys and the interpretation of the results are based on a 70% level of immunity at epidemiological unit (epi-unit) level.

PVE using serology contributes to determining the maintenance of this desired herd immunity threshold.

However, as PVE requires a budget in addition to costs for vaccination campaigns, modelling studies are also recommended to determine the most efficient vaccination frequency and schedule, particularly with respect to the lambing/kidding season.

3.4 Vaccination campaign

Thorough planning of the use of manpower, equipment and transport needs is required. Not in all circumstances will it be possible or desirable to implement the campaign with staff of the public official Veterinary Services only and private veterinary practitioners and veterinary para-professionals will need to be involved as well. Their ability to deliver vaccination campaigns is well recognised and needs to be integrated in order to reach out to small ruminant livestock owners. Therefore effective partnerships between public and private Veterinary Services need to be strengthened.

With this collaboration, more flexible methods of vaccination, other than single large-scale campaigns, can be achieved, such as storage of vaccine at strategic points close to livestock owners, possibly combined with other implements, feeds or drugs, so as to increase the attractiveness for para-professionals. This integrated approach would also facilitate revaccination of young stock as and when required.

Depending on the stage of a given country, vaccination can be a private or a public initiative, targeted at high-risk areas or covering the entire population. Details of the approaches are described in the respective Stage in the PPR Monitoring and Assessment Tool (PMAT).

Regardless of the approach, a minimum of at least the established vaccination coverage threshold should be the goal, to be achieved in the shortest possible time.

Within each area where several teams will be utilised for vaccination it is recommended that at least one team should always remain on a more flexible schedule to be available for contingencies. This team will assist with the routine planned schedule but can be immediately redeployed to vaccinate in locations where surveillance shows the disease is present or suspected, or to assist other teams that have encountered larger populations than expected.

3.5 Vaccination protocols

The vaccination protocols should take into account the type of production system, population dynamics, lambing seasons and movement patterns.

³ ONSSA (Office National de Sécurité Sanitaire des Produits Alimentaire, Direction des Services vétérinaires) post-vaccination monitoring in 2009 revealed a level of protection of 66.8% in sheep and 74.31% in goats after a mass vaccination campaign that covered 95% of the national herd (*EFSA Journal*, 2015, **13** [1])

For the purpose of this strategy, three major production system categories will be referred to when describing the vaccination protocols:

- 1.** Pastoral and agro pastoral systems (hyper-arid, arid, and semi-arid zones)
Vaccination protocol: annually at the beginning of the dry season and before the lambing season.
- 2.** Mixed crop-livestock farming systems with predominance of agriculture (dry sub-humid and humid zones)
Vaccination protocol: twice per year. The time of vaccination has to be adapted to the agricultural calendar and to the availability of farmers.
- 3.** Peri-urban systems
Vaccination protocol: once or twice per year, to be decided depending on the replacement rate of animals in herds/flocks.

The vaccination should be implemented during two successive years followed by the selective vaccination of new born animals only during one or two successive years.

4. METHODS

In small ruminants, which are not often individually identified, a combination of methods should be applied in order to evaluate the effectiveness of the vaccination campaign, such as the estimation of PPR incidence through outbreak reporting (surveillance systems), participatory disease search (PDS) or sero-epidemiological surveys. The results of vaccination can also be evaluated through post-vaccination serology, sociological participatory surveys (particularly appraisal of farmers' and vaccinators perception of vaccination success, including appraisal of the delivery system or flock productivity).

All methods, including serology, must be budgeted and included in the overall costing for PPR control and eradication.

4.1 Post vaccination serology⁴

Serology can be used to evaluate the immune response to vaccination and, given that PPR vaccine confers very high immunity levels, is an important method. Protocols should, wherever possible, be harmonised within countries and at regional level in order to gain a good understanding of the effectiveness of vaccination at national and regional level. Serological surveys post vaccination should also be combined with data collection on CCPs and other potential risk factors for disease spread or vaccine failure (e.g. very poor body condition of animals observed during vaccination). Ideally, these data could also be used to calibrate dynamic models for post-vaccination immunity decline at the population level.

⁴ This paragraph has been prepared in collaboration with Gregorio Torres, OIE Paris, France and Renaud Lancelot, CIRAD, Montpellier, France

4.1.1. General principles

The protocols for serological surveys to evaluate vaccination effectiveness described hereafter serve different purposes. Depending on the analytical spectrum that a country wishes to cover by serology, and on the budget allocated to PVE by serology, protocols are more or less intensive. The basic questions that these protocols try to answer are:

1. to establish the baseline level of epi-units that have been exposed to the PPRV prior to vaccination in the target population
2. to evaluate vaccination effectiveness by estimating the number of epi-units that demonstrate appropriate sero-conversion after each round of vaccination
3. to evaluate population immunity (no of epi-units protected) at a given time and over time after several vaccination campaigns by comparison with the results of the baseline survey
4. to analyse which age strata have been protected.

For all protocols certain preconditions have to be met and some assumptions have been made.

– Preconditions

Livestock owners and Veterinary Services need to be sensitised to understand the usefulness of PVE to determine adequate levels of immune response, which in turn assist in the design of an optimised vaccination programme. In order to effectively carry out this sensitisation, sociological surveys regarding farmers' perception of PPR and PPR vaccination, as well as the identification of the socio-technical networks of interest for vaccine delivery, notably in smallholder production systems, would be very useful.

Surveillance (see Annex 3.5.) and molecular epidemiology should be in place in order to have data on the spatio-temporal distribution of the disease and on high-risk areas for virus introduction.

While it is desirable that animals should be identified as having been vaccinated in order to distinguish them from non-vaccinated animals, this might not often be possible, particularly in extensive rural husbandry systems.

The sampling system proposed in this strategy is based on the assumption that this is not possible. If, however, an identification system can be introduced, PVE sample sizes can be reduced.

As in any other serosurvey strategy, there is a chance of misclassification regarding the protection of the investigated epi-units because of the sensitivity and specificity associated with the selected sampling strategy. Therefore, serological results should be complemented with information collected on CCPs and other risk factors.

– Assumptions

For the proposed PVE sampling strategy the following assumptions are being made:

- each flock will produce susceptible animals through new-born animals or other entrants
- a quality controlled vaccine is being used and it confers 100% sero-conversion
- VNT titres of > 1:10 are protective
- animals younger than three months are protected by maternal antibodies

- the threshold for vaccination to be considered successful is when 70% of animals within epi-units are protected
- the assumed proportion of epi-units exposed to virus (baseline survey) or protected after vaccination is 50%, in order to apply the most conservative sampling size
- the study population is considered to be large (unknown number of epi-units) and therefore the calculation is based on the maximum number of samples
- vaccinated animals are not individually marked or identifiable
- sheep and goats are being sampled.

– **Definitions**

➤ **Target population**

The target population is defined as all susceptible small ruminants in a particular location at risk of PPR.

➤ **Study population**

The study population is defined as epi units included in the vaccination programme. Animals in the epi units can be stratified by:

• Age:

Not included in serological testing for PVE

- 0–3 months, still with maternal antibodies, unvaccinated
- 3-6 months, included in vaccination campaign, but not in PVE⁵
 - This group is excluded from PVE because the 0-3 months group will be in this stratum during the second survey as unvaccinated animals

Included in serological testing for PVE

- 6-12 months
- 12-24 months
- Older than 24 months

Using three age groups will give more precise information on the particular strengths or weaknesses of the vaccination campaigns, as certain age groups might have been favoured by farmers when presenting the animals for vaccination. If, however, the primary objective is the evaluation of the overall protection of epi units without considering differences between all age strata, two groups will suffice:

- 6-12 months,
- Older than 12 months

• Epi units are also stratified according to the prevailing husbandry system:

- Pastoral: nomadic or transhumant, extensive
- Agro-pastoral: transhumant or sedentary, extensive or intensive
- Mixed crop-livestock small farming system: sedentary, extensive or intensive

⁵ They must be included in clinical surveillance; they could also act as sentinels before vaccination

➤ ***Epidemiological unit***

The epidemiological unit (epi-unit) will be defined considering that all small ruminants within each unit will have the same chance of being vaccinated and the same risk of being infected (or have specific antibodies against PPR). Depending on the husbandry system, the village or the flock will be considered the epi-unit.

➤ ***Definition of vaccination failure***

A case of vaccination failure is defined when 30% or more of animals within the epi-unit are negative in the serological test. For the purpose of this study, the epi unit will then be considered incorrectly vaccinated and not protected. In this case the CCPs of the vaccination chain and the assumptions need to be critically evaluated.

– **Sampling methods**

A multi-stage sampling method will be used:

- Epi units will be allocated proportionally according to the husbandry system found in the area/country where PVE will be implemented and the required number selected randomly.
- Within epi-units, households or flocks are selected by systematic random sampling, if feasible.
- Within households or flocks, animals are selected by simple random methods. Consider sampling a maximum of 3 animals per each eligible age stratum in each household/flock. If in the selected household/flock there are not enough animals, then select the closest neighbour.

– **Statistical methods**

➤ ***Sample size calculation***

- For the calculations it is assumed that the diagnostic test has 100% sensitivity and 100% specificity.
- 95% Confidence Interval (CI) and 10% standard error.
- To calculate the sample size of epi-units with a specified level of confidence (CI) and precision, assuming an unknown large population of epi-units, the following formula is used:

$$n = (Z^2 \times P(1 - P))/e^2$$

Z = value from the normal distribution

P = Expected proportion of epi-units protected

e = desired precision

- To calculate the sample size within an epi-unit to assess whether the level of seroprevalence is above (or below) a given threshold, reference is made to the hypergeometric distribution using the following formula:

$$n=[1-(\alpha)^{1/d}]\cdot[N-(d-1)/2]$$

n = required sample size

N = population size

d = expected number of sero-negative individuals in the population

α : Error type 1 confidence level expressed as proportion (=1- α) [since it is assumed that the test is 100% specific there is no type 2 error]

Table 1

Minimum sample size required to assess (at 95% CI) if the prevalence of animals not showing antibodies is equal or above 30% (negative in the serological test)

Number animals in epi-unit	Sample size
0 – 4	All
5-10	6
11 – 26	7
27 – 93	8
>94	9

➤ ***Cut-off point for protected versus unprotected epi-units***

The hypergeometric distribution was used to estimate the probability of finding one or more sero-negative samples in different sample size scenarios. The receiver operating characteristic (ROC) analysis was used to determine the most appropriate balance between specificity (false protected epi-unit) and sensitivity (false unprotected epi-unit) of the sampling strategy.

– **Interpretation of the serology results**

Taking the range of sensitivity and specificity⁶ that were calculated for different sample sizes into consideration, the epi-unit will be considered protected if:

- Number of animals per unit is less than 27: 0-1 animals are found sero-negative.
- Number of animals per unit is more than 27: 0 – 2 animals are found sero-negative.

To mitigate a lack of sensitivity and specificity of the applied sampling strategy, it is recommended to consider also results from participatory methods that can confirm the classification of epi-units.

Once epi-units have been identified as protected (vaccination was effective) or not (vaccination was not effective), results within epi-units can be analysed by age groups and the following classification system could be used as reference point to be established during the baseline

⁶ estimated Sensitivity (SE) and Specificity (SP) ranges of sampling strategy are SE (72.5-85.0) and SP (88.9-94.1).

survey to be compared with any subsequent survey to establish the population immunity and the trend over time, if using protocol 1.

1. All three age strata are protected.
2. Two age strata are protected.
3. One age strata is protected.
4. All three strata are not protected.

Tabulation of # per epi-unit can give a good overview of the level of protection of different age groups. An increase in the proportion of epi-units with a high number of protected age strata that are found after vaccination should be significant in order to declare the vaccination campaign successful.

4.1.2 Protocols for PVE serological surveys

Depending on the purpose for which the PVE was used (Table 2), different protocols are described below, all based on the principles explained above.

These protocols comprise 2 to 3 surveys to be implemented. Their starting point is the establishment of a baseline sero-prevalence of previous exposure to virus or vaccination prior to the initial vaccination, which can be combined with the actual vaccination programme and is therefore to be done on Day 0.

Table 2
Proposed protocols for PVE

	'Protocol 1'	'Protocol 2'	'Protocol 3'
Purpose	Assess: – immune response to vaccination; – population immunity; – trend of the population immunity	Assess immune response to vaccination	Assess trend in population immunity
Number of surveys to complete the protocols	Three serosurveys	Two serosurveys	Two serosurveys + one questionnaire

These protocols are further described below, and examples are given in the Annex.

Sample sizes proposed for each protocol are based on the principles described above, but should be adjusted to prevailing epidemiological conditions in the country and should, wherever possible, be harmonised within and between countries.

– **Protocol 1**

An example of Protocol 1 is given in the Annex.

The aim of using this comprehensive protocol is to assess:

- (i) the immune response to vaccination
- (ii) the population immunity at a given point in time and
- (iii) its trend, if implemented over a sequence of vaccination campaigns

➤ **Establish baseline sero-prevalence – survey on Day 0**

The calculation is based on an estimation of the expected proportion of epi-units protected at 50% with a 95% confidence level and a standard error of 10%. The assumed prevalence at animal level is 30% (sero-negative).

Sample size: at least 97 epi-units need to be selected and in each unit a maximum of nine animals from each eligible age strata, randomly selected (see 1.4), need to be sampled, a maximum total of 2,619 animals.

The respective epi-unit will be classified in four categories (refer to 1.6). When analysing the results, the epi-units will then be classified according to these categories with a view to establishing the proportion of epi-units in each category as a measure of degree of susceptibility in the target population for vaccination. The population immunity will be established against this baseline data.

➤ **Second survey Day 30 to 90 post 1st vaccination**

The aim of this survey is to assess the immune response to vaccination, through sampling of animals in the 6-12 months category as it is assumed they had less chance of contact with either vaccination or the virus prior to the vaccination campaign on Day 0.

It is assumed that at least 50% of vaccinated epi-units will have at least 70% of its population seropositive. The calculations are based on a 95% level of confidence and 10% standard error.

Sample size: at least 97 epi-units need to be selected and in each unit a maximum 9 animals, randomly selected, need to be sampled, a total of 873 animals.

In order to assess the effectiveness of the vaccination campaign, the proportion of epi-units with more than 70% of animals protected within the age stratum 6-12 months needs to be compared to the baseline results. The interpretation of the level of this reduction depends on the local conditions (e.g. easily accessible terrain etc.). The reduction should be statistically significant.

➤ **Third survey 30–90 days after second vaccination and subsequent further vaccinations**

The aim of this survey is to gather information on the trend of population immunity over time.

The calculation is based on an estimation of the expected proportion of epi-units protected at 50% with a 95% confidence level and a standard error of 10%. The assumed prevalence at animal level is 30% (sero-negative). A multi-stage sampling method will be used.

Sample size: at least 97 epi-units need to be selected and in each unit a maximum of nine animals from each eligible age strata, randomly selected (see 1.4), need to be sampled, according to Table 1, a maximum total of 2,619 animals.

The respective epi-units will be classified in four categories (see section 1.6). When analysing the results, the epi-units can then be classified according to these categories with a view to establishing the proportion of epi-units in each category as a measure of

the degree of susceptibility in the vaccinated population. In addition to assessing the effectiveness of the vaccination campaign, the results in each age stratum can now be compared and the trend of increase in the proportion of epi-units with more than 70% of animals protected observed.

Table 3
Overview of ‘Protocol 1’ to assess the immune response to vaccination, the population immunity and the trend of the population immunity

	Survey 1	Survey 2	Survey 3
Sampling time	Day 0 (baseline)	Day 30 – 90 post vaccination	Day 30 – 90 post 2nd +n vaccination
Number of epi-unit selected	97 epi-units	97 epi-units	97 epi-units
Eligible age strata	All three age groups	Age group 6 – 12 months	All three age groups
Number of animals from each eligible age strata	9	9	9
Total number of animals selected	2,619 animals	873 animals	2,619 animals

– **Protocol 2**

The aim of this protocol is to assess the immune response to vaccination as a proxy for the effectiveness of the vaccination campaign.

This protocol is suitable to test that all CCPs are well established and controlled and therefore the vaccination campaign has worked well.

➤ **Establish baseline sero-prevalence – survey on Day 0**

Details of the protocol are shown in Table 4.

➤ **Second survey at Day 30 to 90 post any vaccination**

Use protocol for survey 2 in Table 4.

An increase is expected in the proportion of epi-units with the age strata 6–12 months protected. If no significant increase is observed, the CCPs should be closely examined.

Table 4
Overview of ‘Protocol 2’ to assess the immune response to vaccination

	Survey 1	Survey 2
Sampling time	Day 0 (baseline)	Day 30 – 90 post vaccination
Number of epi-unit selected	97 epi-units	97 epi-units
Eligible age strata	Age group 6 – 12 months	Age group 6 – 12 months
Number of animals from each eligible age strata	9	9
Total number of animals selected	873	873 animals

– Protocol 3

The aim of this protocol is to establish the trend of population immunity over time at epi-unit level only, without differentiating the impact of the vaccination on the different age strata.

This protocol could be useful if it is known that the vaccination campaign is effective but there is a need to define/improve the vaccination schedule. In this protocol a reduced sample size is required, hence a lower budget can be considered.

A precondition for this protocol is a knowledge of the age distribution in the target population. This information can come from a questionnaire survey (as mentioned in the introduction to Methodology).

➤ **Establish baseline sero-prevalence – survey on Day 0**

Protocol: see Table 5, survey 1.

If the age distribution in the epi-units is known, the nine samples should be distributed proportionally to the two age groups. If it is not known, animals should be randomly selected without considering age strata.

➤ **Second survey at Day 30 to 90 post vaccination**

The second survey can be carried out by a questionnaire to inquire on observed effectiveness of the campaign. A serosurvey will not be necessary because the protocol assumes an effective vaccination campaign.

➤ **Third survey 30 – 90 days after second vaccination and subsequent further vaccinations**

Protocol 3 see Table 5, survey 3.

An increase in the level of protection of susceptible epi-unit is expected in the third survey. If this increase is not significant, this could be an indicator that the frequency and/or the schedule of vaccination need to be adjusted.

Table 5
Overview of ‘Protocol 3’ to assess trends in population immunity

	Survey 1	Survey 2	Survey 3
Sampling time	Day 0 (baseline)		Day 30 – 90 post 2nd +n vaccination
Number of epi-unit selected	97 epi-units		97 epi-units
Eligible age strata	Age groups 6 – 12 months and >12 months	No serology, could be replaced by questionnaire	Age groups 6 – 12 months and >12 months
Number of animals from each eligible age strata	9		9
Total number of animals selected	729		729

4.2 Evaluation of PPR incidence / prevalence

4.2.1. Passive surveillance

A well-functioning reporting system to communicate passive surveillance data from the field to the Veterinary Services is an essential component of all Stages in the GCES. It is most likely that new outbreaks of the disease are discovered by passive surveillance. The sources from which passive surveillance data can be retrieved and their respective importance in the different Stages of the GCES are further elaborated in the Annex.

4.2.2. Active surveillance / disease search

While the reporting of passive surveillance data is of great importance, active disease search needs to be integrated into the overall surveillance system as well. Methods such as sero-epidemiological surveys, participatory disease search, use of sentinel herds, etc. fall into this category. Their importance in the different Stages of the GCES is further elaborated in the Annex.

It is important to recall that sero-epidemiological surveys (as part of the active surveillance methods to evaluate the PPR incidence in vaccinated areas or production systems) are to be used in unvaccinated flocks only since the diagnostic tests cannot differentiate between vaccinated and infected animals. The specific objectives of these surveys will therefore be limited, for example, to cross-checking the results provided by the PDS surveys or to assess the homogeneous distribution of PPR infection across the villages enrolled in the different vaccination-protocol categories.

– Participatory disease search (PDS)

➤ *Introduction*

This section is limited to an introduction to the method since detailed descriptions and guidelines have already been published.

Participatory techniques have been adopted relatively recently by veterinary epidemiologists. In the field of transboundary animal diseases (TADs), they were developed during the final stages of rinderpest eradication in remote and/or insecure regions. More generally, they have shown to be promising in developing regions.

PDS is one of the methods of participatory epidemiology (PE), which uses participatory approaches and methods to improve the understanding of disease epidemiology. These approaches and methods are derived from the participatory appraisal method. The basic principle is that public or private veterinary professionals and local people work together to appraise and analyse situations. Participatory methods build on farmers' knowledge and use of their skills in disease surveillance and control. In the case addressed here, the objective of PDS is to assess the incidence of PPR outbreaks.

PE methods are most often based on qualitative techniques using semi-structured questionnaires applied at a collective level (e.g., village). Results can sometimes be turned into quantitative or semi-quantitative results but this does not represent the fundamental objective of PE. Also, a number of primary or secondary data sources can be used, the former originating from the studied communities, and the latter from, for example, previous studies, disease reports, serological surveys, etc.

Among PE methods, PDS is useful when other epidemiological approaches are not easy to implement or when the interpretation of survey results is not easy without knowing the

context. These circumstances can be encountered, for example, when disease monitoring is difficult to implement using event-based surveillance.

➤ **Implementation**

– Goal

The goal of PDS is to provide an estimate of PPR annual clinical incidence in the target small ruminant population at the national level, either at the initial stage of the control and eradication strategy, or during all Stages of its implementation.

– Sampling and logistics

Given the collective nature of PDS, epi-units are villages or their equivalent for transhumant/nomadic farmers. In most cases, stratification of the national population will be necessary to achieve a better precision of estimates. Stratification criteria and sample sizes can be the same as for post-vaccination sero-monitoring (see 4.1.1). For PDS in a given epi-unit (e.g. village), a sample of 10 farmers is required but this figure is indicative, the goal being to get a panel of farmers interested in small ruminant production and representing the possible diversity of small ruminant farming systems existing in the village.

Though the costs of PDS are in general lower than other programmed surveillance surveys, they are not negligible and necessitate very good preparation and a sufficient survey period. Indeed, a single team cannot survey more than 1 or 2 villages each day. Moreover, large-scale PDS requires the implementation of a specific information system as well as a well-designed protocol, the implementation of which will have to be closely monitored by a coordinator.

– Field surveys

PDS requires small teams of at least two surveyors. They have to be well and specifically trained for this type of survey. Moreover, they have to understand and speak fluently the local languages, which might be a challenge to be carefully addressed in some cases.

Several methods are used successively during PDS:

1. semi-structured interviews including focus-group discussions or individual farmers;
2. ranking and scoring (e.g. disease matrix scoring);
3. visualisation through mapping, timelines, etc. This information must be cross-checked by using secondary information sources, by probing, by using triangulation and saturation principles, and/or by using laboratory diagnostics.

The surveyors conducting the discussion act as facilitators. An example is given below, listing the different steps to follow.

- Introduce the team as an animal-health appraisal team (do not focus on PPR).
- Identify the respondents among the farmers, establish whether they are small ruminant owners and establish their main livestock farming locations (mapping).
- Assess if they belong to groups or farmers association.
- Ask what kind of animal health services they use.
- Ask the local names of the diseases currently occurring in their herds or in the area. Try to figure out how they recognise them: describe the clinical signs of these diseases.
- If they cite PPR-like diseases affecting their small ruminants, ask when and where was the last occurrence.

- Investigate the mortality rates related to this PPR-like disease among targeted farmers with the largest small ruminant flocks.
- Finally and most importantly:
 - if the local names provided by the farmers correspond to syndromes (well identified set of clinical signs), draft with them a disease scoring matrix;
 - otherwise facilitate the identification of these syndromes with the use of cards.

– Disease scoring matrix (Fig. 1)



A paper board and a fixed number of small stones or equivalent material (e.g. beans) can be used as the main devices. The farmers work collectively on a single matrix per small group of people. The work is done when the matrix is completed and validated by the whole group.

The following method must be used to draw the matrix:

1. Draw one column for each local name of the diseases/syndromes provided by the farmers, and write its local name in the column heading.
2. Draw one row for each individual clinical sign provided by the farmers and write its name in the row heading.
3. For each clinical sign (each row of the matrix), the farmers put an amount of stones in proportion to the intensity of the symptom for each disease.

Fig. 1
Building a disease scoring matrix during a focus group meeting with farmers in Ghana, April 2013
Photo R Lancelot CIRAD 2014

When a syndrome (matrix column) provides an overall clinical picture compatible with PPR, the farmers are asked to date the last clinical outbreak and to indicate the number of deaths per species as well as the total numbers of small ruminants owned.

– Disease anamnesis using cards (Fig. 2)

Sometimes, only individual clinical signs are identified by the farmers. This situation may occur when livestock farming is a recent or minor activity, or when herd sizes are small. Cards may then be used to facilitate disease reporting. Farmers are firstly asked to draw the clinical signs on a card. These cards are then placed in their order of appearance for each herd to draw up the 'disease anamnesis' of the last year. When an overall clinical picture is compatible with PPR, the date of the last outbreak is noted as well as the number of deaths by species.



Fig. 2
Example of overall clinical picture elicited by Cards
(salivation +ocular discharge + bloody urine)
Photo F. Bouyer CIRAD 2014

On the basis of the results provided by the disease scoring matrix or the anamnesis-by-cards, a PPR suspicion is defined when three or more of the following clinical signs are reported:

- salivation or 'sores in the mouth',
- nasal discharge,
- ocular discharge,
- haemorrhagic diarrhoea, or severe diarrhoea,
- coughing,
- emaciation or severe loss of appetite / general condition,
- high mortality.

References

Ameri A.A., Hendrickx S., Jones B., Mariner J., Mehta P. & C. Pissang (2009). – Introduction to Participatory Epidemiology and its Application to Highly Pathogenic Avian Influenza Participatory Disease Surveillance: A Manual for Participatory Disease Surveillance Practitioners. Nairobi: ILRI. Available at : <https://cgspace.cgiar.org/handle/10568/367?show=full>.

Bellet C., Vergne T., Grosbois V., Holl D., Roger F. & Goutard F. (2012). – Evaluating the efficiency of participatory epidemiology to estimate the incidence and impacts of foot-and-mouth disease among livestock owners in Cambodia. *Acta Tropica*, **23**, 31–38.

Bett B., Jost C. & Mariner J. (2008). – Participatory investigation of important animal health problems amongst the Turkana pastoralists: Relative incidence, impact on livelihoods and suggested interventions. Discussion Paper 15, ILRI / VSF Belgium, 50 pp.

Catley A., Alders R.G. & Wood J.L. (2012). – Participatory epidemiology: Approaches, methods, experiences. *Vet. J.*, **191** (2), 151–160.

Food and Agriculture Organization of the United Nations (FAO) (2000). – Manual on participatory epidemiology – Method for the collection of action-oriented epidemiological intelligence (C. Jeffrey & R. Paskin, eds). Animal Health Manual, 10.

International Livestock Research Institute (ILRI) (2013). – Participatory epidemiology. A toolkit for trainers (S. Dunkle & J. Mariner, eds), 153 pp.

Jost C.C., Mariner J.C., Roeder P.L., Sawitri E. & Mc Gregor-Skinner G.J. (2007). – Participatory epidemiology in disease surveillance and research. *Rev. Sci. Tech. Off. Int. Epiz.*, **26** (3), 537-549.

Latour B. (2005). – Reassembling the social. An introduction to actor-network-theory, Volume 1. Oxford Univ Press.

Mariner J.C., House J.A., Mebus C.A., Sollod A.E., Chibeu D., Jones B.A., Roeder P.L., Admassu B. & van't Klooster G.G.M. (2012). – Rinderpest eradication: appropriate technology and social innovations. *Science*, **37** (6100), 1309–1312.

Vétérinaires Sans Frontières-Belgium (VSF-B) (2007). – Rinderpest participatory searching: A manual for veterinarians and animal health workers in Southern Sudan. VSF-B (Vétérinaires Sans Frontières-Belgium).

4.3. Sociological surveys⁷

The assessment of the perception of PPR vaccination efficacy can be done through participatory approaches. The aim of this assessment is to highlight the main determinants influencing the implementation of the PPR vaccination campaign in order to better understand the drivers impacting on its efficacy in terms of vaccine coverage and to draw up recommendations for corrective actions. The perceptions and action logic of vaccinators and farmers towards implementation of the PPR

⁷ This paragraph has been prepared with the collaboration of Marisa Peyre (marisa.peyre@cirad.fr) and Fanny Bouyer (neptisliberti@gmail.com), CIRAD. A detailed guide for these sociological surveys is available (request to be sent to renaud.lancelot@cirad.fr or to Marisa Peyre or Fanny Bouyer). The support from Daniel Bourzat and Joseph Domenech, when applying these methods in the field (as well as other methods: see footnote N°8), was provided through the implementation of an OIE project, supported by the Bill and Melinda gates Foundation.

vaccination campaign are analysed along with the socio-technical network of small ruminants' health management in place.

4.3.1. Method rationale

The implementation process of the vaccination campaign along with the organisation of the local socio-technical network is analysed by linking the factual and conceptual information of the different stakeholders (vaccination teams and livestock keepers) captured by participatory diagnosis (Catley *et al.*, 2012). Participatory epidemiology tools enable users to produce semi-quantitative data and to compare the results between the different areas selected. It is important to know what the usual communication networks are and also to focus on the communication routes linked to the PPR vaccination campaign (what message is conveyed, by whom and how), as involvement in the vaccination campaign is not a personal and technical choice for the livestock keepers: it is the result of the request of a socio-technical network to participate in an innovation, namely mass vaccination against PPR (Latour *et al.*, 2005; Ruault, 1996, Weber, 1971). The content of the semi-structured interviews is analysed by linking the similarities and differences between the practices and concepts in order to highlight the logic of the actions according to the points of view objectively defined (social group to which the livestock keepers belong). The main study subject is not the action of vaccination but the vaccination campaign itself. Finally, a synthesis and an analysis of the stakeholders' perception of the strengths and weaknesses, including any corrective actions suggested by the stakeholders, are performed using a social network analysis approach.

4.3.2. Study design

– Secondary data collection

In order to design the study protocol and define the study sample, all available secondary data regarding the vaccination programme under assessment need to be collected and reviewed. Secondary data could be information retrieved from scientific literature (review of published articles), grey literature (project reports, internal reports to be collected from the local partners), or data generated by other survey implemented within the framework of the same project. This information provides essential elements on the actors involved in the vaccination process and the selection of a study area where the PPR disease situation is more or less important.

– Participatory epidemiology training

The selection of the interviewer team background and the initial training of the team on participatory epidemiology and participatory approach is a critical element to ensure the success of the study. Students or researchers with a sociological background should be preferred wherever possible as they have a good background in participatory interviews and analysis of sociological issues. However, they will require specific training on participatory epidemiology assessment linked to the project context (PPR vaccination). Local veterinarians or animal health technicians can also be recruited; however, they will require specific training on participatory interview techniques, to limit expert bias both during the interviews and during data recording. During the training, emphasis is placed on non-leading interview techniques and on data recording techniques (e.g. using full transcripts of the interviewees' replies instead of relying on notes; avoiding any interpretation of the information provided, etc.). A good approach is also to promote a multidisciplinary team, combining sociologists and veterinarians. All the interviewers should attend the initial training course, independently of their background.

The training includes theoretical sessions and field practice sessions and is tailor-made to fit the objectives of the project. The field study protocol and checklists/tools will be finalised and

tested with vaccinators and farmers during the training field practice sessions under the supervision of the trainer.

– **Sampling**

➤ ***Choice of the study area***

The study area is selected to reflect the major livestock farming systems existing in the country, accounting also for the specificity of the socio-technical network in place. The choice of the study area could also be made following vaccinators' interviews.

➤ ***Vaccinator selection***

Wherever possible, all the vaccinators involved in the project should be interviewed. If this is not possible, then at least the vaccinator from the areas under study should participate.

➤ ***Farmer selection***

A stratified random selection of geographical areas and villages is performed within the selected regions. If one of the objectives of the survey is to compare different vaccination protocols, the selection will consider vaccinators' perception of each village being classified as either 'successful' (e.g. >80% coverage) or 'less successful' coverage (e.g. <30% coverage). An optimal sociological survey should include 20 villages selected using this stratified sampling strategy and within each village a focus group will involve 10-15 farmers and 5-10 individual interviews of farmers. The total sample size for the comprehensive study will reach 200-300 interviewed actors but simplified surveys with smaller sampling sizes can be considered when undertaking routine PVE studies (e.g. based on the epidemiological sampling frame to assess post-vaccination coverage levels). The number of interviews performed by villages can in fact be kept open and data are collected until the triangulation principles are reached. Individual farmers' interviews should include a selection of farmers who were not involved in the vaccination campaign.

– **Comprehensive or semi-structured interview**

The methodology of the comprehensive interview is based on open questions concerning the practices and the events (the 'how') but not directly on the justifications (the 'why'). The interviewer acts as a coordinator of the debates. The interviewers will feed the discussion by using statements rather than questions (e.g. 'you said that...'), which will help to elicit the interviewees' entire reasoning with less bias. This can also be used during the collective interviews to disconnect a declaration from the social status of the informant and help the reflexive activity of the group.

– **Data collection and recording**

– During the group and individual interviews of vaccinators, data on the general organisation of the PPR vaccination campaigns and the general perception of the vaccinators on its strengths and weaknesses are collected using an interview checklist developed during the initial training session. During the group and individual interviews of farmers, data on the importance of small ruminant breeding, the perceived impact of PPR, the strengths and weaknesses and the general perception of the farmers on the PPR vaccination campaigns are collected.

– A transcript of all the interviews is produced by the interviewer without deleting any aspects, without summarising and without altering the vocabulary used. Specific terms or

new concepts are reported in the language of the stakeholder. To facilitate the understanding of the answers and to be precise during the transcript, the interviewer will not express any value judgment, add any suggestions or even make any deductions.

4.3.3. Visualisation and scoring tools: flow chart diagrams

For each focus group and individual interviews, a flow chart of the links between the factors impacting the PPR vaccination campaign are drawn by the participants. The participants will then quantify the relative importance of each factor by proportional piling and/or pair-wise ranking.

Proportional piling (PP) is used to give relative scores to a number of different items or categories according to one criterion. For example, the participants are asked to divide the 100 counters between the factors previously displayed in the flow chart according to 1) their negative impact on the PPR vaccination campaign implementation; 2) their positive impact. The participants are then asked to do the same for the corrective actions proposed according to their perceived importance.

In some situations, PP might not be appropriate (e.g. no difference in the relative importance of the factors is observed as they have been allocated the same number of counters). In these cases pair-wise ranking is used. The participants are asked to compare each factor individually with all the others one by one. However, this method should not be preferred as it is more complex than PP and takes more time.

4.3.4. Data extraction and analysis

The different transcripts are analysed individually and then a crossed analysis is made to extract the main information to answer the following questions:

- What is the usual socio-technical network?
 - How was the communication about the campaign organised, and what tools are used?
 - What was the degree of involvement of the actors in the vaccination campaign?
 - What were the perceived strengths and weaknesses of the vaccination campaign?
 - what are the proposals for corrective actions?
- **Descriptive analysis of the factors and links between factors impacting the PPR vaccination campaign**

The flowcharts drawn up by the vaccinators and the farmers are used for network analysis to display the links between the factors and to assess the difference between the networks in terms of type of factors mentioned and relative importance of each factor.

- **Semi-quantitative analysis of the importance of the factors impacting the PPR vaccination campaign**

The overall impact of each factor on the implementation efficacy of the PPR vaccination campaign was assessed by weighting the relative ranking of each factor and its frequency of being reported.

References

Calba C., Ponsich A., Nam S., Collineau L., Min S., Thonnat J. & Goutard F. (2014). – Development of a participatory tool for the evaluation of village animal health workers in Cambodia. *Acta tropica*, **134**, 17-28. Available at: <http://dx.doi.org/10.1016/j.actatropica.2014.02.013>.

Catley A., Alders R.G. & Wood J.L. (2012). – Participatory epidemiology: Approaches, methods, experiences. *Vet. J.*, **191** (2), 151–160.

Delabougliuse A, Antoine-Moussiaux N., Phan T.D., Dao D.C., Nguyen T.T., Truong D.B.T., Nguyen X.N., Vu D.T., Nguyen V.K., Le T.H., Salem G. & Peyre M. (2015) – The perceived value of animal health surveillance: The case of HPAI in Vietnam. *Zoonosis and Public Health* (in press).

Latour B. (2005). – Reassembling the social. An introduction to actor-network-theory, Volume 1. Oxford Univ Press.

Ruault C. (1996). – L’invention collective de l’action: Initiatives de group d’agriculteurs et de développement. Éditions L’Harmattan.

Weber M. (1971). – Économie et société, vol. 1. Plon, Paris.

4.4. Herd/Flock productivity

The impact of vaccination against PPR on small ruminant productivity is an important aspect, in particular as a component of the cost-benefit analysis. To assess changes in productivity linked to vaccination is, however, a difficult task, because many uncontrolled factors may interfere with the productivity measures, such as the occurrence of diseases other than PPR (sheep and goat pox, Rift Valley fever, etc.), or changes in environmental conditions (e.g. drought, flooding). Moreover, such an assessment must compare productivity in PPR-affected with PPR-unaffected epi-units.

4.4.1. Animal productivity

Peste des petits ruminants mostly affects developing countries with low-input, extensive, small ruminant farming systems. In these systems, animal productivity is governed by demographic parameters, either natural (reproduction, survival rates) or anthropic (offtake rates). Demographic production rates are of the form P/N , where the numerator P represents production (number of animals) and the denominator N is a population size related to P . Here, N is the size of the epi-unit, or a subsample of it. For practical reasons (see below), the mono-specific herd (either sheep or goats) together with the farmer is chosen as the sampling unit.

Thus, N may be defined either by the herd size at the beginning of the year:

$$N = n_t, \text{ or by the mean herd size over the year, for instance } N = (n_t + n_{t+1}) / 2.$$

Three usual production rates are presented below:

- The annual crude offtake rate OFF is the total offtake hazard rate when N is the mean herd size: $OFF = m_{off} / N$, with m_{off} the number of animals that have been utilised in this herd during the year (sales, slaughtering, gifts, loans, etc.);
- The annual net offtake rate OFF_{net} represents the balance between offtake and intake: $OFF_{net} = (m_{off} - m_{int}) / N$
- The annual total production rate $PROD$ is the stock annual variation plus the net offtake: $PROD = (\Delta n + m_{off} - m_{int}) / N$, with $\Delta n = n_{t+1} - n_t$

$PROD$ also represents the overall ‘demographic natural productivity’ because its numerator is equal to the balance between births and deaths.

4.4.2 General design

A two-step approach is proposed:

1. Estimate annual PPR incidence at the level of epi-units.
2. Estimate small ruminant productivity in affected and non-affected epi-units.

The first step is by itself an important component of PPR post-vaccination evaluation. It can be implemented by a combination of methods including:

- event-based (passive) surveillance,
- programmed (active) surveillance: participatory epidemiology (e.g. participatory disease searching), serological surveys, clinical surveys, etc. See the corresponding chapter of this guide for further details.

The design of the second step is more complex, as outbreaks of PPR cannot be anticipated in advance. Moreover, clinical incidence of PPR will be lower when progress is made towards eradication. Therefore, an average animal productivity in PPR-affected epi-units needs to be estimated based on surveys implemented at the early stages of a PPR control programme, i.e. when PPR clinical incidence is still high.

The assessment of productivity in PPR-free epi-units is less problematic, because epi-units that have been vaccinated against PPR can be selected. However, the assessment should be implemented every year to account for productivity changes unrelated to PPR.

4.4.3 Productivity surveys⁸

Several survey methods are available to estimate demographic parameters needed to compute productivity indices. Here, retrospective surveys consisting of farm visits and questionnaire surveys applied to the owner and people taking care of the animals are proposed. The goal of these surveys is to record the full set of demographic events that occurred in the herd during the past 12 months. The so-called 12MO method has been formalised and published in scientific journals. A comprehensive set of methodological and training manuals, field questionnaires, corresponding databases and statistical software to analyse the data is freely available at <http://livtools.cirad.fr/>.

– **Sampling**

➤ **Sampling units**

12MO surveys can only be implemented on small or medium-sized herds: the method does not apply to herds of several hundred animals, for practical reasons (survey time, farmer's memory).

➤ **Sampling frame**

Here, a stratified random sampling frame is used to carry with the following main stratification criteria needed to get relevant productivity estimates.

- **Species:** because demographic parameters are different from species to species, sheep and goat data must be considered as separate herds, even if animals belong to the same farmer.

⁸ This paragraph has been prepared in collaboration with Renaud Lancelot, CIRAD, Montpellier, France. It was also supported by Daniel Bourzat and Joseph Domenech (see footnote N°7)

- **Agro-ecological zone:** in low-input small ruminant farming systems of most developing countries, animal productivity is strongly dependent on natural forage resources. Therefore, agro-ecological strata might consist of the geographical subdivisions of a given country based on the aridity index AI (AI = mean annual precipitation / mean annual potential evapotranspiration): hyper-arid, arid, semi-arid, sub-humid and humid areas]. AI maps and datasets are freely available on the CGIAR-CSI website at <http://www.cgiar-csi.org/data/global-aridity-and-pet-database>.
- **Finer strata** might be needed, according to their possible effect on productivity, e.g. pastoral and agro pastoral systems (hyper-arid, arid, and semi-arid zones) versus mixed crop-livestock farming systems with predominance of agriculture (dry sub-humid and humid zones).
- **The PPR status of the herds:**
 - **PPR-free herds** should be selected within vaccinated herds or in epi-units free of PPR during the last 12 months if vaccination has not yet started. This information can be obtained after taking blood samples in at least 28 lambs and/or kids > 3 months and < 12 months randomly selected in the epi-unit (species does not matter in this case). If all of them test serologically negative, the probability that the PPR seroprevalence rate is 10% is at the most 95%. Because PPR seroprevalence would certainly be > 10% if the PPR virus was circulating in the epi-unit, the herd coming from this unit can be categorised as free of PPR.
 - **PPR-infected herds** should be selected in epi-units where PPR clinical suspicions have been confirmed by virological or serological tests in lambs or kids > 3 months and < 12 months. In these herds, the 12MO survey should be implemented just after the end of the outbreak, i.e. when no more clinical cases are observed. Importantly, this 12MO survey should be implemented together with a serological survey in a random sample of 20 animals (regardless of their clinical PPR status) selected in the same herd where the 12MO survey is done. The sample size of 20 ensures a precision < 10% when the seroprevalence rate is $\geq 80\%$. Together with the estimate of mortality rate available from the 12MO data, these seroprevalence data will enable the estimation of the basic reproduction number R_0], an epidemiological indicator of crucial importance for the implementation of PPR vaccination campaigns.

➤ **Sample size**

Within-stratum sample size depends on many different parameters: it is difficult to provide general figures applicable in any situation. However, during previous 12MO surveys in agro-pastoral farming systems in semi-arid environments, reasonably good estimates of animal productivity were achieved with sample sizes of 20 herds in each stratum, representing ca. 1,000 recorded animals for each species and stratum.

– **Survey protocol**

12MO surveys are based on farmer interviews. During the interview, the enumerators have to count all the animals present in the herd at the date of survey, and then to record all the demographic events (births, natural deaths, slaughtering, loans, purchases, etc.) that occurred over the last 12 months.

The 12MO questionnaire is composed of two sub-questionnaires called Q1 and Q2.

- The purpose of Q1 is to enumerate individually all the animals in the herd and describe their characteristics, and for each female enumerated to record data reflecting its reproductive performance over the last 12 months.
- The purpose of Q2 is to enumerate and describe all herd entries and exits over the 12 months preceding the survey. Data are recorded by annual age classes: class '0' represents exact ages from 0 to 1 year, class '1' represents exact ages > 1 to 2 years, etc.

4.4.4. Training and implementation

Enumerators can be selected with a particular focus on (but not necessarily limited to) technicians of the Veterinary Services or extension services of the Ministry of Agriculture. Several days of training are necessary for the enumerators to produce reliable results. These training sessions should encompass an appropriate balance of theoretical training and, most importantly, field training in real-life situations. A one-week training session should be sufficient in most cases.

When the 12MO survey starts, it is important that the coordinator regularly supervises the field staff and collects the questionnaires to check and analyse the data. This allows early correction of mistakes and misconceptions, and ensures the production of reliable results.

Data analysis must be done by staff with sufficient skills and training in advanced statistics (including linear, Poisson and logistic regression methods) and, ideally, in population dynamics modelling.

References

- De Koeijer A., Diekmann O. & Reijnders P. (1998). – Modelling the spread of phocine distemper virus among harbour seals. *Bull. Math. Biol.*, **60** (3), 585–596.
- Lesnoff M. (2008). – Evaluation of 12-month interval methods for estimating animal-times at risk in a traditional African livestock farming system. *Prev. Vet. Med.*, **85** (1-2), 9–16.
- Lesnoff M. (2009). – Reliability of a twelve-month retrospective survey method for estimating parturition and mortality rates in a traditional African livestock farming system. *Rev. Élev. Méd. vét. Pays Trop.*, **62** (1), 49–57.
- Lesnoff M., Lancelot R., Moulin C.-H., Messad S., Juanès X. & Sahut C. (2014). – Calculation of demographic parameters in tropical livestock herds. A discrete time approach with LASER animal-based monitoring data. Springer, the Netherlands.
- Trabucco A. & Zomer R. (2009). – Global aridity index (global-aridity) and global potential evapotranspiration (global-PET) geospatial database. CGIAR Consortium for Spatial Information.

5. FOLLOW UP OF THE POST VACCINATION EVALUTION: INVESTIGATING VACCINATION FAILURE

The PVE tool is a guide presenting the available methods to be used to assess the results of the vaccination campaigns, particularly through the evaluation of post vaccination immunity levels, the reduction of PPR outbreak incidence or the increase of productivity. The results will give an indication of whether or not the vaccination campaign has failed.

If the methods described in this Annex indicate that the vaccination campaign has not been successful, investigations to identify the source of the failure have to be undertaken.

This chapter will not detail the methods to perform that evaluation of all the vaccination chain steps. It will rather position the principles of how to go back to these steps and, after checking what happened at each CCP level (e.g. quality of the vaccines received and stored through sampling vials for laboratory analysis; other examples include: cold chain, with verification of the equipment and temperatures), how to correct the failures.

To assess where the possible failures are and how to correct them represents the monitoring dimension of the vaccination campaign.

Indeed, the PVE represents the basis, allowing further monitoring of the vaccination campaign. However, a detailed description of the monitoring methods all along the vaccination chain is outside the scope of this PVE tool guide.

A very systematic approach is to be followed with all steps of the vaccination chain being investigated to detect possible problems that could explain vaccination failure.

When a problem has been identified the cause will be assessed and corrective measures will then be proposed and implemented. If the problem is related to an incorrect or inappropriate vaccination protocol or vaccination programme, the PPR control or eradication strategy will have to be revised partially or entirely. The permanent evaluation of the results and the subsequent monitoring with any corrective measures is one of the very most important features of how a PPR control and eradication strategy must be implemented over time.

To effectively undertake monitoring of the control and eradication programme, performance indicators related to the expected results must be defined and used. These can be the reduction of disease (stage 2) or the eradication of the virus circulation (stage 3).

Along the vaccination chain the following elements will be investigated to identify possible failures and some corrective measures are also indicated:

- Vaccine quality: quality certificates to be checked, laboratory quality control to be undertaken.
- Vaccine storage: cold chain from the central store to the field level; quality of the cold chain to be checked and where necessary corrected.
- Conditions and efficacy of vaccine transport all along the vaccination chain, from the central storage to the field: any logistical issues to be resolved.
- Vaccine delivery system:
 - veterinarians, veterinary para-professionals, vaccinators, community health workers: qualification/capability of each actor in the vaccination chain. Control of the quality of the activities, training

- private/public: quality and efficacy of the partnership
 - planning of the vaccination: appropriate choice of the period of the year regarding weather conditions (temperature), flock movements and the parturition peak in pastoral system areas, availability of the farmers according to the agricultural calendar in in dry sub-humid and humid mixed crop-livestock farming systems
 - quality/reliability of the vaccination timing: advance information on the vaccinators' interventions, reliability of appointments with the owners. Appointments must be announced in good time and the planned times must be respected
 - quality of the vaccination: biosecurity measures, equipment (needles, syringes, etc.).
- Vaccine coverage:
- Small ruminant population census: knowledge of the population numbers. If necessary, a census must be carried out.
 - Response of the owners: presentation of the small ruminants to be vaccinated depends on the awareness and sensitisation of the owners. The quality of the communication campaign is crucial and it has to be assessed and adapted/strengthened accordingly (see below).
- Relations between the owners and the vaccinators have to be built and improved continuously. The owners will not bring their animals for vaccination if they do not know and trust the vaccinators. The best use of community-based actors such as the community animal health workers (CAHWs) is to be promoted as well as successful communication campaigns using all possible means, such as for example griots (persons in Africa who relate traditional stories and fables and have an important role in maintaining strong community relations) , radio, leaflets, community leaders, etc.).
- Control measures other than vaccination have to be evaluated since the effectiveness of a PPR control and eradication programme is the result of a combination of several complementary activities, some of which are listed below:
- control of movements
 - biosecurity at farm level
 - biosecurity at market level and along the market routes
 - communication on the above issues
 - surveillance for epidemiology intelligence purposes or for early detection and response to outbreaks
 - stamping out.



ANNEX

EXAMPLES OF THE IMPLEMENTATION OF *PESTE DES PETITS RUMINANTS* PVE PROTOCOLS

1. Setting the scene. Assumptions

1.1 Region of study and epidemiological unit

The epi-unit in the study region will be the village. There are a total of 2,000 villages; the name and location of each of the village is available from the Veterinary Services.

In the region there are three types of husbandry systems. The approximate distribution of villages according to the most predominant husbandry system is as follows:

- 20% Pastoral
- 30% Agro-pastoral
- 50% Agricultural.

*2,000 villages
(epi-unit)*

*Three husbandry
systems*

Five age-strata

1.2 Study population

In the study region the small ruminant population is composed of sheep and goats. The population will be stratified by age as follows:

- 0 – 3 months⁹
- 3 – 6 months¹⁰
- 6 – 12 months
- 12 – 24 months
- older than 24 months.

The proportion of sheep and goats is unknown. It is assumed that at the time of the PMV serosurvey, the age distribution in the population included in the serosurvey is as follows:

- 40% of populations will be in the age stratum of 6 – 12 months
- 50% of population will be in the age stratum older than 12 months
- 10% of population will be in the age stratum older than 24 months.

⁹ Not included in either the vaccination campaign or the serosurvey

¹⁰ Included in the vaccination campaign but not in the serosurvey

2. Protocols

2.1 Protocol 1

Assessing the immune response to vaccination, the population immunity and the trend of the population immunity over a period of time

2.1.1. Establish baseline sero-prevalence. Survey on Day 0

The vaccination campaign will target 100% of the villages in the study region (n=2,000). For the purpose of establishing a baseline level of susceptibility and according to the calculation indicated in the protocol, animals from at least 97 villages will be sampled. In each village, a maximum of nine animals from each of the three age strata (6-12 months, 12-24 months and older than 24 months) will be sampled. A total of 27 animals per village will be sampled.

*100 villages
proportionally to
husbandry system*

*A maximum of
27 animals per village*

➤ *How to select the appropriate villages*

The number of statically required villages will be rounded up to 100 to account for any non-collaboration incident during the implementation phase. The 100 selected villages will be sampled during the vaccination activities.

Step 1. Sort and number the villages according to the most common husbandry system in each village (data provided by the Veterinary Authorities). In this example:

- From 1 to 400 (20%) are pastoral
- From 401 to 1000 villages (30%) are agro-pastoral
- From 1001 to 2000 villages (50%) are agricultural

Step 2. Select a number of villages in each of the husbandry systems by simple random sampling (e.g. using a random table).

- 20 villages (20% of total village sample size) from pastoral
- 30 villages (30% of total village sample size) from agro-pastoral
- 50 villages (50% of total village sample size) from agricultural

➤ *How to select the appropriate animals in each village*

In this example one of the villages that will be sampled has 50 flocks/households. There are also more than 50 animals in each of the three age-strata eligible to be sampled (6-12 months, 12-24 months and older than 24 months).

Step 1. We will need to select at least 3 flocks/households.

- Randomly select one flock/household out of the 50
- Select the other two by selecting one flock/household every 15 flocks/households.

Step 2. In each selected flock/household randomly select three animals from each of the three eligible age strata; total of 9 animals per flock/household.

In each of the selected villages/flocks a questionnaire will be administered to gather information on the factors that could determinate the success of the vaccination campaign.

2.1.2. Serosurvey at day 30 to 90 post first vaccination and any subsequent vaccination (step 1.2 and 1.3 of Protocol 1)

The selection procedure will follow the same steps as described in section 2.1 of Protocol 1. However, note that the second serosurvey (30-90 days post first vaccination) will only require animals from the age stratum 6-12 months, whereas the third serosurvey requires all age strata to be included.

- List all the epi-units.
- Randomly select epi-units with stratification proportional to the husbandry system ¹¹.
- Randomly select a minimum of three flocks/households.
- Randomly select nine animals per flock/household.

100 villages proportionally to husbandry system

Minimum three flocks

Maximum nine animals per flock

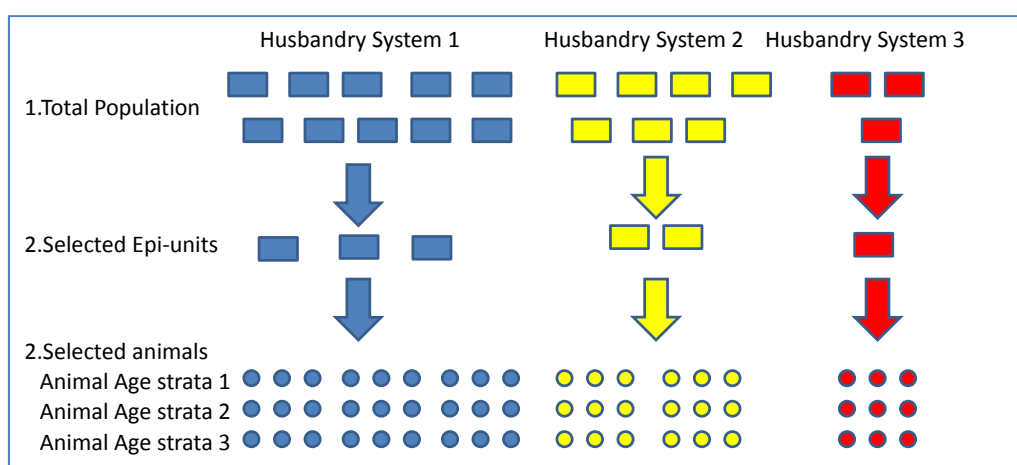


Fig. 1
Summary of the selection process

2.2 Protocol 2

Protocol 2 can be calculated using the elements presented under Protocol 1 and the information given in the main text

2.3 Protocol 3

Assessing the trend of the population immunity over time at epidemiological unit level (no differentiation among age-strata)

Two age strata will be considered: 6–12 months and older than 12 months. It will require two sampling rounds. The first one is to establish the baseline level and the subsequent serosurveys, 30-90 days after each vaccination, to estimate the population immunity trend. The number of epi-units and the number of animals to be selected are described in the main document.

¹¹ The number of villages to be sampled will be 97 (rounded up to 100 to account for any lost to follow up)

➤ ***How to select the appropriate animals in each village***

Step 1. Sort and number the villages according to the most common husbandry system in each village (data provided by the Veterinary Authorities). In this example:

- From 1 to 400 (20 %) are pastoral
- From 401 to 1000 villages (30%) are agro-pastoral
- From 1001 to 2000 villages (50%) are agricultural

Step 2. Select a number of villages in each of the husbandry systems by simple random sampling (e.g. using a random table).

- 20 villages (20% of total village sample size) from pastoral
- 30 villages (30% of total village sample size) from agro-pastoral
- 50 villages (50% of total village sample size) from agricultural

➤ ***How to select the appropriate animals in each village***

Step 1. We will need to select at least 3 flocks. Considering that in this example, in the targeted village, there are 50 flocks.

- Randomly select one flock/household
- Select the other two by selecting one flock/household every 15 flocks/households.

Step 2. In each village a maximum of nine animals will be sampled. The samples will be distributed proportionally to the age strata, if these are known. In this example:

- four samples (40% of sample size) from animals in the age stratum '6-12 months'
- five samples (60% of samples) from animals in the age stratum 'older than 12 months'.

If age strata are not known, the nine animals are selected randomly.

Annex 3.5.: Surveillance

1. Introduction

For countries that wish to engage in the GCES, the national disease control plan, which now includes *peste des petits ruminants* as one of the priority diseases, should contain a surveillance plan for this disease. The surveillance methods used will depend on the epidemiological situation of the country. However, passive surveillance is the most likely way that PPR outbreak occurrences will be detected and reported throughout all of the stages.

While an active surveillance plan also has to be included in the national control strategy, conventional methods alone might not suffice to detect PPR in small ruminant husbandry systems other than semi-intensive and intensive. Participatory surveillance methods might need to be employed particularly in extensive and pastoral husbandry systems.

National Epidemiology Units and Regional Epidemiology Networks (e.g. EpiNet in West Africa and EpiNet in South-East Asia) will play an important role in designing the national surveillance plan and in harmonising national plans at regional level. Their role in collecting, collating and interpreting data provided by surveillance field teams is crucial.

For countries that seek recognition of country or zonal freedom from PPR, or that seek to re-establish freedom following an outbreak, as well as for the maintenance of PPR free status, the OIE *Terrestrial Animal Health Code* provides guidelines for surveillance in articles 14.7.27. onwards of chapter 14.7.

2. Objectives

Depending on the epidemiological situation of a country, the objectives can be one or several amongst those listed:

- early detection of the appearance of the disease
- assessment of the health status of a population, including collection of baseline data
- definition of the priority areas for disease control and prevention activities
- provision of information to plan, prioritise and conduct research
- demonstrate the absence of PPR clinical disease or infection
- determine and monitor the prevalence, distribution and occurrence of the disease or infection.

3. Background and supporting information

In order to design and establish a PPR surveillance plan, essential information should be collected, including, but not limited to, that listed below:

- stakeholders and their respective roles (e.g. livestock owners, producer associations, exporters, marketing agents, etc.)
- TARGET (general population at risk) and study populations (e.g. livestock census data, information on animal husbandry systems)

- accessibility of study population
- vaccination history (if applicable)
- reporting systems and IT systems in place
- laboratory at national and regional levels and nearest laboratory to receive samples
- risk factors, e.g. population risk factors that might influence interpretation of surveillance data.

4. Methodology

4.1 General

Countries engaging in the prevention, control and eradication of PPR can be categorised into (i) free or (ii) infected countries or zones. Depending on the GCES Stage a country is at, the objectives for a surveillance strategy can differ.

Table I summarises the recommended surveillance category (active/passive) to be integrated into the surveillance system for each Stage of the GCES (see also Part B.1 of the GCES) and Table II suggests relevant surveillance methods under each category.

Table I
Surveillance methods recommended for different stages of the Global Control and Eradication Strategy for *peste des petits ruminants*

Stage No.	Stage title	Stage objective	Related objective of surveillance	Surveillance category	
				Active	passive
1	Assessment	Assessment of epidemiological situation (presence or absence of PPRV)	Establishment of surveillance plans/strategies to search for disease, collect baseline data and define priority areas for control	+++	+
2	Control	Implementation of a targeted control strategy	Detection of disease/virus circulation in unvaccinated and vaccinated populations	++ *	++
3	Eradication	Implementation of a nation-wide control programme and development of an eradication strategy	Increased sensitivity of the surveillance system by including specific, susceptible population sub-groups in the surveillance system	++ *	+++
4	Post-Eradication	Evidence is provided that no PPR virus (PPRV) is circulating	Prove absence of PPR virus (PPRV), with focus on risk areas for re-introduction	+ **	++++ **

+ import ++ very important +++ most important

* In vaccinated flocks, sero-surveillance is used as a post vaccination evaluation (PVE) to evaluate the vaccination programme effectiveness

** In compliance with *Terrestrial Animal Health Code* Chapter, articles 14.7.29–31

It should be noted that the use of sero-surveys for the purpose of disease surveillance should be limited to unvaccinated populations: geographical areas or farming systems at Stage 1, 2 or 3 which

are not vaccinated or, at national level at Stage 4 (no vaccination), in order to collect baseline data on prevalence and spread of the disease (Stages 1, 2 and 3) and to prove absence of virus circulation (Stage 4).

In vaccinated populations (Stages 2 and 3), sero-surveys are deployed for the purpose of post-vaccination evaluation (PVE) to detect vaccine-induced antibodies. The methods are described in Annex 3.4. In the absence of a DIVA vaccine and associated tests, methods such as clinical/syndromic surveillance or PDS need to be deployed to search for virus intrusion into vaccinated populations.

Table II
Surveillance methods applicable to different stages of the GCES

Active surveillance	Stages	Passive surveillance	Stages
Serology	1, 4		
Clinical/syndromic	1, 2, 3		
Abattoir (specific surveys)	1, 2	Abattoir (reported cases)	2, 4
Wildlife (as sentinels)	2, 3	Wildlife (reported cases)	2, 3, 4
Markets (specific surveys)	1, 2, 3	Markets (reported cases)	2, 3, 4
Border VS post inspection surveys	3, 4	Border VS post inspection reports	3, 4
Participatory disease search	1, 2, 3		
Questionnaire surveys	1, 2		
		Reporting systems from veterinary/para-vet. networks	1, 2, 3, 4

4.2 Sampling methods for sero-surveillance to support the demonstration of freedom from disease in unvaccinated populations

The provisions to declare a country or zone free from PPR according to the international standards are described in Articles 14.8.3. and 14.8.4. of the OIE *Terrestrial Animal Health Code (Terrestrial Code)*.

The standard surveillance strategies for PPR are described in Articles 14.8.27. to 14.8.33. of the *Terrestrial Code*.

4.2.1 Definitions

➤ Target population

The target population is defined as all susceptible small ruminants in a particular location at risk of PPR.

➤ Study population

The study population is defined as the population included in the surveillance programme; it can be stratified by:

- Age:
 - 0–3 months, still with maternal antibodies, unvaccinated¹
 - 3-12 months
 - older than 12 months²
- Husbandry system:
 - Pastoral: nomadic, semi-sedentary
 - Agro-pastoral: transhumant, sedentary
 - mixed crop-livestock small farming system: sedentary

➤ Epidemiological unit

The epidemiological unit will be defined on the basis that all small ruminants within the unit will have the same chance of being infected with PPRV. Depending on the husbandry system, the village or the flock will be considered the epidemiological unit.

➤ Case definition

According to Article 14.7.1. of the *Terrestrial Code* a case is defined when the presence of PPRV or specific antibodies against PPRV antigens is demonstrated in susceptible domestic small ruminants.

4.2.2. Assumptions

To prove absence of disease, the following minimum infection levels would be expected in a susceptible population:

- 5%³ of epi units will have at least one positive animal and
- 30% of animals within each epi unit will be infected with PPRV

4.2.3. Sampling strategy and sample size calculation

The sampling strategy will involve a two-stage sampling with the first stage being the epi unit and the second stage individuals animals within the selected epidemiological units.

The number of epi units that need to be randomly selected depends on the total number of epi units in the study area. Corresponding sampling size is shown in Table III.

¹ Not to be included in surveillance as protected by maternal antibodies

² Not to be included in surveillance as they could carry antibodies from previous infections or vaccinations, e.g. if bought from other areas and introduced into the flock

³ Parameters can be adjusted according to the epidemiological situation of the country

Table III**Sample size to detect at least 5% of prevalence at epi unit level with 95% confidence intervals**

Number of epi Units	Sample size
0- 25	All
26-30	26
31-40	31
41-50	35
51-70	40
71-100	45
101-200	51
201-1,200	57
>1,200	59

Once the epi units have been randomly selected, the number of animals to be randomly selected in each of the epi units depends on the total number of animals in each epi unit. The sample size required is shown in Table IV.

Table IV**Animal sample size to detect at least 30% of prevalence within each epi unit with 95% confidence intervals**

Number animals in epi unit	Sample size
1-6	All
7-10	6
11-25	7
26-55	8
>56	9

➤ Selection criteria:

- a) The epidemiological units distributed with proportional stratification according to the husbandry system.
- b) Select the epi units by simple random sampling
- c) Select household or flocks by systematic random sampling, if feasible
- d) Select animals by simple random sampling in a minimum of three households.

4.2.4. Surveillance based on risk of PPRv introduction or spread

Provided the country has information on risk factors for disease introduction, such as in unvaccinated areas bordering an infected country or in areas with a lot of animal movements, or livestock markets, the sensitivity of the surveillance to detect the disease could be increased by using structured non-random surveillance targeting those epi units with a higher risk of being infected (larger flocks, high number of flock movements, common grazing, etc.). The sample size required will be the same as described in 4.2.3.

4.2.5. Interpretation of results

One animal that shows a positive result in the serological test indicates the possibility of the virus being present. This finding needs to be followed up by further epidemiological investigations to rule out the presence of infection.

5. Implementation of surveillance

Once the surveillance plan is developed, surveillance teams from the public services with their private partners (owners, private veterinarians and veterinary para-professionals) need to be set up and the logistics (e.g. transport, maps, equipment) organised. A dedicated budget for the surveillance activities needs to be provided. The reporting system (e.g. using mobile phones or conventional, paper based methods) needs to be tested prior to application in the field.

Personnel on the surveillance teams need to be trained before embarking on their activities and training must be regularly updated.

Livestock owners need to be made aware of the purpose and objectives of surveillance and the benefits that they will derive from it; hence, awareness campaigns should precede surveillance activities.

Annex 3.6: **OIE Standards related to peste des petits ruminants (PPR)**

The World Organisation for Animal Health's (OIE) standards specific to peste des petits ruminants (PPR) are contained in the current Chapter 14.7. of the OIE *Terrestrial Animal Health Code* (the *Terrestrial Code*) and Chapter 2.7.11. of the OIE *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* (the *Terrestrial Manual*).

Peste des petits ruminants is a disease for which countries can apply to the OIE for official recognition of their PPR free status and for endorsement of their national PPR control programmes.

A. Standards of the OIE *Terrestrial Animal Health Code*

1. Standards specific to PPR

The OIE standards regarding PPR can be found in the OIE *Terrestrial Code*:

- Volume II. Recommendations applicable to OIE Listed diseases and other diseases of importance to international trade
- Section Caprinae
- Chapter 14.7. Infection with peste des petits ruminants virus.

This chapter 14.7 contains 34 articles including five articles on country status, 19 articles on recommendations for importing commodities, one article on inactivation of the virus, seven articles on surveillance and one article on endorsement of national official control programmes:

- Article 14.7.1. General provisions
- Article 14.7.2. Safe commodities
- Article 14.7.3. PPR free country or zone
- Article 14.7.4. PPR free compartment
- Article 14.7.5. PPR virus (PPRV) infected country or zone
- Article 14.7.6. Establishment of a containment zone within a PPR free country or zone
- Article 14.7.8. Recommendations for importation from PPR free countries or zones
- Article 14.7.9. Recommendations for importation from PPR free countries or zones
- Article 14.7.10. Recommendations for importation from countries or zones considered infected with PPRV
- Article 14.7.11. Recommendations for importation from countries or zones considered infected with PPRV
- Article 14.7.12. Recommendations for importation from PPR free countries or zones
- Article 14.7.13. Recommendations for importation from countries or zones considered infected with PPRV
- Article 14.7.14. Recommendations for importation from PPR free countries or zones
- Article 14.7.15. Recommendations for importation from countries or zones considered infected with PPRV
- Article 14.7.16. Recommendations for importation from countries or zones
- Article 14.7.17. Recommendations for importation of fresh meat and meat products from sheep and goats
- Article 14.7.18. Recommendations for importation from PPR free countries or zones
- Article 14.7.19. Recommendations for importation from countries or zones considered infected with PPRV

- Article 14.7.20. Recommendations for importation from countries or zones considered infected with PPRV
- Article 14.7.21. Recommendations for importation from PPR free countries or zones
- Article 14.7.22. Recommendations for importation from countries or zones considered infected with PPRV
- Article 14.7.23. Recommendations for importation from countries or zones considered infected with PPRV
- Article 14.7.24. Recommendations for importation from countries or zones considered infected with PPRV
- Article 14.7.25. Recommendations for importation from countries or zones considered infected with PPRV
- Article 14.7.26. Procedures for the inactivation of the PPRV in casings of sheep
- Article 14.7.27. Introduction to surveillance
- Article 14.7.28. General conditions and methods for surveillance
- Article 14.7.29. Surveillance strategies
- Article 14.7.30. Surveillance in wildlife
- Article 14.7.31. Additional surveillance requirements for Member Countries applying for OIE recognition of PPR free status
- Article 14.7.32. Additional surveillance requirements for recovery of free status
- Article 14.7.33. The use and interpretation of serological tests for serosurveillance of PPR
- Article 14.7.34. OIE endorsed official control programme for PPR.

2. Generic standards applicable to all diseases (horizontal standards)

Several chapters of the OIE *Terrestrial Code* are related to several infectious diseases such as:

- **Section Animal disease diagnosis, surveillance and notification**
 - Chapter 1.1. Notification of diseases and epidemiological information
 - Chapter 1.2. Criteria for the inclusion of diseases, infections and infestations on the OIE List
 - Chapter 1.3. Prescribed and alternative diagnostic tests for OIE listed diseases
 - Chapter 1.4. Animal health surveillance
 - Chapter 1.6. Procedures for self-declaration and for official recognition by the OIE.
- **Section Risk Analysis**
 - Chapter 2.1. Import risk analysis.
- **Section Quality of Veterinary Services**
 - Chapter 3.1. Veterinary Services
 - Chapter 3.2. Evaluation of Veterinary Services
 - Chapter 3.3. Communication
 - Chapter 3.4. Veterinary legislation.
- **Section General recommendations: disease prevention and control**
 - Chapter 4.1. General principles on identification and traceability of live animals
 - Chapter 4.2. Design and implementation of identification systems to achieve animal traceability
 - Chapter 4.3. Zoning and compartmentalisation
 - Chapter 4.4. Application of compartmentalisation
 - Chapter 4.12. Disposal of dead animals
 - Chapter 4.13. General recommendations on disinfection and disinsection.
- **Section Trade measures, import export procedures and veterinary certification**
 - Chapter 5.1. General obligations related to certification.
 - Chapter 5.2. Certification procedures

- Chapter 5.4. Animal health measures applicable before and at departure
- Chapter 5.5. Animal health measures applicable during transit from the place of departure in the exporting country to the place of arrival in the importing country
- Chapter 5.6. Border posts and quarantine stations in the importing country
- Chapter 5.7. Animal health measures applicable on arrival
- Chapter 5.8. International transfer and laboratory containment of animal pathogens
- Chapter 5.10. Model veterinary certificates for international trade in live animals, hatching eggs and products of animal origin.

B. *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* (*Terrestrial Manual*)

1. Standards specific to Peste des petits ruminants

The OIE standards regarding PPR diagnostic tests and vaccines can be found in Vol 2. Part 2. (OIE Listed Diseases and Other Diseases of Importance to International Trade), Chapter 2.7.11 of the *Terrestrial Manual* (Version adopted by the World Assembly of Delegates of the OIE in May 2013).

The content of this Chapter is the following:

A. Introduction

B. Diagnostic techniques

1. Collection of samples
2. Identification of the agent
3. Serological tests

C. Requirements for vaccines

1. Background
2. Outline of production and minimum requirements for conventional vaccines
3. Vaccines based on biotechnology

References

2. Generic standards applicable to all diseases (horizontal standards)

Several chapters in Vol. 1 of the OIE *Terrestrial Manual* are related to several infectious diseases such as:

- **Introduction** including list of tests for international trade
- **Part 1 on General standards:**
 - Chapters 1.1.1. and 1.1.2: Collection, submission, storage and transport of diagnostic specimens
 - Chapters 1.1.3 and 1.1.4.: Biosafety , biosecurity and bio risk and quality management in the veterinary diagnostic microbiology laboratory and animal facilities
 - Chapter 1.1.5: Principles and methods of validation of diagnostic assays for infectious diseases
 - Chapters 1.1.6 to 1.1.10: Principles of veterinary vaccine production (including diagnostic biologicals), minimum requirements, tests for sterility, quality control, quality standards for vaccine banks.

Annex 4 **Research**

Research needs for *peste des petits ruminants* (PPR) control¹

The tools that were key elements in the global control and eradication of rinderpest were:

1. a common highly efficacious vaccine and
2. specific diagnostic tests that were easy to implement.

While such tools already exist for the effective control of *peste des petits ruminants* (PPR), further research is needed in specific areas to make this control and the disease eradication programme more efficient by facilitating the campaign and speeding up the course of the programme. Research is needed not only to improve the vaccine and diagnostic tools but also to improve our knowledge of PPR epidemiology so that this can be taken into account in the control programme plans and disease legislation. Assessment of the socio-economic impact of PPR will help with refining control strategies to adapt them to regional and production system conditions.

1. Research needs for *peste des petits ruminants* vaccines

The currently available vaccines are live attenuated forms of PPR virus (PPRV). These vaccines are highly effective, providing long-lasting protection. There is only one serotype of PPRV, and any vaccine strain appears able to protect against any naturally occurring strain of the virus. One of the major limitations of the vaccines currently available on the market is their limited thermotolerance. However, this issue has now been addressed by many laboratories and the technologies that have been developed to improve PPR vaccine thermotolerance now have to be transferred to vaccine manufacturers (review in Diallo *et al.*, 2007). The second drawback of the PPR vaccines currently in use is that they do not enable the differentiation between infected and vaccinated animals (DIVA) (Diallo A., 2003; review in Diallo *et al.*, 2007). A DIVA vaccine would be useful at stages of the campaign where disease surveillance is being implemented at the same time as vaccination. Research is required and is currently being done to develop and validate such a vaccine. For example, adenovirus or capripox vectored vaccines expressing one or both surface glycoproteins of the virus have been shown to protect small ruminants against PPRV challenge, and provide a DIVA capability (review in Diallo *et al.*, 2007; Herbert *et al.* 2014). The duration of protection for this type of vaccine has yet to be determined. Since there is no guarantee that such vectored vaccines will ultimately be successful, in particular in the presence of pre-immunity against the vector in the case of capripox, it is important to continue research to explore other options for a DIVA vaccine and associated tests, particularly the development of marked (genetically modified) versions of PPRV. The technology to produce genetically modified vaccines is now established (Hu *et al.* 2012). Modified versions of the attenuated PPRV should be developed in two ways: expression of a highly immunogenic foreign protein/peptide for detection of vaccinated animals (positive marker) and deletion from the PPRV genome of a gene corresponding to an immunodominant region of a PPRV native protein, the negative marker, to enable the differentiation between animals infected with

¹ This annex has been prepared by Adama Diallo with contributions from Renaud Lancelot (CIRAD, France), Tabitha Kimani (FAO Kenya) and Nicoline DeHann (Consultative Group of International Agriculture Research (CGIAR), Sri Lanka)

normal virus (presence of antibodies against the protein not expressed by the vaccine) and the vaccinated animals (no antibodies against this negative marker).

The major cost of vaccination programmes is that of vaccine delivery. Significant benefit/cost improvements will be achieved by simultaneous vaccination against several small ruminant diseases. This issue can be addressed either by recombinant vaccines such as capripox/PPR recombinant vaccines (Diallo *et al.*, 2007) or by combined vaccination against PPR and sheep/goat pox, which has already been shown to be effective (Martrenchar *et al.*, 1997; Hosamani *et al.* 2006). For a combined vaccination strategy, further research is needed to determine the safety and efficacy of different combinations of vaccines.

2. Research needs for diagnostic tests

Since the beginning of 1990, considerable progress has been made in the development of tests for PPR diagnosis (Forsyth and Barrett, 1995; Libeau *et al.*, 1994; 1995; Singh *et al.*, 2004a; 2004b; Couacy *et al.*, 2002). Although these tests are effective, there is a need for research so that the test can be constant improved and adapted to contend with any new situations that may arise along the pathway to PPR eradication.

As indicated earlier, a research area to be encouraged and even to be started at the first stage of the PPR eradication programme is to assess the potential role of animal species other than domestic sheep and goats in the epidemiology of PPR. To this end, the tests currently available for the serodiagnosis of PPR will have to be validated in serum samples of those animal species, camels for example, or group of species (wildlife).

There is also a need to develop improved, low-cost diagnostics, and in particular simple tests for the virus that can be applied in the field or in a low technology situation, such as predominates in countries where PPR is endemic (Baron *et al.* 2014). In addition, a multi-disease diagnostic test would be very useful, given that it is planned in the PPR control strategy to encourage vaccination against other small ruminant diseases along with PPR; it will therefore be useful to develop and make available tests for the simultaneous surveillance of PPR and other small ruminant diseases. A multi-disease diagnostic test will also be needed during the final stages of the eradication programme when all PPR-like disease symptoms will have to be investigated to confirm or not the absence of PPR and to give correct diagnostic results to the animal holders.

PPRV belongs to the morbillivirus group, which includes measles and canine distemper viruses. Their genome is composed of a single RNA molecule. One of the characteristics of RNA viruses is their rate of mutation with the appearance of variants. This potential event has to be taken into consideration for research to develop appropriate tests.

3. Research needs in the socio-economic impacts of *peste des petits ruminants*

In view of its high morbidity and mortality rates that can reach up to 80%, considerable attention is being focused on this disease as a major constraint to the production of sheep and goats, animal species that play an important role in wealth accumulation for poor livestock keepers in Africa, Asia and the Middle East.

Despite this increasing attention on PPR, much has yet to be done to fully understand the impact of this disease on livelihoods of small ruminant keepers and national economies across the world, Research is therefore needed:

- (i) to better assess the role and importance of goats and sheep within agriculture;
- (ii) to understand the multiple uses and services they provide and the role they play in different farming systems.

This will help to gain a thorough understanding through the application of socio-economic approaches to assess more accurately the impact of PPR on sheep and goat production and to adapt the control strategies accordingly. For PPR, there are a number of research gaps in this field which will need to be addressed to successfully deal with the disease.

The main economic and social issues surrounding PPR control include:

- a) justification for control through impact studies;
- b) identification of best-bet strategies that are economically sound and appropriate for the prevailing farming systems and socio-economic status of the infected countries;
- c) approaches that mainstream PPR control into holistic small ruminant health and development programmes;
- d) understanding the small ruminant value chains, including people, decisions and flow of incentives;
- e) raising the profile of small ruminants and their associated livelihoods in decision-making tables to sustain the interest in PPR control in both governments and livestock keepers; and
- f) funding strategies, cost-recovery and efficient vaccine delivery systems.

At the moment, PPR impacts are not well understood as information has only just begun to emerge from countries, and the results are often not comparable because different analytical approaches and tools have been used. To improve information on PPR socio-economics, there is need for researchers to develop appropriate analytical tools/models, manuals, and frameworks to guide socio-economic studies in different farming systems and those that can allow comparison of information between countries or regions. The frameworks should facilitate generation of evidence on all the socio-economic issues mentioned above. At the moment, most analytical tools for animal diseases do not focus enough on small ruminant systems and in particular the non-commercially orientated extensive and smallholder systems.

More research also needs to be done to understand the action and entry points, the incentives and disincentives associated with small ruminant production. The products and services offered by the small ruminants kept in these systems include tangible and intangible ones. Depending on the role of small ruminants in the livelihood dimensions of food sources, household income and assets accumulation, the intangible services such as insurance, pasture improvement, and socio-cultural roles can carry a higher importance to the livestock keepers compared to tangible benefits that can be assigned a monetary value. Developing analytical approaches to estimating and comparing all products and services will help to highlight the true worth of small ruminants. At present, such frameworks are lacking. In their absence, there is diverse information on impacts that cannot be compared across systems and countries,

with the result that appropriate action plans cannot be developed and appropriate responsibilities and accountability cannot be attributed. This socio-economic study will have to take into consideration information gained from a thorough participatory disease search (PDS), which will provide an estimate of PPR annual clinical incidence in the target small ruminant population at the national level, either at the initial stage of the eradication strategy, or during its implementation, up to the eradication stage.

4. Research needs in epidemiology

Peste des petits ruminants is primarily a disease of domestic sheep and goats. However, there are indications that PPRV might cause disease in other animal species, small ruminant wildlife and camels (Khalafalla *et al.*, 2010; Bao *et al.*, 2011; Hoffman *et al.*, 2012). Such cases are certainly the result of PPR spill-over from infected domestic sheep and goats and are unlikely to have a substantial impact on the disease control programme. In the case of rinderpest, it is well known that many ruminant species are susceptible to rinderpest virus. But only buffaloes and cattle, the most susceptible animal species to this virus, were considered in the vaccination campaigns for rinderpest eradication and this strategy led to the success of the programme. While it can be anticipated that the situation could be similar with PPR, a study will have to be conducted to assess the precise role of wildlife and camels in the epidemiology of PPR. Other areas that warrant further studies for better clarification of the epidemiology of PPR and to be taken into consideration for tailoring the eradication programme are:

1. The modelling of PPRV transmission based on virus excretion duration from an infected animal and survival of virus particles in excretions;
2. Small ruminant population dynamics (Lesnoff *et al.*, 2000), multiple hosts and transmission routes (direct, indirect), and spatial heterogeneity (meta-population spread models);
3. Assessment of PPRV genetic variability and its changes in space and time, through monitoring of circulating PPR viruses (outbreak investigations). This assessment is of special importance in vaccinated areas to quickly detect potential PPRV mutants and eventually develop appropriate tests.

References

- Bao J., Wang Z., Li L., Wu X., Sang P., Wu G., Ding G., Suo L., Liu C., Wang J., Zhao W., Li J. & L. Qi (2011). – Detection and genetic characterization of peste des petits ruminants virus in free-living bharals (*Pseudois nayaur*) in Tibet, China. *Res. Vet. Sci.*, **90**, 238–240.
- Baron J., Fishbourne E., Couacy-Hyman E., Abubakar M., Jones B.A., Frost L., Herbert R., Chibssa T.R., Van't Klooster G., Afzal M., Ayebazibwe C., Toye P., Bashiruddin J. & Baron M.D. (2014). – Development and Testing of a Field Diagnostic Assay for Peste des petits ruminants Virus. *Transboundary Emerging Dis*, **61**, 390-396.
- Diallo A. (2003). – Control of Peste des Petits ruminants: Classical and new generation Vaccines. *Dev. Biol. Basel*, **114**, 113-119.
- Diallo A., Minet C., Le Goff C., Berhe G., Albina E., Libeau G. & Barrett T. (2007). – The Threat of Peste des Petits Ruminants: Progress in Vaccine Development for Disease Control. *Vaccine*, **25**, 5591-5597.

- Forsyth M.A. & Barrett T. (1995). – Evaluation of polymerase chain reaction for the detection and characterisation of rinderpest and peste des petits ruminants viruses for epidemiological studies. *Virus Res.*, **39**, 151-163.
- Herbert R., Baron J., Batten C., Baron M. & Taylor G. (2014). – Recombinant adenovirus expressing the haemagglutinin of peste des petits ruminants virus (PPRV) protects goats against challenge with pathogenic virus; a DIVA vaccine for PPR. *Veterinary Research*, **45**, 24.
- Hoffmann B., Wiesner H., Maltzan J., Mustefa R., Eschbaumer M., Arif F.A. & Beer M. (2012). – Fatalities in wild goats in Kurdistan associated with peste des petits ruminants virus. *Transboundary Emerging Dis.*, **59**, 173–176.
- Hosamani M., Singh S.K., Mondal B., Sen A., Bhanuprakash V., Bandyopadhyay S.K., Yadav M.P. & Singh R.K. (2006). – A bivalent vaccine against goat pox and Peste des petits ruminants induces protective immune response in goats. *Vaccine*, **24**, 6058-6064.
- Hu Q., Chen W., Huang K., Baron M.D. & Bu Z. (2012). – Rescue of recombinant Peste des petits ruminants virus: creation of a GFP-expressing virus and application in rapid virus neutralization test. *Veterinary Research*, **43**, 48.
- Khalafalla A.I., Saeed I.K., Ali Y.H., Abdurrahman M.B., Kwiatek O., Libeau G., Abu Obeida I. & Abbas Z. (2010). – An outbreak of peste des petits ruminants (PPR) in camels in the Sudan. *Acta Trop.*, **116**, 161–165.
- Lesnoff M., Lancelot R., Tillard E. & Dohoo I.R. (2000). – A steady-state approach of benefit-cost analysis with a periodic Leslie-matrix model: presentation and application to the evaluation of a sheep-diseases preventive scheme in Kolda, Senegal. *Prev. Vet. Med.*, **46**, 113–128.
- Libeau G., Diallo A., Colas F. & Guerre L. (1994). – Rapid differential diagnosis of rinderpest and peste des petits ruminants using immunocapture ELISA. *Vet. Rec.*, **134**, 300-304.
- Libeau G., Prehaud C., Lancelot R., Colas F., Guerre L., Bishop D.H. & Diallo A. (1995). – Development of a competitive ELISA for detecting antibodies to the peste des petits ruminants virus using a recombinant nucleoprotein. *Res. Vet. Sci.*, **58**, 50-55.
- Martrenchar A., Zoyem N. & Diallo A. (1997). – Study of a mixed vaccine against peste des petits ruminants and capripox infection in Northern Cameroon. *Small ruminant Research*, **26**, 39-44.
- Singh R.P., Sreenivasa B.P., Dhar P., Shah L.C. & Bandyopadhyay S.K. (2004a). – Development of Monoclonal antibody based competitive-ELISA for detection and titration of antibodies to peste des petits ruminants virus. *Vet. Microbiol.*, **98**, 3-15.
- Singh R.P., Sreenivasa B.P., Dhar P. & Bandyopadhyay S.K. (2004b). – A sandwich-ELISA for the diagnosis of Peste des petits ruminants (PPR) infection in small ruminants using anti-nucleocapsid protein monoclonal antibody. *Arch. Virol.*, **149**, 2155-2170.

Annex5

Costing of the PPR Global Control and Eradication Strategy

Project supported and directed by OIE/FAO

Cost estimate of the Global FAO/OIE Strategy for the Control of *Peste des petits ruminants* (PPR)

By

Jonathan Rushton

Nick Lyons, Joao Afonso & Alana Boulton

Final Report

19 February 2015

Jonathan Rushton
72 Bradmore Green, Hatfield,
Hertfordshire, AL9 7QT
United Kingdom

Summary

It is estimated that 330 million poor people keep livestock across Africa, the Middle East and Asia and that sheep and goats play an important role in the livelihoods and food security of poor families. They are important to the people who manage and own the animals in terms of the provision of quality and nutritious food – milk, dairy products and meat – and fibre and wool in some systems, as a way to generate cash for expenditures on school fees and other foods and as a store of wealth. In addition these animals have a role in returning nutrients to the soil through the production of manure to cropping system.

Peste des petits ruminants (PPR) can have dramatic impacts not simply on the families who manage and produce sheep and goats, but also along well defined and complex value chains these production systems supply. The development of sheep and goat production and value chains requires stability and therefore the removal of transboundary diseases such as PPR should be a priority to decision makers interested in make food value chains less risky for the people involved and the consumers they supply. Measures such as the control and eradication of PPR will improve not only the income from small ruminant systems, it will also reduce costs leading to improved profitability and productivity. This in turn will allow the small ruminant economy to contribute effectively to economic development.

The estimated maximum undiscounted costs for a fifteen year global PPR strategy is between US\$7.6 and US\$ 9.1 billion with the first five years costing between US\$ 2.5 and 3.1 billion. The lower range is 16.5% less and would be expected as a consequence of a rapid decrease in PPR incidence in countries employing an effective vaccination strategy. In all scenarios tested there are significant vaccination campaigns that could well be reduced with strong targeting of at risk populations through carefully epidemiological and economic analysis. These costs have also given a realistic figure on vaccine dose costs and an amount to cover the delivery costs in different scenarios.

It is important to note that the cost of the component 2 of the strategy (strengthening Veterinary Services) and of the component 3 (combining with other diseases) have not been included in this evaluation. The support to Veterinary Services is the object of specific investments after countries have evaluated their needs particularly through the use of the PVS Gap Analysis tool. The cost of combating other diseases in combination with PPR control and eradication activities is extremely difficult to estimate since the list of priority diseases to be addressed will be defined after discussions to be held during regional and national workshops and subsequent definition of specific control strategies against other diseases. But the investments in supporting activities against PPR will have benefits on the Veterinary Services activities (e.g. surveillance systems) and finally to animal health improvement in all targeted countries.

These costs need to be placed into the perspective of the numbers of animals that are being protected by the measures proposed – nearly a billion sheep and a billion goats. A rough estimate of the average cost per shoaat year would mean an investment of between US\$ 0.27 and 0.32. In contrast to an assessment of the annual global impact of the disease these costs are small. It has been estimated that annual losses of production and the death of animals due to PPR are between US\$1.2 to 1.7 billion. There is also an estimated expenditure of between US\$270 to 380 million on PPR vaccination. Therefore the current annual impact alone PPR causes between US\$1.45 to 2.1 billion per year, and with a successful eradication programme this impact would be reduced to zero. It is important to recognise that without the strategy anything between US\$ 4.0 and 5.5 billion would be spent over a 15-year

period on poorly targeted vaccination campaigns that is unlikely to lead to eradication. In summary the global spending on control will cost between US0.14 to 0.20 per sheep or goat year, which is far less economically profitable than a coordinated eradication programme.

Given the importance of PPR and the availability of known technologies it is strongly recommended that a Global Strategy for Control of PPR is funded and initiated. The final cost is likely to be different from the cost estimates in this report, but they serve to demonstrate that the successful control and ultimate eradication of this disease would be economically profitable and that it will benefit the lives of many people around the world.

Table of contents

Executive Summary.....	2
Table of contents	4
Acknowledgements.....	5
Introduction	6
Background	7
The progressive phased approach for <i>peste des petits ruminants</i>	7
Characteristics of countries by <i>peste des petits ruminants</i> status level	8
Laboratory and epidemiology network	11
Economics of Controlling Livestock Diseases	12
Costing the Global PPR Strategy – 2015-2030	13
Global and regional level costs	14
Key national level assumptions.....	14
Animal population.....	14
Ex-ante assessment.....	15
Vaccination cost	15
Surveillance	15
Outbreak investigation	15
Components of the actions at the national level.....	16
Ex-ante assessment.....	16
Vaccination.....	16
Active surveillance through serological surveys	16
Active surveillance through disease search	16
Outbreaks investigations related to passive surveillance.....	16
Overall implementation of the components in the four stages of PPR management	16
Overall costs of the PPR programme 2015-30.....	18
Global and regional coordination costs	19
National level costs	19
Conclusions and recommendations	24
Annex 1. Costs of the <i>peste des petits ruminants</i> Global Strategy at regional and global levels.....	26
Costs at the global level	26
Personnel	26
Support missions to regions and countries.....	26
GF TADs global coordination.....	26
Global laboratory network and epidemiology.....	26
International conference	26

Costs at the regional level.....	27
Personnel	27
Expert support missions.....	27
Regional coordination.....	27
Regional laboratory network	27
Regional epidemiology network	27
Quality control centres for vaccine testing (Asia, Africa, Eurasia).....	27
Database for epidemiology and laboratory	27

Acknowledgements

The authors want to thank the PPR teams in OIE/FAO in particular the support and guidance of Joseph Domenech, the contribution of Renaud Lancelot (CIRAD, France) with regard to the evaluation of the small ruminant populations in each country according to the farming systems and the careful revision of the document by Juan Lubroth and Eran Raizman. Contributions have also been made by Felix Njeumi and Subhash Morzaria.

Introduction

Peste des petits ruminants (PPR) is an acute, highly contagious disease of sheep and goats caused by PPR virus, a member of genus *morbillivirus* of family *Paramyxoviridae*. PPR is primarily a disease of sheep and goats although cattle, camels, buffaloes and some wild ruminant species can also be infected, indicating the spillover of PPR virus from domestic sheep and goats. Goats are affected severely but sheep often undergo a mild form of the disease

Morbidity and mortality risks in small ruminants vary but can be as high as 100 and 90%, respectively, these risks are usually lower in endemic areas and mortality can be as low as 20% maintained in the new-borns unless complicated with other concurrent infections. In arid and semi-arid zones, where the endemic form persists, PPRV acts as a predisposing factor for secondary bacterial infections.

Given the importance of PPR a Global Strategy for Control and Eradication of PPR over a fifteen year period has been developed by the Food and Agriculture Organization (FAO) and the World Organisation for Animal Health (OIE) as part of the Global Framework for the Progressive Control of Transboundary Animal Diseases (GF-TADs).

The objective of the paper is to prepare a cost estimate of the global PPR strategy at the country, regional and global level covering the entire fifteen year strategy being the target for achieving global freedom of disease.

It is important to note that the cost of the component 2 of the strategy (strengthening Veterinary Services) and of the component 3 (combining with other diseases) has not been included in this evaluation. The support to Veterinary Services is the object of specific investments after countries have evaluated their needs particularly through the use of the PVS Gap Analysis tool. The cost of combating other diseases in combination with PPR control and eradication activities is extremely difficult to estimate since the list of priority diseases to be addressed will be defined after discussions to be held during regional and national workshops and subsequent definition of specific control strategies against other diseases. But the investments supporting activities against PPR will have benefits on the Veterinary Services activities (e.g. surveillance systems) and finally to animal health improvement in all targeted countries.

The paper heavily relies on the discussions with and the data provided by experts whom we consulted during the period November 2014 through January 2014. At this initial step of evaluation, the paper is subject to two major limitations. First, as cost information at the individual country level is not available, the estimate should not be viewed as any country's 'budget'. Second, as the global strategy builds on on-going PPR control programmes, the economic theory suggests that we need to investigate how 'incremental' (or 'additional' or 'marginal') investment would bring extra benefits. However, as the information to calculate incremental costs is not readily available in practice at the country level, the paper will report 'total' costs as a first step. This exercise should be seen as a preliminary stage, allowing re-examination of costs with budget refinements, and in line with reassessments of the areas with the highest benefit-cost ratios.

Following this introduction, Section II presents briefly the background of this study, including the nature of the progressive phased approach of the strategy composed of four stages, the characteristics of countries by stage and the tools and mechanisms to be used at national, regional and global levels such as laboratory and epidemiology networks. Section III turns to Tisdell's (2006) model to illustrate the costs and benefits of animal disease control programmes, especially when countries face initial fixed

costs in starting a programme. Section IV presents data, methodology and our initial cost estimates of the global strategy at national, regional and global levels. Section V presents conclusions. We also document the spreadsheets used to calculate the costs of the global strategy. The spreadsheets are designed to be flexible so that one can easily change assumptions and data as new information becomes available and alternative approaches are investigated.

Background

The progressive phased approach for *peste des petits ruminants*

The control of PPR will be assisted through a process of identifying the status of different countries in their understanding and their actions to manage the disease. Each country will also be encouraged to progressively improve its status over a 15-year period with the intention that by the end of the period all countries will be able to report freedom of PPR.

At the beginning of the strategy (2015), there are 3 countries at Stage 0, 30 at Stage 1, 29 at Stage 2 and 11 countries at Stage 3.

In 2015, 66 countries are infected or suspected to be infected, including countries at Stage 0 which are supposed to be infected and part of the countries still not officially recognised free by the OIE (assuming that part of the countries considered to be at this Stage 3 in 2015 are already free).

Regarding vaccination, some free countries can decide to vaccinate areas bordering contaminated areas/countries. It will have to be done on a country basis.

Finally more than 70 countries are expected to receive vaccination at some point during the global eradication campaign.

Taking into consideration the fact that only a percentage of the countries at Stage 2 and 3 will be vaccinating and not all of the small ruminant population will need to be included, and for the purpose of calculating the costs the following principles are proposed. But this amount is more a maximum of the cost than an average. The cost could actually be less according to the evolution of the national or regional situations. A quick decrease of the PPR incidence as assessed by monitoring and evaluation investigations will allow updating the control and eradication strategies.

- Countries at **Stage 2**: 50% of the adult populations to be targeted for vaccination in year 1 and again in year 2. Either one or two annual campaigns will take place in mixed crop/livestock zones compared with one in pastoral and agro pastoral zones
 - And then followed by the vaccination of new born animals (estimated as 40% of the total population) for two more years targeting 100% coverage
- Countries at **Stage 3**: The vaccination strategy among adults will depend on the success of Stage 2 as effectiveness gauged through post-vaccination evaluation (PVE) surveys. Where PPR absence has been demonstrated in the vaccinated zones, the other 50% of non-vaccinated adults during Stage 2 would be vaccinated during two following successive years with the same protocols as described above (i.e. 50% coverage each year). Where PPR absence has not been demonstrated in vaccinated areas, 100% adult coverage will be targeted. Therefore for the purposes of the model a 75% target coverage will be used in Stage 3 to account for this

difference. The adult campaign will be followed by targeting 100% coverage of young stock for two successive years irrespective of the PVE results.

- When a country wants to go directly from Stage 1 to 3 without going through the Stage 2, 100% of the populations should be vaccinated during two successive years (same protocols than above: one or two annual campaigns according to the production systems (pastoral-agropastoral or humid agriculture systems) and one or more vaccinations of new born animals as appropriate, according to the results of PVE surveys.

It is acknowledged that the vaccination levels required in Stages 2 and 3 will vary according to the outcomes of Stage 1 (results of the epidemiology investigations) and 2 (results of the vaccination) and the estimates given may be an overestimate of the actual costs of vaccination for effective control. Therefore to account for a range in scenarios, high, medium and low cost strategies are presented reflecting different levels of vaccination required in Stage 2 and 3.

The principles described above represent the hypothesis which has been retained for an optimal global control and eradication strategy.

Considering that the majority of the global cost of the strategy comes from vaccination, any change in the percentage of small ruminant to be vaccinated will have an important impact on the global cost.

But according to the results of the PPR situation evaluation as assessed in Stage 1 and of the vaccination campaigns as assessed through monitoring and evaluation surveys in Stages 2 and 3 different percentages of the population to be vaccinated could be considered:

- Stage 2: the range of targeted vaccination percentage could be from 20 to 50% of the total population
- Subsequently at Stage 3 the vaccination of the population not being vaccinated in Stage 2 will vary according to the results of Stage 2 vaccinations and according to the evolution of the epidemiological situation in the country. The range of the vaccination percentages can be calculated with various scenarios and they can go from 20 to 75 (the percentage being used in the calculation exercise)

Different cost estimates could be given related to assumptions on the outbreak investigations (lower estimates do not include a background level of outbreak investigation across all stages), to different active surveillance strategies (lower estimates have more intensive sampling after the vaccination campaign has finished whilst the more expensive strategy has less intensive sampling but in every stage of control). Assumptions on the frequency of vaccination could also be mentioned, to be applied to specific situations (lower estimates with single annual vaccination for the mixed systems instead of two).

Characteristics of countries by *peste des petits ruminants* status level

There is substantial variation in economic structure and income level across different PPR control stages in the infected regions with 3 countries in Stage 0, 30 countries in Stage 1, 29 in Stage 2 and 11 in Stage 3 (Fig. 1).

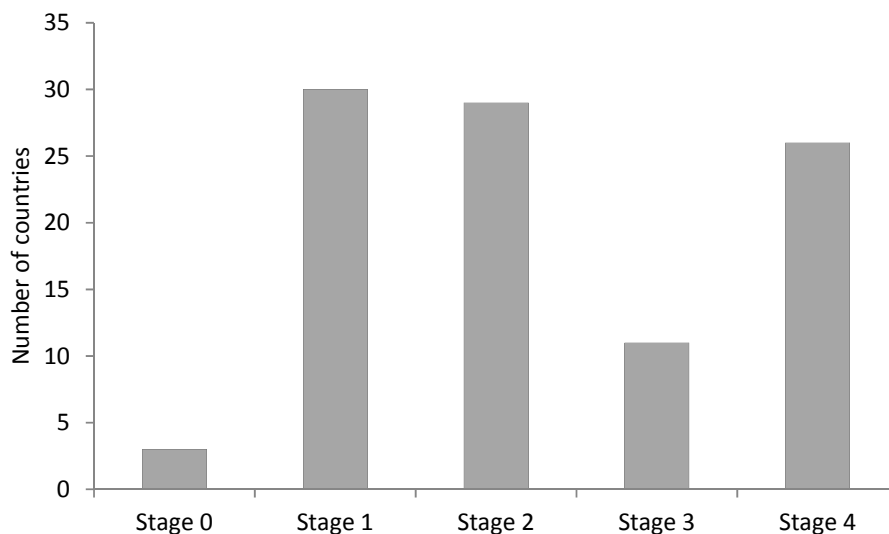


Fig. 1
Number of countries by stage of PPR control in 2015

Figure 2 shows the average proportion of agricultural value added in Gross Domestic Product (GDP) by stage countries. Countries in Stages 0, 1 and 2 are the economies whose incomes depend most on agriculture, with their median agricultural value added representing 14, 19 and 22% of GDP respectively. In contrast, PPR-free countries are those who rely the least on agriculture, with their income from agriculture representing 10% of GDP.

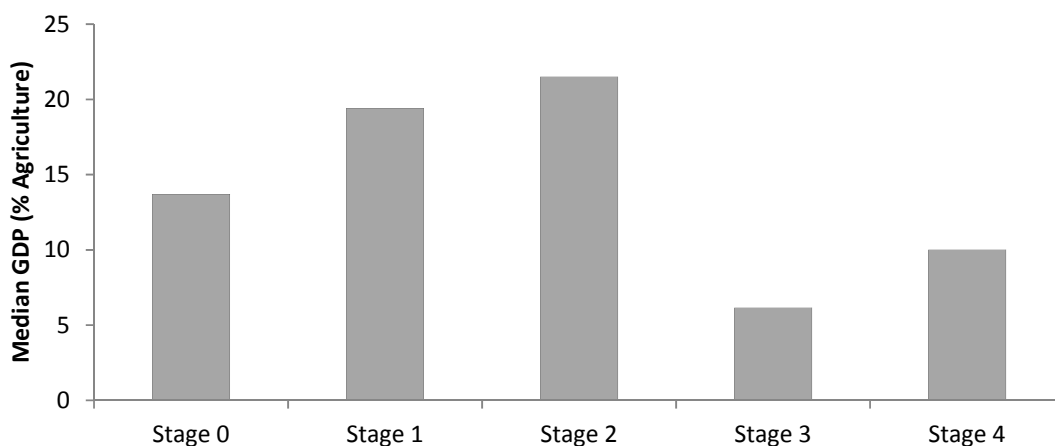


Fig. 2
Median agriculture Value Added in GDP (%)

Source: the World Development Indicator (WDI), the World Bank

Figure 3 demonstrates average Gross National Income (GNI) per capita by PPR stage. Countries in Stage 1 are the poorest with their median GNI measuring \$1,040 (versus \$5,290 in Stage 3 countries) whereas GNI in PPR-free countries reached on average \$23,054 in 2010.

In 2009, the world exports of 'meat' and 'live animals' susceptible to PPR reached US\$8.5 billion, and Stage 3 and PPR-free countries (Stage 4) accounted for 5% and 31% of the exports of this category respectively. Most of the exports came from Stage 2 countries (61%) reflecting the large numbers of animals in countries of this stage. Figure 4 presents exports of live animals and meat per capita by PPR control stage. In 2009, Stage 3 and PPR-free countries exported \$12.3 and \$17.6 worth of these products per capita respectively. The countries in Stages 0, 1 and 2 have much less opportunity to participate in (official) export markets with their average exports in per capita terms measuring less than \$5.0 per year. PPR presence may play a role in this low level of export market participation. It also recognised that there may be structural limitations in the livestock sectors in those countries including relatively small livestock populations and low investments in processing and marketing infrastructure.

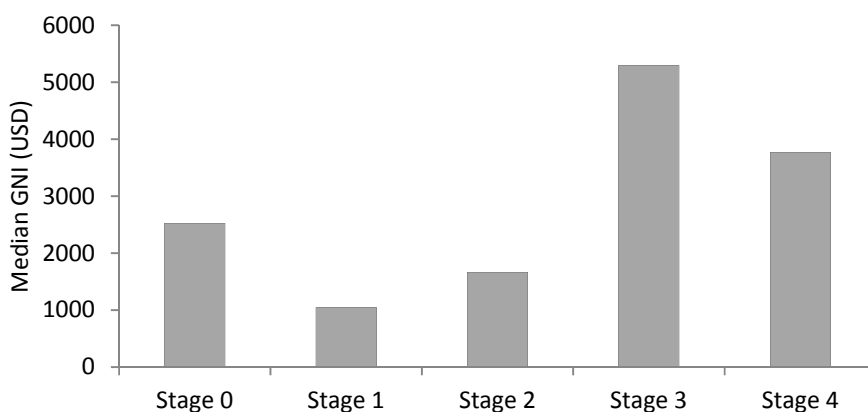


Fig. 3
Median Gross National Income (GNI) per capita (\$)

Source: the WDI, the World Bank

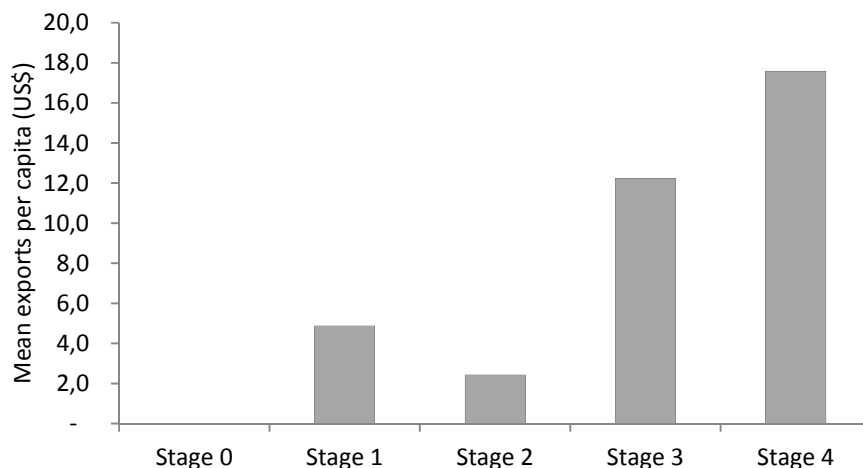


Fig. 4
Mean exports of Live Animals & Meat per Capita (US\$) according to PPR control stage

No export data could be found for Stage 0 countries

Source: the UN Comtrade System; the WDI, the World Bank

Laboratory and epidemiology network

The laboratory and epidemiology network proposed by the global strategy is characterised by its 'layered structure' at the national, regional and global level with its main activities clustered at the regional level. The latter structure is designed to provide the global strategy with an effective and efficient regional approach addressing the issues of externality, epidemiology, economies of scale and quality assurance.

The transboundary nature of animal disease implies the existence of a negative externality (Ramsay, Philip, Riethmuller, 1999) as the participation (or non-participation) of a country in a control programme will lead to a decreased (or an increased) risk of contracting the disease for other countries. A regional approach through which countries coordinate and harmonise control or eradication programmes has been long recognised as a key strategy to address contagious and transboundary communicable livestock disease.

The geographical definition of the Regions/Sub Regions included in a regional network is based on the member country list of the relevant Regional Economic Community (REC) which is targeted for owning and managing the network (Fig. 5). The number of countries in each region by the control stage is shown in Figure 6.

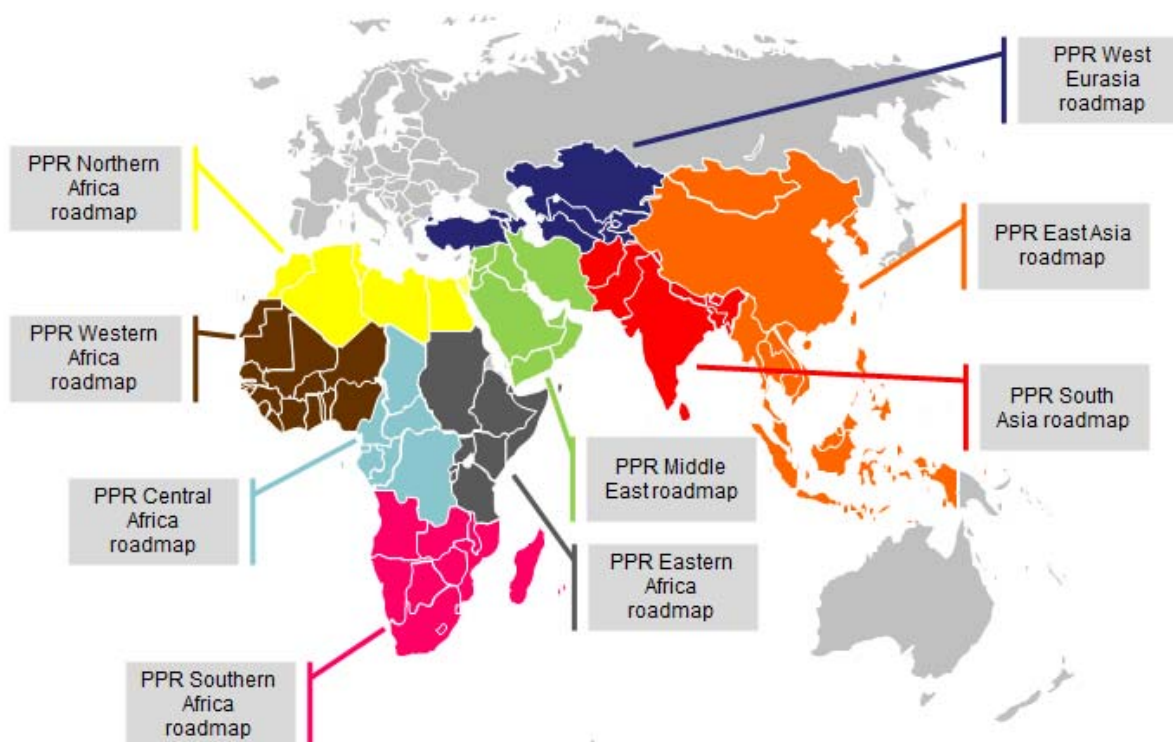


Fig. 5
Regional groups for the *peste des petits ruminants* control

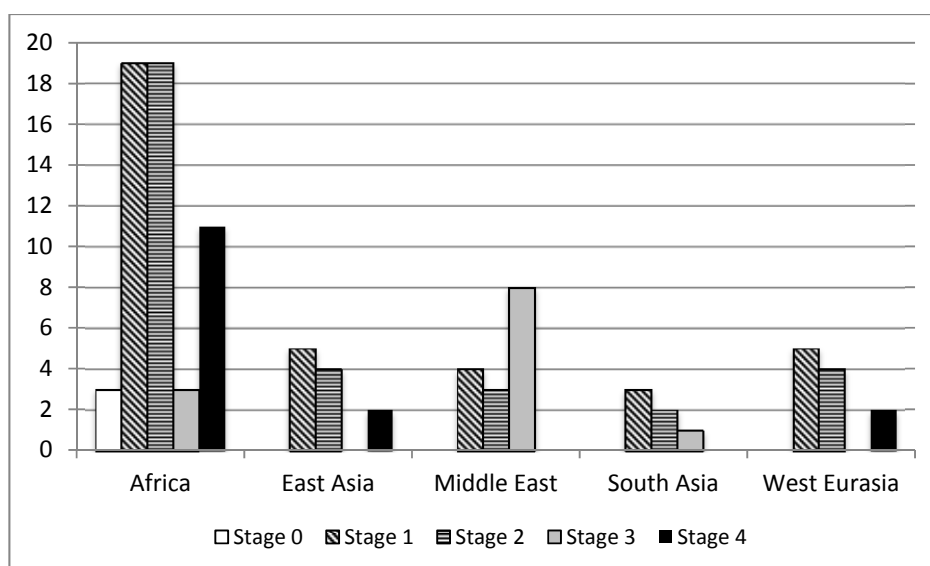


Fig. 6

Number of countries in global *peste des petits ruminants* control strategy by region and stage in 2015

Economics of controlling livestock diseases¹

Tisdell (2009) developed a model which relates the benefit which arises from a control programme and the total cost of the programme. According to Tisdell, the net benefit (NB) from disease control is:

$$NB = f(E) - TC$$

Where $f(E)$ is the benefit function, E represents the level of variable cost of control of the disease. The total cost TC of control programme consists of potential start-up or fixed costs, k , and variable outlays, E .

Thus, $TC = k + E$.

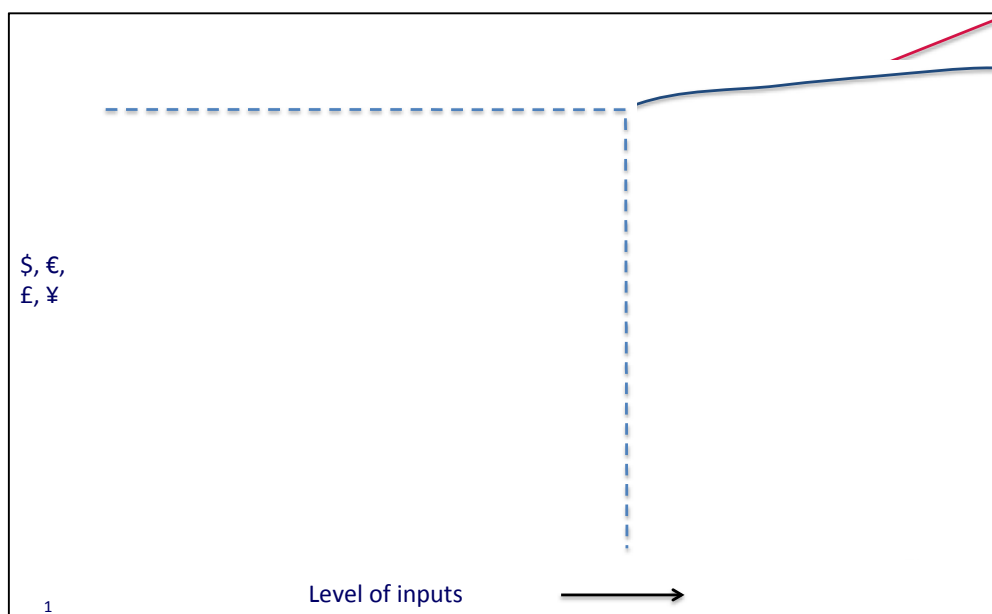
If the benefit function increases at a decreasing rate, i.e., if $f' > 0$ and $f'' < 0$, net benefits of control programme will be maximised when an additional value of E is such that the extra economic benefit from control programme equals an additional dollar of investment:

$$f'(E^*) = 1$$

where E^* is the optimal level of expenditure.

Figure 7 illustrates the model with the presence of start-up cost for controlling a disease, $k > 0$ (Tisdell, Fig. 2, p.3). In this figure, start-up costs are shown as OH and line HJ (a 45 degree line) represents the total cost of controlling the disease. The curve marked OP demonstrates the benefit function. Figure 7 indicates that at least the level of expenditure of E_0 is required before benefits cover costs

¹ This section heavily draws from Tisdell (2006)

**Fig. 7****Cost benefit model for livestock disease**

(Tisdell, 2006)

Tisdell's model is convenient in explaining the costs and benefits of control programme for countries in different stages of PPR control. One insight from this figure is that countries which are in zero or low stages may face a start-up cost and it may take some time before the benefits start to outweigh the costs. In addition, given the scarcity of resources in many endemic countries, the fixed cost to participate in the programme may be prohibitively high for them. Thus, a 'big push' to cover these fixed costs from the international community may be particularly critical for this group of countries. These costs will benefit not only the PPR programme, but a range of animal health and disease issues, and therefore assigning all costs to PPR is not strictly correct. In short a PPR programme will contribute significantly the overall development of Veterinary Services through improving human capacities and infrastructure.

Therefore, the importance of the Tisdell model is the distinction between the fixed and variable costs of animal disease management. In the context of the cost analysis presented it is assumed that the fixed cost elements such as provision of trained staff and infrastructure such as laboratories and transport will be accounted for through the either existing vet services or through investment in the vet services after a PVS gap analysis and remedy. The costs presented are therefore direct mainly at the variable costs of additional surveillance and control activities directly associated with PPR.

Costing the Global PPR Strategy – 2015-2030

Below are the provisional results of a cost model to estimate the cost of the global PPR control programme to run between 2015 and 2030. The cost for each country is dependent on the stage that country at the beginning of the control programme and its expected transition through the stages.

Global and regional level costs

To support the global eradication programme there will be a global team working to coordinate the activities of the regional and national level efforts and there will be nine regional teams, one for each regional economic community. These global and regional teams will focus on strengthening the skills and activities of disease management through inputs on epidemiology and laboratory management. There will also be a component on communications. Full details on the inputs to these activities can be found in Annex 1.

Key national level assumptions

The national level actions are split into the following components:

- An ex-ante assessment of the PPR situation in the country.
- Vaccination to manage PPR.
- Surveillance to follow the disease which has several components such as:
 - active surveillance (mainly active in Stage 1, combined in Stages 2 and 3) including disease search and investigation, and sero-surveillance
 - passive (mainly passive in Stage 4).
- Surveillance to verify the efficacy of vaccination programmes are included in the PVE component including post vaccinal serological monitoring

Details of each component is provided in the next sections followed by a description of how these components are employed in the different stages of the PPR process.

For the purposes of the costing exercise it is assumed that countries remain in a stage for a minimum period of 3-years (a range of between three to five years). It is recognised that in all likelihood there will be some variation in this period based on the result of PVE with suggested ranges being:

- Stage 1 → minimum 12 months and up to 3 years
- Stage 2 → 3 years for Stage 2 (from 2 to 5 years)
- Stage 3 → 3 years for Stage 3 (from 2 to 5 years)
- Stage 4 → 24 months for Stage 4 and up to 3 years.

Therefore three different costs are presented to reflect the likely range reflecting the variation in vaccination effectiveness. The 'High Cost' strategy assumes four-year vaccination campaigns in Stages 2 and 3 as outlined in Table 1. The 'Medium Cost' strategy assumes a three-year vaccination campaign in Stage 3. The 'Low Cost' strategy assumes three-year campaigns in both Stages 2 and 3.

Additional assumptions are as follows:

- No. of working hours per day: 8
- No. of working days per month: 22
- No. of working months per year: 11.

Animal population

The small ruminant population remains constant throughout the 15-year period. The age distribution was assumed to be 40% below six months (youngstock) and the remaining 60% above 6 months (adults). The distribution of the small ruminant population by production system is based on modelling the aridity index and aligned to the FAOStat population data (Lancelot, 2014).

Ex-ante assessment

Three people paid 10,000 US\$/month. 9 months per country fixed fee (i.e. independent of animal population of country size). The cost will be the same in each strategy considered and will be independent of the country size and animal population.

Vaccination cost

The average cost of vaccinating one animal is calculated assuming:

- a vaccine cost of US\$ 0.10 (vaccine and diluent) regardless the production system
- a cost of delivering the vaccine of US\$ 0.60 USD in a mixed crop/livestock system per animal
- a cost of delivering the vaccine of US\$ 0.40 in a pastoralist/agro-pastoralist system per animal

Additional assumptions include:-

- Each vaccination team has three people including a vet (7US\$/hour) an assistant (2.81US\$/hour) and a driver (2.81US\$/hour).
- The costs with materials, transportation and other expenses are assumed to be 1,000 US\$ per team.
- Vaccination campaign lasts one month.
- Teams can vaccinate 500 animals per day.

Surveillance

The surveillance is broken into two separate parts, active and passive.

Active surveillance

Sampling teams are similar to the vaccination ones in terms of composition and costs. Additionally:

- teams can sample 500 animals per day
- sampling campaign lasts for one month.

Passive surveillance

The cost of the network represents a very substantial part of the budget of the Veterinary Services. Therefore its cost is not included in the PPR Global Strategy component cost but they should rather be included in the strengthening of Veterinary Services component.

The cost of running a competition ELISA for PPR is assumed to be 1.5 US\$ per sample.

The cost the Component 1 (PPR specific) alone will include part of the surveillance: PPR specific, means:

- active PPR surveillance (disease search, surveys, investigations... including sero surveys) during the Stage 1
- surveys to confirm absence of PPRV circulation during Stage 4 (including sero surveys)
- some active surveillance/investigations during Stage 2 and 3
- post vaccination monitoring at Stages 2 and 3.

Outbreak investigation

The cost of investigating a single outbreak of disease is estimated to cost an average of 1,000US\$.

Components of the actions at the national level

Ex-ante assessment

This is performed in Stage 1.

Vaccination

See Table 1 for vaccination scheme for the relevant stages. Two vaccination rounds will take place in mixed crop-livestock populations.

Active surveillance through serological surveys

At all stages of disease management it is assumed there will be surveys that will take serum samples in order to test for seropositivity of the animals. This active surveillance will have several purposes depending on the stage in which it is being applied:

1. informing the ex-ante assessment and therefore the required country specific vaccination strategy (Stage 1)
2. support the confirmation of absence or presence of virus in the populations at risk (Stage 4).

In Stage 1, one serosurvey is performed per country year in Stage 1. In Stages 2-4, a single survey is performed per stage. It is assumed that 6,000 samples are taken per survey.

The serological surveys will also be implemented together with other methods to support the vaccination campaigns through verifying the levels of vaccination coverage and efficacy (post vaccination immunity) (Stages 2-3) and consequently being used as part of the PVM for each Stage 2-3.

Active surveillance through disease search

During Stage 1 disease search is one of the major method being used, accompanied by supplementary outbreak investigations.

Outbreaks investigations related to passive surveillance

In all stages there will be a component of investigation of outbreaks reported through passive surveillance systems.

The passive surveillance costs are not explicitly included as this is considered part of component 2 (strengthening of Veterinary Services). However, the PPR specific outbreak investigations that occur as a result of this passive surveillance are included in the cost model. These outbreak investigations will also form a part of the PVE through performing appropriate vaccine effectiveness studies where outbreaks occur in Stage 2 and 3. The number of suspected outbreak numbers are assumed based on the population at risk and to vary according to the stage at which the PPR management has progressed. The ratios are given in Table 1. The costs of investigating and dealing with an outbreak are assumed to be 1,000 USD.

Overall implementation of the components in the four stages of PPR management

The components of the PPR control strategy would be applied at different stages (Table 1). The ex-ante assessment would be carried out in the Stage 1 in order to identify disease presence, maintenance and potential introductions. This information would be used in order to identify the populations at risk for the vaccination programme that would be implemented in Stage 2.

The progressive phased approach for the PPR vaccination programme is assumed to last for a period of three years with a target of vaccinating half the population in the first two years and then the following two years to target 100% of youngstock. In Stage 3 that on average 75% of adult population would be vaccinated for two years followed by a two-year period of targeting 100% of youngstock. As said above (see paragraph Background) the vaccination levels required in Stages 2 and 3 may vary according to the outcomes of Stage 1 (results of the epidemiology investigations) and 2 (results of the vaccination). Different percentages of the population to be vaccinated could be considered with a range from 20 to 50% in Stage 2 and 20 to 75% in Stage 3.

By Stage 4 PPR virus is assumed to be no longer circulating in the populations and the vaccination programmes will be stopped. This final stage will include countrywide surveillance, mostly passive surveillance, and some sero-surveillance (appropriate sampling strategy) to determine freedom of disease.

While active surveillance will be the essential method during Stage 1, running through Stages 2, 3 and 4 is a surveillance system that detects small ruminant disease outbreaks. In classic terminology this would be stated to be the essentially 'passive' surveillance system complemented by 'active' surveillance when needed. It is assumed that as PPR is managed leading to eradication the number of outbreaks will reduce from 20 per 500,000 animals to 1 per 500,000. A summary of all these actions is shown in Table 1.

Within the vaccination costs it has been assumed that the delivery cost per animals will be used to cover:

- actual delivery of the vaccine to the animals
- communication of the programme with a strong focus on ensuring that people understand that vaccine is to be delivered. It is estimated that between 2 to 3% of the vaccine delivery costs are allocated to this item
- capacity building, particularly on the management of the strategy, implementation of the surveillance, control and prevention activities. At a national level it is suggested that approximately 5% of the vaccine delivery costs are allocated to this component.
- post-vaccination costs which overall would be around 1% of the total global costs of the vaccination programmes and that this will include post vaccination serological surveys.

Table 1. Control strategy applied according to disease control stage

Stage	Ex-ante assessment	Vaccination ²	Surveillance ³	Outbreaks
1	✓ 3 people		The ex-ante assessment will include some elements of active surveillance	✓ 20 outbreaks per 500,000 heads
2		✓ Years 1-2: 50% adults (in ovine no lambs, in caprine no kids) Years 3-4: 100% youngstock (just lambs and kids) ⁴ Year 5: no vaccination	✓ 6,000 samples, per year per country during five years (3,000 in sheep population + 3,000 in goat population)	✓ 10 outbreaks per 500,000 heads
3*		✓ Years 1-2: 75% of the whole population Years 3-4: 100% youngstock (just lambs and kids) ⁴ Year 5: no vaccination	✓ 6,000 samples, per year per country during five years (3,000 in sheep population + 3,000 in goat population)	✓ 5 outbreaks per 500,000 heads
4		No vaccination	✓ 6,000 samples, per year per country during five years (3,000 in sheep population + 3,000 in goat population)	✓ 1 outbreaks per 500,000 heads

* Countries going directly from Stage 1 to 3: 100% of the whole population vaccinated during two successive years. During the following two years 100% of youngstock are targeted

Overall costs of the PPR programme 2015-2030

The costs of the PPR programme over the first five years have been split into:

- Global and regional coordination costs
- National costs

It is assumed that the global and regional costs will not vary even if the national level activities increase. Therefore the costs for each five years of the programme at international and regional levels will be the same throughout the programme.

² These figures retained here represent maximum vaccination percentages but according to the epidemiological situations and to the results of the Stage 2 vaccination campaigns, a range of 20 to 50% in Stage 2 and 20 to 75% in Stage 3 could be implemented.

³ Sero survey figures given here represent maximum numbers. According to the results of situation assessments (through continuous monitoring and evaluation of the programmes) the numbers could be lower. They also assume a component of communication and capacity building

⁴ Four year campaigns are assumed in the 'High Cost' strategy. In the 'Medium Cost' strategy a three-year campaign is assumed in Stage 3. In the 'Low Cost' strategy a three-year campaign is assumed in both Stages 2 and 3.

Global and regional coordination costs

The global coordination costs are estimated to be US\$ 10.7 million (Table 3) for each 5 year period and therefore US\$ 32.1 million for the 15-year programme. Full details of the costs can be found in Annex 1.

Table 2. Estimated costs of the *peste des petits ruminants* global strategy coordination costs (US\$) for five years

Item	Total (US\$)
Personnel	3,110,000
Support missions	525,000
Coordination	1,112,000
Database	1,750,000
Epidemiology and Laboratory Support	3,232,000
Overall support	1,000,000
Total (US\$)	10,729,000

The regional coordination centres will be nine in total, one for each identified region show in Figure 5. The costs for these regional centres are estimated to be US\$43.1 million dollars over the first five years (Table 4) and therefore US\$ 129.45 million for the full 15 year programme. The full details of these costs can be found in Annex 1.

Table 3. Regional coordination costs for the *peste des petits ruminants* global strategy for five years

Item	Total (US\$)
Personnel	9,900,000
Support missions	3,150,000
Coordination	650,000
Database	9,500,000
Epidemiology and Laboratory Support	18,950,000
Overall support	1,000,000
Total (US\$)	43,150,000

National level costs

The overall national costs of the programme by region are shown in Table 4, detailing the high, medium and low cost alternatives. Figure 8 shows these costs by five year blocks for the whole 15-year period. These estimates are based on the assumption that each country will only manage to pass through one stage in each 5 -year period between 2015 and 2030 (although it is acknowledged that in reality this will range from 2-5 years depending on the country). The overall global estimate (2015-2030) for national level activities ranges from US\$ 7.6 billion to US\$9.1 billion over a 15-year period. The overall difference between the high and low cost strategies is 16.5%. The distribution of the global costs is mostly due to vaccination which makes up around 95% off the total cost in all three costing strategies (Table 5, Figure 9). The largest cost is in Africa at around 40% of the overall amount in both strategies (Table 5, Figures 10-11).

Figure 12 shows the distribution of costs by activity over time and shows that the vaccination costs are greatest between years 6 and 10 of the strategy.

Table 4. Summary of costings for each region according to the for each five year block of the 15-year control period
All costs in US\$

	Region	High cost	Medium cost	Low cost	Mean col %
1-5 years	Africa	\$1,060,008,186	\$1,041,313,220	\$846,086,129	34%
	East Asia	\$978,691,613	\$978,688,774	\$769,779,232	31%
	Middle East	\$234,871,764	\$198,232,647	\$195,718,042	7%
	South Asia	\$595,759,219	\$595,759,219	\$474,801,357	19%
	West Eurasia	\$227,655,676	\$284,555,643	\$182,146,064	8%
	Total	\$3,096,986,458	\$3,098,549,504	\$2,468,530,823	
6-10 years	Africa	\$1,269,122,749	\$1,164,441,368	\$1,026,169,826	31%
	East Asia	\$1,221,141,411	\$1,012,231,868	\$1,012,231,868	29%
	Middle East	\$56,229,812	\$53,907,094	\$44,239,854	1%
	South Asia	\$1,037,137,601	\$1,037,137,601	\$966,866,139	27%
	West Eurasia	\$435,401,012	\$435,134,343	\$353,711,943	11%
	Total	\$4,019,032,586	\$3,702,852,275	\$3,403,219,630	
11-15-years	Africa	\$1,296,038,525	\$1,099,295,923	\$1,071,792,683	64%
	East Asia	\$4,967,493	\$4,967,493	\$4,967,493	0%
	Middle East	\$58,572,597	\$48,905,357	\$48,905,357	3%
	South Asia	\$413,589,607	\$413,589,607	\$413,589,607	23%
	West Eurasia	\$212,443,970	\$176,261,275	\$176,261,275	10%
	Total	\$1,985,612,192	\$1,743,019,655	\$1,715,516,415	
Regional totals (1-15 years)	Africa	\$3,625,169,460	\$3,305,050,511	\$2,944,048,638	39%
	East Asia	\$2,204,800,517	\$1,995,888,136	\$1,786,978,593	24%
	Middle East	\$349,674,173	\$301,045,098	\$288,863,253	4%
	South Asia	\$2,046,486,427	\$2,046,486,427	\$1,855,257,103	24%
	West Eurasia	\$875,500,658	\$895,951,261	\$712,119,281	10%
	Total	\$9,101,631,236	\$8,544,421,434	\$7,587,266,868	34%

Table 5. Summary of costings for each region by the control activity for the *peste des petits ruminants* control programme (2015-2030)

All costs in US\$

	Region	High cost	Medium cost	Low cost	Mean col %
Ex-ante assessment	Africa	\$6,750,000	\$6,750,000	\$6,750,000	68%
	East Asia	\$-	\$-	\$-	0%
	Middle East	\$1,080,000	\$1,080,000	\$1,080,000	11%
	South Asia	\$810,000	\$810,000	\$810,000	8%
	West Eurasia	\$1,350,000	\$1,350,000	\$1,350,000	14%
	Total	\$9,990,000	\$9,990,000	\$9,990,000	
Vaccination	Africa	\$3,478,878,630	\$3,158,759,681	\$2,797,757,807	39%
	East Asia	\$2,141,348,037	\$1,932,435,656	\$1,723,526,113	24%
	Middle East	\$329,235,992	\$280,606,917	\$268,425,072	4%
	South Asia	\$1,960,012,336	\$1,960,012,336	\$1,768,783,013	24%
	West Eurasia	\$837,363,970	\$857,814,573	\$673,982,593	10%
	Total	\$8,746,838,965	\$8,189,629,163	\$7,232,474,598	
Surveillance	Africa	\$4,573,830	\$4,573,830	\$4,573,830	54%
	East Asia	\$1,267,480	\$1,267,480	\$1,267,480	15%
	Middle East	\$1,208,181	\$1,208,181	\$1,208,181	14%
	South Asia	\$604,091	\$604,091	\$604,091	7%
	West Eurasia	\$776,688	\$776,688	\$776,688	9%
	Total	\$8,430,271	\$8,430,271	\$8,430,271	
Outbreak	Africa	\$134,967,000	\$134,967,000	\$134,967,000	40%
	East Asia	\$62,185,000	\$62,185,000	\$62,185,000	18%
	Middle East	\$18,150,000	\$18,150,000	\$18,150,000	5%
	South Asia	\$85,060,000	\$85,060,000	\$85,060,000	25%
	West Eurasia	\$36,010,000	\$36,010,000	\$36,010,000	11%
	Total	\$336,372,000	\$336,372,000	\$336,372,000	

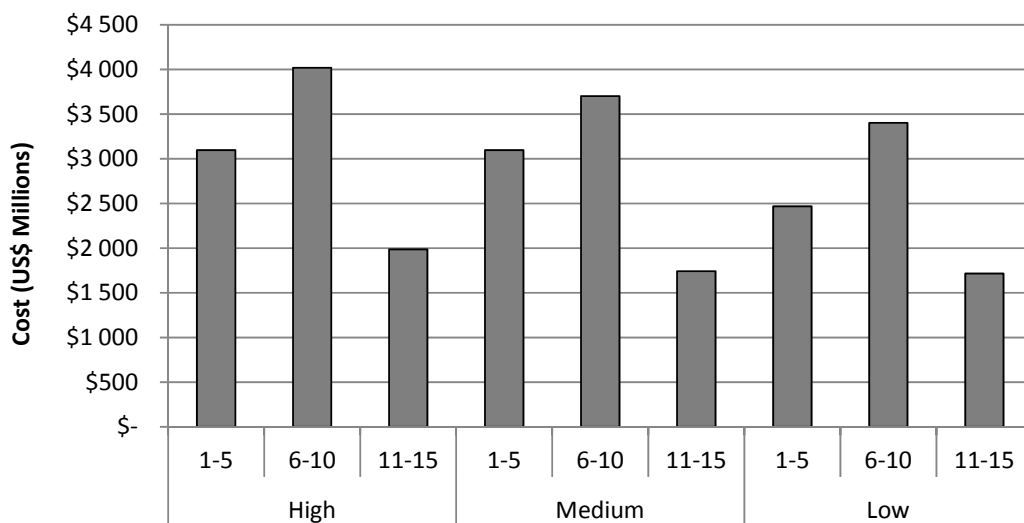


Fig. 8
Overall costs for each five year block for the high, medium and low cost strategies

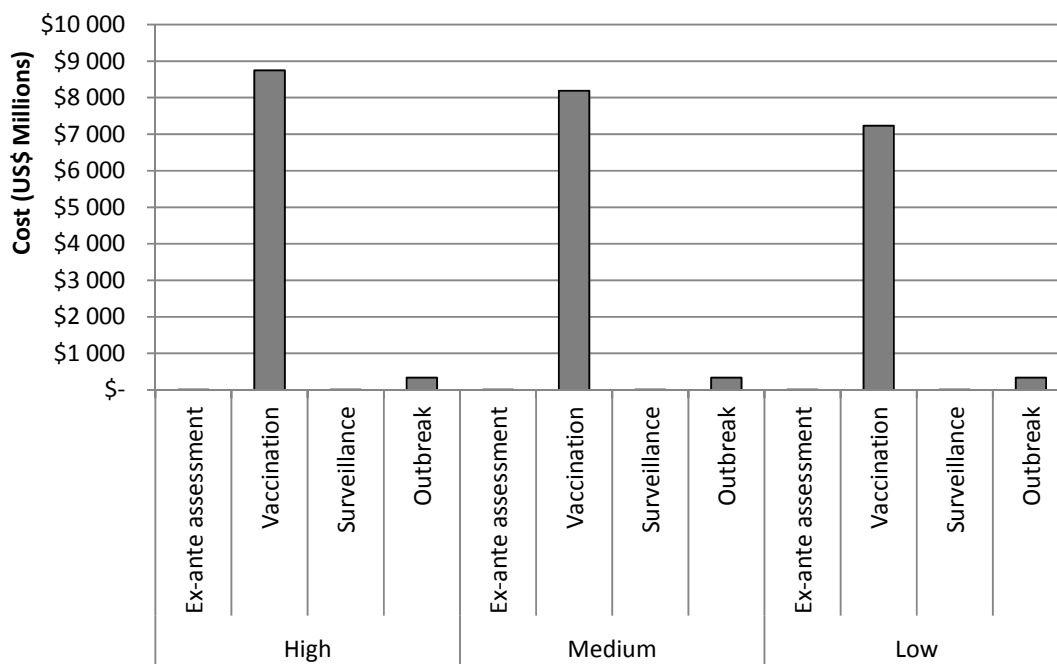


Fig. 9
Distribution of overall PPR global control costs (US\$) according to the control activity with high, medium and low costs strategies for the total 15-year period⁴

⁴ Active surveillance costs (passive surveillance is not included in the PPR specific component of the CES):

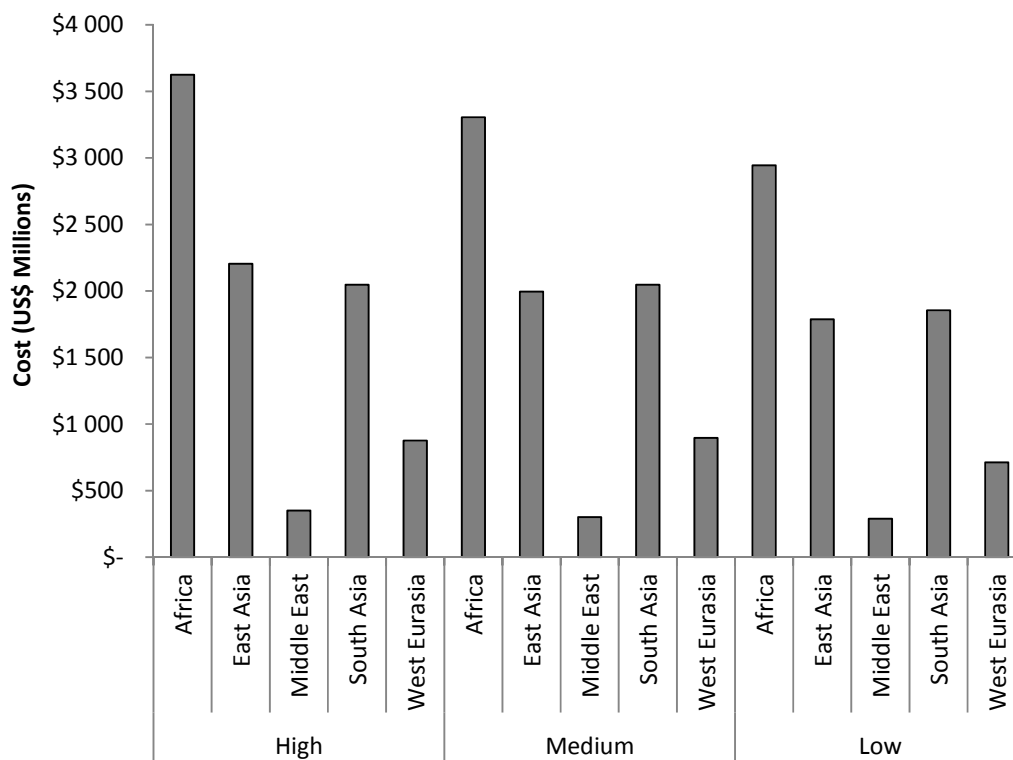


Fig. 10
Distribution of global *peste des petits ruminants* control costs (US\$) by region for the 15-year strategy

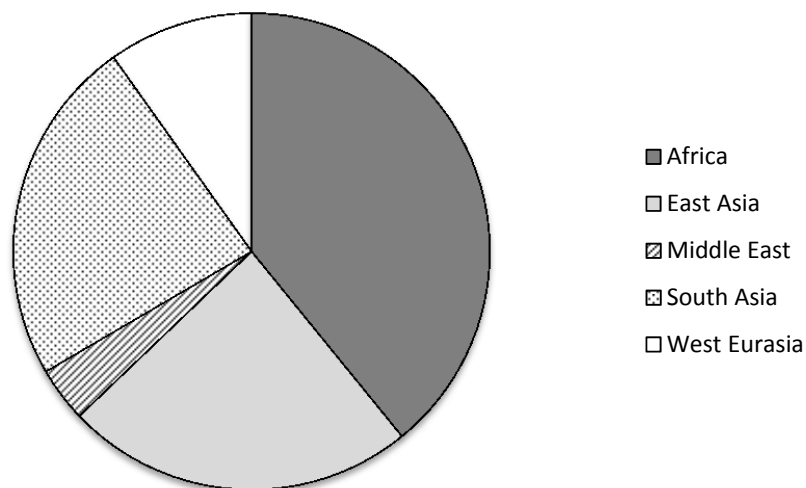


Fig. 11
Distribution of costs by region for the 15-year *peste des petits ruminants* control programme (mean proportion for high, medium and low cost strategies)

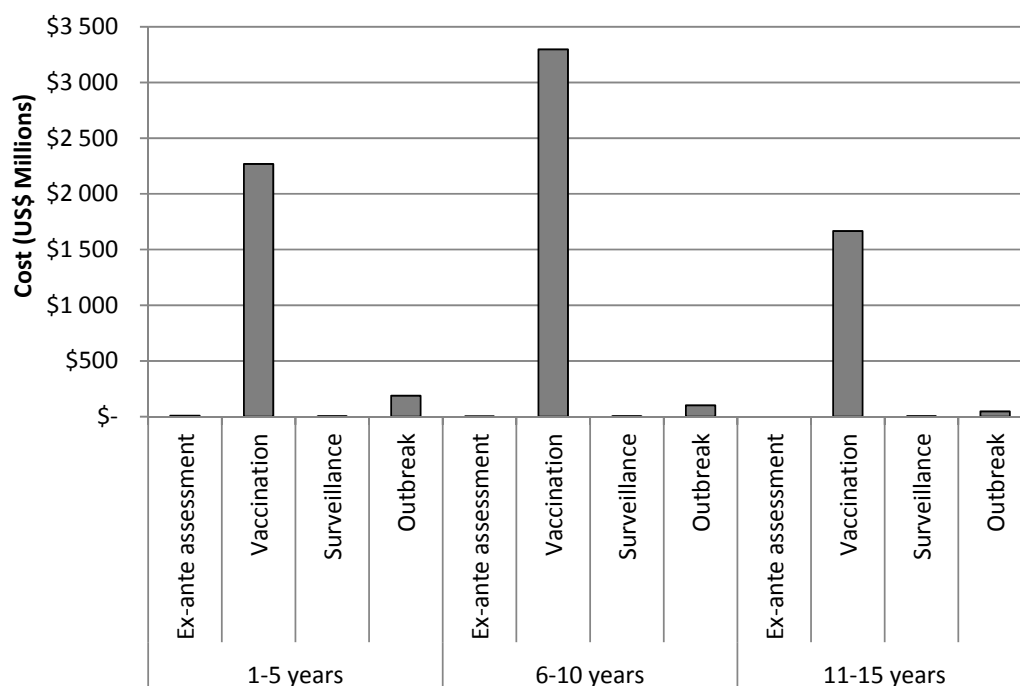


Fig. 12
Distribution of costs by control activity for each five year period for years 2015-2030 using the low cost strategy

Conclusions and recommendations

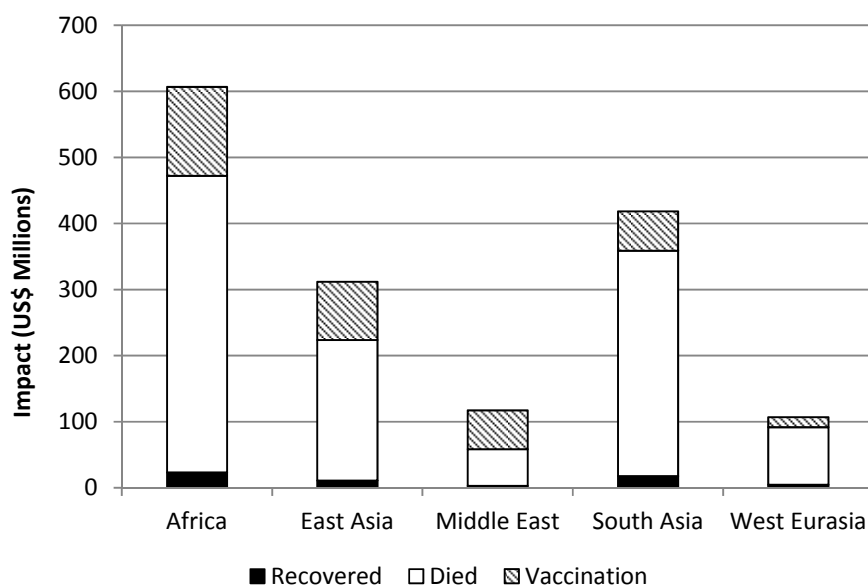
The cost of the Global Strategy has been estimated for the specific PPR control and eradication activities only (component 1 of the Global Strategy). The PPR control and eradication activities cannot be seen as ‘stand-alone’ activities but the investment needs for the strengthening of Veterinary Services (component 2) are addressed apart with specific country evaluation exercises particularly through the use of the PVS Gap Analysis tool. The cost of combating other diseases in combination with PPR control and eradication activities (component 3) has not been evaluated since it is extremely difficult to estimate. As a matter of fact the list of priority diseases is not well known and is to be addressed through discussions to be held during regional and national workshops.

On the other hand it is also important to note that the investments in supporting activities against PPR will have benefits on the Veterinary Services activities (e.g. surveillance systems) and finally to animal health improvement in all targeted countries. Finally strengthening VSs and controlling PPR and priority diseases come together with reciprocal, spin-off benefits.

The estimated cost of a global PPR strategy is, regarding specific PPR control and eradication activities (component 1 of the strategy), between US\$ 7.6 billion and US\$ 9.1 billion for the 15-year period. Costs estimates have deliberately not been discounted. The range in costs is related to the effectiveness of the vaccination campaigns with the lower cost being linked to three year vaccination campaigns in Stages 2 and 3 that have been effectively evidenced by post vaccination monitoring. High vaccine coverage has

been accounted for although lower coverage is anticipated based on the ex-ante assessments making these figures likely over-estimates representing a worse-case scenario.

These very large numbers need to be placed into the perspective of the numbers of animals that are being protected by the measures proposed – nearly billion sheep and a billion goats. A rough estimate of the average cost per shoat year would mean an investment of between US\$ 0.27-0.32. These numbers also have to be contrasted to an assessment of the impact of the disease on annual basis. It has been estimated that annual losses of production and the death of animals due to PPR are between US\$1.2 to 1.7 billion. There is also an estimated expenditure of between US\$270 to 380 million on PPR vaccination. Therefore in annual impact alone PPR causes between US\$1.45 to 2.1 billion per year.



Approximately a third of the impact occurs in Africa, with a further quarter occurring in South Asia. This large impact will be eliminated with the successful eradication of PPR, implying that a programme estimated to cost an initial 5 years of the control and eradication programme of US\$1.4 billion (undiscounted costs), which is equivalent to approximately US\$0.28 billion per year, appear small. A **reduction of 18%** in the impact of PPR would **justify the annual expenditure** alone and it should be recognised that the strategy aims to eradicate PPR which means that the impact will be an **everlasting benefit** to global society – one of the rare **perpetuities in animal health**. From an economic assessment there is evidence that the eradication programme will be economically profitable when compared to the alternative of continuing with uncoordinated control efforts.

Given the importance of PPR and the availability of known technologies it is strongly recommended that a Global Strategy for Control of PPR is funded and initiated. The final cost is likely to be different from the cost estimates in this report, but they serve to demonstrate that the successful control and ultimate eradication of this disease would be economically profitable and that it will benefit the lives of many people around the world.

Annex 1. Costs of the *peste des petits ruminants* Global Strategy at regional and global levels

Costs at the global level

Personnel

- 0.5 P5 level GF TADs Working Group (WG) staff for Epidemiology network
- 0.5 P5 level WG staff for Laboratory network
- 0.5 P5 level staff for Secretariat
 - 1.5 people x \$19,000/month x 12 months x 5 years = \$1,710,000.
- 0.5 P4 level GF TADs WG staff for epidemiology network
- 0.5 P4 level WG staff for laboratory network
- 0.5 P4 level staff for Secretariat
 - 1.5 people x \$15,000/month x 12 months x 5 years = \$1,350,000.
- One communication specialist for one month per year
 - 1 person x \$10,000/month x 5 years = \$50,000.

Support missions to regions and countries

- Specific support missions to regions and to countries such as Veterinary Service (VS) support missions:
 - 1 person x (\$1,500 + \$400*5-days) x 10 times x 5 years = \$175,000.
- Support to the SC and PCP meetings in regional organisations such as hard copy materials for meetings and communication:
 - 7 regions x \$10,000 x 5 years = \$350,000.

GF TADs global coordination

- Regular meetings.
 - 10 people (WG staff and other ad hoc experts) x (\$600 + \$400*2-days) x 6 times x 5 years = \$420,000.
- Participation in regional SC meetings:
 - 2 people x (\$1,500 + \$400*2-days) x 5 times x 5 years = \$115,000.
- Participation in regional PCP meetings:
 - 4 people x (\$1,500 + \$400*3-days) x 6 times x 5 years = \$324,000.
- Participation in workshops and conferences:
 - 2 people x (\$1,500 + \$400*2-days) x 3 times x 5 years = \$69,000.
- Support to expert group to participate in conferences:
 - 2 people x (\$1,500 + \$400*2-days) x 3 times x 5 years = \$69,000.
- Support to expert group to participate in WG regular meetings:
 - 5 people x (\$1,500 + \$400*2-days) x 2 times x 5 years = \$115,000.

Global laboratory network and epidemiology

- Training for regional and reference laboratories:
 - \$300,000 x 5 years = \$1,500,000.
- Support to proficiency testing and laboratory analysis:
 - \$300,000 x 5 years = \$1,500,000.
- Meetings for coordination and harmonisation on epidemiology:
 - 2 people x (\$3,000 + 400*7-days) x 4 times x 5 years = \$232,000.

International conference

- An international conference with global experts and funded places for all countries involved
 - Estimated to be in the region of \$1,000,000 and held only once every 5 years

Costs at the regional level

Personnel

- Nine regional epidemiologists at the P4 level one for each region.
 - 9 people x \$150,000 x 5 years = \$6,750,000. They may be based in the Global Framework for Trans-boundary Animal Diseases (GF TADs) Regional Support Unit (RSU) or Regional Animal Health Center (RAHC) or within Regional Organisations.
- Nine regional laboratory experts in seven pools in the regional leading and reference laboratories.
 - 9 people x \$60,000 x 5 years = \$2,700,000.
- One communication specialist for one month per year for each region.
 - 9 people x \$10,000/month x 5 years = \$450,000.

Expert support missions

- Support missions to countries by ten regional epidemiologists.
 - \$1,500 for travel and \$400 Daily Subsistence Allowance (DSA)⁵. 9 people x (\$1,500 + \$400*5-days) x 10 times x 5 years = \$1,575,000.
- Support missions to national laboratories by seven laboratory experts.
 - 9 people x (\$1,500 + \$400*5-days) x 10 times x 5 years = \$1,575,000.

Regional coordination

- Regional Steering Committee (SC) meetings:
 - 20 people x (\$1,500 + \$400*2-days) x 1 time x 5 years = \$230,000.
- Regional PCP meetings:
 - 20 people x (\$3,000 + \$400*3-days) x 1 time x 5 years = \$420,000.

Regional laboratory network

- Regional laboratory trainings for reference laboratories a total of nine events in 5 years each costing \$350,000 and for nine future regional laboratories twice in 5 years each costing \$250,000:
 - (10 reference labs x \$350,000) + (9 regional labs x \$250,000 x 2) = \$7,650,000.
- Training on calibration of pipettes and scales as part of quality control:
 - (9 reference labs + 9 regional labs) x \$16,000 x 5 years = \$1,440,000.
- Regional lab test kits (PCR, ELISA, VI) for nine reference laboratories and nine future regional laboratories
 - (9 reference labs + 9 regional labs) x \$100,000 x 5 years = \$9,000,000.

Regional epidemiology network

- Coordination meetings:
 - 20 people x (\$1,500 + \$400*7-days) x 2 times x 5 years = \$860,000.

Quality control centres for vaccine testing (Asia, Africa, Eurasia)

- 3 centres x \$200,000 x 5 years = \$3,000,000

Database for epidemiology and laboratory

- \$500,000 for set-up of a database and \$200,000 for maintenance per region and per year:
 - \$500,000 + (\$200,000 x 9 regions x 5 years) = \$7,500,000.

⁵ Travel cost is assumed to be \$600 for travel within region, \$3,000 for extensive travel, and \$1,500 otherwise. The DSA is assumed to be \$400 per day.

**GLOBAL STRATEGY FOR THE CONTROL
AND ERADICATION OF PPR**



FAO AND OIE
INTERNATIONAL CONFERENCE FOR THE
**CONTROL AND ERADICATION
OF PESTE DES PETITS RUMINANTS (PPR)**
ABIDJAN, CÔTE D'IVOIRE
31 MARCH – 2 APRIL 2015